GROSS RESERVOIR EXPANSION PROJECT

Denver Water's Gross Reservoir Expansion Project

Areas and Activities of State Interest (1041) Permit Application

Submitted: September 21, 2020

DENVER WATER

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List of Acronyms and Abbreviations

°F	Degrees Fahrenheit
1041	Areas and Activities of State Interest
ACHP	Advisory Council on Historic Preservation
AF	Acre-Feet
AF/yr	Acre-Feet Per Year
ANFO	Ammonium Nitrate Fuel Oil
APE	Area of Potential Effect
ARNF	Arapaho and Roosevelt National Forests
BMP	Best Management Practice
CAFR	Comprehensive Annual Financial Report
CCR	Code of Colorado Regulations
CDOT	Colorado Department of Transportation
CDPHE	Colorado Department of Public Health and Environment
CO	Carbon Dioxide
Corps	U.S. Army Corps of Engineers
CFR	Code of Federal Regulation
CFS	Cubic Feet Per Second
CNHP	Colorado Natural Heritage Program
CPW	Colorado Parks and Wildlife
CR	County Road
CRCA	Colorado River Cooperative Agreement
CRS	Colorado Revised Statutes
CSA	Combined Service Area
CWCB	Colorado Water Conservation Board
DO	Dissolved Oxygen
DRCOG	Denver Regional Council of Governments
ECA	Environmental Conservation Area
EIS	Environmental Impact Statement
FEMA	Federal Emergency Management Administration
FERC	Federal Energy Regulatory Commission
FHWA	Federal Highway Administration
FTA	Federal Transit Administration
GIS	Geographic Information System
HAER	Historic American Engineering Record
HPMP	Historic Properties Management Plan
HRMP	Historic Properties Management Plan
I-	Interstate
IGA	Intergovernmental Agreement
IRP	Integrated Resource Plan
MGD	Million Gallons Per Day
MOA	Memorandum of Agreement

MSL	Mean Sea Level
NDIS	Natural Diversity Information Source
NEPA	National Environmental Policy Act
NHPA	National Historic Preservation Act
NOI	Notice of Intent
NO_x	Oxides of Nitrogen
NRCS	Natural Resources Conservation Service
PA	Programmatic Agreement
PIA	Primary Impact Area
PCA	Potential Conservation Area
PEM	Palustrine Emergent Wetlands
PM2.5	Particulate Matter Less than 2.5 Microns in Diameter
PM10	Particulate Matter Less than 10 Microns in Diameter
PMJM	Preble's Meadow Jumping Mouse
RAQC	Regional Air Quality Council
RTD	Regional Transportation District
SCS	Soil Classification System
SEO	State Engineer's Office
SH	State Highway
SHPO	State Historic Preservation Officer
SIA	Secondary Impact Area
SO_2	Sulphur Dioxide
TOC	Total Organic Carbon
US-	U.S. Highway
tpy	Tons Per Year
USFS	U.S. Forest Service
USGS	U.S. Geological Survey
USFWS	U.S. Fish and Wildlife Service
VOC	Volatile Organic Carbon
WQCC	Water Quality Control Commission
WTP	Water Treatment Plant
WWTP	Wastewater Treatment Plant

Introduction

Denver Water is submitting this Areas and Activities of State Interest (1041) permit application as authorized by Title 24, Section 65.1 501 of the Colorado Revised Statutes and Article 8 of the Boulder County Land Use Code (Boulder County 2018) for the Gross Reservoir Expansion Project (Project). As described in this 1041 permit application, the Project would conform to Boulder County 1041 permit requirements.

Document Organization

This 1041 permit application has been organized and numbered to mirror the application submittal requirements of the Boulder County Land Use Code, Article 8, which contains Boulder County's content requirements for Areas and Activities of State Interest permits. Procedural descriptions, definitions, and other sections from Article 8 that do not relate specifically to the 1041 permit application are not included in this document.

Denver Water reviewed Article 8 in its entirety and considered guidance provided by Boulder County staff in identifying the specific sections of the Land Use Code that are addressed in this 1041 permit application. Denver Water relied on the hardcopy of Article 8 that Boulder County staff highlighted and provided to Denver Water during the April 5, 2019, pre-application conference, as well as the detailed direction from staff during that meeting and the subsequent meeting with Parks and Open Space staff on June 20, 2019. These documents can be found in Exhibit 8. Denver Water also incorporated subsequent updates to the Land Use Code (including Article 8) by reviewing the version posted on Boulder County's website, dated June 18, 2019.

Denver Water notes that Boulder County staff identified the following subsections in Section 8-308 (Specific Designations) as applying to this Project during the April 5, 2019, Pre-Application Conference.

A. Activities of State Interest
    2. Major extensions of existing domestic water and sewage treatment systems;
    4. Site selection and construction of major facilities of a public utility;
B. Areas of State Interest
    4. Natural Hazard areas, which are flood hazard areas and geologic hazard areas

In addition, Boulder County highlighted that Section 8-401.D (Expansion of any existing reservoir for a municipal or industrial or domestic treated water use) applied to the project.

Boulder County Parks & Open Space staff also identified that Section 8-507.D5 (development located in Natural Resource Areas of statewide importance) also applies because these areas include "shorelands of major publicly owned reservoirs".

During the Pre-Application Conference, Boulder County staff identified several subsections in Section 8-511 (Standards for Approval of a Permit Application) that also apply to this Project, including Sections 8-511.C (Additional standards for approval of municipal and industrial water projects), 8-511.E (Additional

standards for major facilities of a public utility), 8-511.K (Additional standards for development in flood hazard areas), and 8-511.L (Additional standards for development in geologic hazard areas).

During the Pre-Application Conference, Boulder County also clarified that the only road in the Project that qualifies as an “arterial highway” is State Highway 72 (SH 72; a rural arterial road).

Finally, Boulder County suggested that if Denver Water had any concerns about the sections identified as applicable by the County, that Denver Water request waivers (per Section 8-503, Waiver of Submission Requirements) via email to Community Planning & Permitting staff, who would confirm the application requirements. Denver Water emailed County staff on May 31, 2019, to confirm that several sections were not applicable. See Exhibit 8. Denver Water did not receive any response from Boulder County to that clarification request.

In Section 8-503 of this permit application, Denver Water renews its waiver request for certain sections of Article 8 that Boulder County staff indicated apply to the Project during the pre-application process. Denver Water reserves its right to contest the applicability of those sections to this Project. Despite Denver Water’s renewal of its waiver request and reservation of its rights, Denver Water has attempted to address in this 1041 permit application all specific sections of Article 8 that Boulder County staff identified during the pre-application process. Denver Water hopes this approach of providing as complete an application as practicable will facilitate Boulder County’s review.

The application is organized as presented below:

- Project Description
- Public Involvement and Stakeholder Outreach
- Article 8
  - 8-206, Relationship with Other Requirements
  - 8-308, Specific Designations, Activities of State Interest, Major Extensions of Existing Domestic Water and Sewage Treatment Systems
  - 8-401, Specific Water and Sewage Treatment Activities Requiring Permits
  - 8-406, Determination of Whether a Proposed Activity or Development Must go Through the Permit Process
  - 8-502, Application Fee
  - 8-503, Waiver of Submission Requirements
  - 8-504, Intergovernmental Agreements
  - 8-505, General Process
  - 8-506, Pre-application Conference
  - 8-507, Application Submittal Requirements
  - 8-508, Referral Requirements
  - 8-509, Notice of Permit Hearing
  - 8-511, Standards for Approval of a Permit Application
- References
- Exhibits

In general, detailed information and analysis about the Project are presented in Section 8-507, and compliance with the 1041 permit standards for approval is summarized in Section 8-511. Exhibits provided with the application are listed in Table 1.

Table 1:
List of Exhibits Included with the Application

Exhibit	Content
1	Figures and Design Drawings
2	Denver Water's Integrated Resource Plan
3	1041 Permit Application Form and Related Materials
4	Traffic Impact Analysis
5	Federal and State Approvals and Agreements
6	Community and Stakeholder Outreach Information
7	Cultural Resources Programmatic Agreements
8	Denver Water Correspondence with Boulder County
9	Boulder County Meeting Minutes for Proposed IGA
10	Product Operation and Resource Utilization
11	Comparison of Existing and Project Spillway Rating Curves
12	Geotechnical Data Reports
13	Wetland Delineation Report and Mitigation Letter
14	Air Quality Impact Study
15	Noise Studies
16	Property Owners within 1,500 feet
17	Boulder County Wildlife Species of Interest
18	Boulder County Plant Species of Interest

The information and analysis presented in this 1041 permit application were gathered from permitting documents for the Project, including:

- Federal Energy Regulatory Commission (FERC) Order Amending License and Extending License Term—FERC Project 2035-099, July 16, 2020 (FERC 2020; FERC Order).
- FERC Final Supplemental Environmental Assessment (SEA) for Amendment of Hydropower License Gross Reservoir Hydroelectric Project—FERC Project No. 2035-099, February 2019 (FERC 2019; FERC Final SEA).
- Denver Water Letter Re: Denver Water (Licensee) comments on Supplemental Environmental Analysis for FERC Project No. 2035-099 (Denver Water March 2018; Denver Water's comments to FERC SEA).
- U.S. Army Corps of Engineers (Corps) File No. (ACTION ID): NWO-2002-80762-DEN Applicant: Board of Water Commissioners for the City and County of Denver (Denver Water), Project Name: Moffat Collection System Project. September 2017.
- U.S. Army Corps of Engineers (Corps) Moffat Collection System Project Record of Decision (Corps July 2017; Corps ROD).

- Denver Water Moffat Collection System Project Final FERC Hydropower License Amendment Application Gross Reservoir Hydroelectric Project—FERC Project No. 2035 (Denver Water November 2016; Denver Water's FERC License Amendment Application).
- U.S. Army Corps of Engineers (Corps) Moffat Collection System Project Final Environmental Impact Statement (Corps April 2014; Corps Final EIS).

The Corps Final EIS, Denver Water's License Amendment Application to the FERC, the FERC SEA, and the agency approval documents listed above are included in Exhibit 5 of this 1041 permit application. Additional documents used in the Federal and State approval process have been included in Exhibit 5 (except where noted) and include the following:

- Colorado Department of Public Health and Environment (CDPHE) 401 Certification (June 2016)
- Fish and Wildlife Mitigation Plan prepared for CPW and CWCB (June 2011)
- U.S. Fish and Wildlife Biological Opinion(s) (December 2013 and January 2016)
- Endangered Species Act Section 7 correspondence between FERC and USFWS
- U.S. Forest Service Settlement Agreement (September 2016) (Exhibit 3)
- Colorado River Cooperation Agreement (September 2013)
- Letter from Governor John Hickenlooper (June 2012)

Maps presented in this 1041 permit application are listed in Table 2. Most of these maps make use of the same data as maps in the permitting documents listed above. Denver Water has reformatted them to meet Boulder County's 1041 permit application map requirements.

Table 2:
List of Figures Included in Exhibit 1

Figure	Caption
1-1	Site Plan
1-2	Gross Reservoir Components
2	Floodplain Overlay Districts
3-1	Geologic Hazard and Constraint Areas
3-2	Geology
4	Threatened and Endangered Species Map—Preble's Meadow Jumping Mouse
5	Critical Wildlife Habitat and Migration Corridors
6	Environmental Conservation Areas
7-1	System Capacity and Service Area Plans and Maps
7-2	General Design Drawings of Principal Project Works
7-3	Collection System Components
7-4	Combined Service Area, Fixed Contracts, and Major Distribution Facilities
8	Historical and Archeological Resource Areas
9	Terrestrial and Aquatic Animals and Habitat Map—Mule Deer Habitat
10	Terrestrial and Aquatic Animals and Habitat Map—American Elk Habitat
11	Terrestrial and Aquatic Animals and Habitat Map—Sensitive Areas and Wildlife Corridors
12	Terrestrial and Aquatic Animals and Habitat Map—Bald Eagle Habitat
13-1	Land Ownership at Gross Reservoir

Table 2:
List of Figures Included in Exhibit 1

Figure	Caption
13-2	Recreation Areas at Gross Reservoir
14	Significant Agricultural Lands
15	Figure 15 was omitted in final editing
16	Location of Water Wells
17	Wetlands and Riparian Areas
18	Terrestrial and Aquatic Animals and Habitat Map—High Biodiversity Areas
19	Terrestrial and Aquatic Animals and Habitat Map—Rare Plant Areas & Significant Natural Communities
20	Public Outdoor Recreation and Open Space Areas Map—Recreation Resources
21	County Trails
22	Natural Areas and Natural Landmarks
23	Photographic Simulation of the Planned Project at Gross Reservoir
24	View Protection Corridors
25	60% Design Drawings
26	Site Development and Grading

Project Description

Gross Dam was completed in 1954 and is the primary storage facility for the Moffat Collection System. When designed in the late 1940s, Denver Water looked towards the future and designed the existing reservoir with a future expansion in mind. Thus, the foundation and outlet works of the existing dam were constructed to accommodate an expansion, and the infrastructure to move water to and away from Gross Reservoir was sized to accommodate an expanded Gross Reservoir.

Pursuant to the Federal Energy Regulatory Commission's July 2020 Order Amending License for FERC Project 2035-099 (FERC Order), Denver Water plans to enlarge its Moffat Collection System by expanding Gross Dam and Reservoir to store an additional 72,000 acre-feet of water (77,000 acre-feet total will be added to include a 5,000 acre-feet "Environmental Pool" described later in the document as an environmental enhancement of the Project). Water diverted under existing water rights and facilities from the Upper Williams Fork and Fraser Rivers and South Boulder Creek to the expanded Gross Reservoir will provide 18,000 acre-feet per year of additional supply and improve Denver Water's system reliability. This additional storage and supply will provide system resiliency to meet Denver Water's mission to serve customers of Denver Water's combined service area reliable, high quality water by increasing supply, decreasing vulnerability, and increasing reliability. Now, more than ever, water providers must be prepared for ever-changing conditions within the watersheds. Drought and multiple forest fires have highlighted the need for a resilient water collection system that can adapt to the unexpected. Approximately 1.5 million people in the Denver Metropolitan area depend entirely upon Denver Water for their treated municipal, industrial and commercial water. In addition to treated water, Denver Water also provides recycled water and raw water to customers. Denver Water's Integrated Resource Plan (IRP) (Exhibit 2) provides more detail on Denver Water's customer obligations. The Moffat Collection System currently supplies just 10 percent of Denver Water's overall reservoir storage capacity

and 20 percent of its total water supply. This limited storage constrains Denver Water's ability to deliver water to its customers and presents risks to the overall system. As confirmed by the U.S. Army Corps of Engineers (Corps) in its review and approval of the Project, despite water conservation efforts, Denver Water's system is vulnerable to natural or manmade disaster, prone to severe shortages in even a single-year drought, and inadequate to meet the projected water supply needs of the area's growing population. The Project will increase supply to meet future demands and reduce system vulnerability to catastrophic events by better balancing storage between the North and South Systems. The North System is outlined in green and the South System in red in Figure 7-1.

Gross Dam and Reservoir are features of a FERC licensed hydroelectric project (Project No. 2035) and occupy or affect land withdrawn by the federal government for hydropower production purposes. Denver Water generates electricity at Gross Dam and Reservoir when water is released for municipal water supply. The increased Dam and Reservoir will increase hydropower production by 4.4 gigawatt-hours (GWh) annually. As a facility regulated by FERC through its Federal Power Act authority, Denver Water was required to amend the project license to construct the dam raise and to maintain and operate the expanded dam and reservoir and FERC has issued its order for Denver Water to expand Gross Dam and Reservoir and increase the hydropower capacity.

Gross Reservoir is located on South Boulder Creek in Boulder County, Colorado (Figures 1-1 and 1-2). The effects of the Project's construction, operation, and the amendments to the FERC license have been analyzed and mitigated through an EIS prepared by the Corps, and a Final SEA conducted by FERC. "Together, these documents provide a complete record of analysis for Denver Water's proposals to expand the Moffat Collection System and amend the license for the Gross Reservoir Hydroelectric Project." FERC 2020. The environmental analysis has been relied on by numerous other federal and state agencies in issuing approvals or agreements associated with the Project, including *inter alia* the U.S. Forest Service (USFS), the U.S. Fish and Wildlife Service (USFWS), the State Historic Preservation Officer (SHPO), Colorado Department of Public Health and Environment (CDPHE), and Colorado Parks and Wildlife (CPW). Denver Water has committed to extensive mitigation conditions (incorporated in the agency decisions and permits) as well as an abundance of environmental enhancements enforceable through various agreements with federal, state and local governments and entities. Denver Water has engaged extensively with the public throughout the project planning process.

Denver Water owns, has the rights to use, or will obtain permissions prior to construction for all land required by the Project and existing water rights to fill the expanded reservoir. On September 7, 2016, Denver Water and the USFS executed an agreement for the utilization of National Forest System land associated with the construction, operation and maintenance of the Project as permitted by the Corps and as authorized under the amended FERC license.

Table 3 provides a summary of the proposed changes to Gross Dam and Reservoir (Project) that are described in this 1041 application.

Table 3:
Gross Dam and Reservoir Features

Gross Dam and Reservoir Features	Existing	Project (with an Environmental Pool)
Additional Storage Volume (acre-feet)	—	77,000 (72,000 + 5,000)
Approximate Storage Volume (acre-feet)	42,000	119,000
Normal Water Surface Elevation (feet msl[1])	7,282	7,406
Surface Area (acres)	418	842
Dam Raise (feet)	—	131
Dam Height (feet)[2]	340	471
Dam Crest Length (feet)**	1,050	1,940
Dam Raise Volume, including Spillway (cubic yards)	—	930,000
Spillway Elevation (feet msl*)	7,282[3]	7,406
Saddle Dam	No	Added
Outlet Works	—	No major change
Inlet	—	No major change

1 msl = above mean sea level
2 Existing spillway crest includes 2 feet of flashboards.
3 The approximate dam height and dam crest length are based on preliminary design work subject to final review and approval by FERC

Construction

Construction Sequence and Preliminary Schedule

The general construction sequence for the various components of the Project is assumed to include the following activities: mobilization, site development (access roads, staging areas, quarry development, and clearing and grubbing), on-site quarry, on-site aggregate production, dam foundation excavation, grouting (curtain/blanket), dam foundation treatment, roller compacted concrete (RCC) mixing, dam concrete placement (main dam, thrust blocks, and saddle dam), drain holes (dam/foundation), saddle dam completion, slope protection, reservoir clearing (tree removal), site restoration, and demobilization.

The Gross Dam raise construction, including offsite and ancillary improvements to support the dam construction, will be completed over a 6-year period that includes safety improvements made to area access roads and the intersection at SH 72 and Gross Dam Road. A preliminary construction schedule is provided in Table 4.

Table 4:
Anticipated Project Timeline

Anticipated Project Timeline

Activity	1	2	3	4	5	6	7
Site Mobilization							
Dam surface preparation, Materials Lab, early site grading for temporary facilities							
Public access to South Shore closed (North Shore open throughout construction)							
Install temporary recreation facilities, public road improvements, site development							
Quarrying operations							
Dam foundation excavation, grouting, plant setup							
Dam raise activities - materials trucking							
Forestry activities/tree clearing							
First fill							

Presently, Denver Water anticipates Year 1 to begin in 2022. Updated 8/2020

Construction Traffic Estimates

Pursuant to FERC Order Article 425, within one year of the date of FERC's Order and after conferring with certain governmental stakeholders, including Boulder County, Denver Water must submit a Traffic Management Plan for FERC's review and approval. Denver Water will provide the draft Traffic Management Plan to Boulder County for review and comment in accordance with the terms of FERC's Order.

Denver Water's Traffic Impact Analysis that includes estimated peak vehicle trips during construction is included in Exhibit 4. The analysis in Exhibit 4 is based on the latest construction evaluations prepared by Denver Water in coordination with the Construction Manager General Contractor (CM/GC) and feedback from stakeholders. Denver Water would encourage construction carpooling and has incorporated a bussing option into the evaluation of transporting workers to and from the construction site (see Section 7.4 of Exhibit 4). For cement and fly ash transportation, Denver Water estimates additional tractor trailer trips each day based on a 5-day delivery schedule between April and October, for a two to three-year period during the dam raise activity. A detailed Traffic Impact Analysis is included as Exhibit 4.

Construction Activities Affecting Land Use

Construction activities affecting land use within Boulder County are associated with the following activities.

Dam

Denver Water would raise the dam crest by 131 feet to a final height of approximately 471 feet. Based on preliminary design, the length of the dam crest would increase by about 790 feet to 1,940 feet. The actual dam crest length would be determined during final design. Denver Water would construct the raised dam with RCC and the modified dam would have approximately the same dam axis, arch radius, crest width, and downstream slope as the existing dam, subject to evaluations during final design.

The main dam raise using RCC placing is anticipated to occur over two years and would be performed 24 hours per day during the construction season. Concrete would not be placed during the winter due to cold temperatures. During concrete placement, night work and noise impacts can be expected, although Denver Water will try to minimize disturbance at night. Otherwise, construction is expected 12 hours per day, 5 to 6 days per week. The closest impacted residents are in the North Shore community to the north of the reservoir (approximately 0.75 miles from the dam) and the Miramonte community to the south of the reservoir (approximately 1.5 miles from the dam).

Primary Spillway

Denver Water would raise the primary spillway crest, which would be located near the center of the dam, about 126 feet to elevation 7,406 feet msl. The spillway configuration will be similar to the existing spillway and able to pass the inflow design flood without overtopping the dam (meeting both the Office of the State Engineer and FERC requirements). Denver Water coordinated with the FERC Division of Dam Safety and Inspections and the Independent Board of Consultants on the design and location of the spillway.

Saddle Dam

There is a topographic saddle along the reservoir rim to the south of Gross Dam that requires a small water impounding structure (commonly referred to as a saddle dam). The Saddle Dam will be in a topographic saddle about a mile south of Gross Dam near the intersection of Gross Dam Road and the access road for the Haul Road/Osprey Point Recreation Area and is shown on Fig 1-2. The Saddle Dam will not impound the reservoir during normal operations. However, during large storm events, impounded water may submerge the heel of the exposed dam.

The current Saddle Dam configuration considers an RCC dam structure with covered with earthen upstream and downstream faces. The total dam height including portions below existing grade is approximately 40 feet. Given the existing terrain at the Saddle Dam location, the dam height above final grade is only about 9 feet. The RCC dam crest is 20 feet wide and will be covered with a thin layer of engineered fill to produce a relatively unobtrusive embankment.

Onsite Quarry for Borrow/Aggregate Materials

Pursuant to FERC Order Article 424, within one year of the date of FERC's Order and after conferring with certain governmental stakeholders, including Boulder County, Denver Water must submit Quarry Operation and Reclamation Plans for FERC's review and approval. Denver Water will provide the draft Quarry Operation and Reclamation Plans to Boulder County for review and comment in accordance with the terms of FERC's Order.

Denver Water will obtain the aggregate required for construction of the dam raise from an onsite primary quarry, called Osprey Point Quarry (Figure 1-2). However, if necessary, it would also utilize an alternative quarry site, which was analyzed in the Final EIS (Final EIS quarry). Both the Osprey Point Quarry and the Final EIS quarry were designed to be able to produce at least one and a half the volume of aggregate (approximately 1.2 million cubic yards) required for construction of the dam. Denver Water intends to use the Osprey Point Quarry as its primary quarry, and would only develop the alternative Final EIS quarry in the unlikely event the primary quarry does not produce the quality or quantity of aggregate required for the project.[1] Denver Water planned the layout in order to minimize or avoid quarry-related impacts identified in the Final EIS, as explained below.

The Osprey Point Quarry would be located near Osprey Point, west of the planned saddle dam, in an area entirely on Denver Water property. The quarry would occupy approximately 14 to 16 acres, with a total of 41 to 43 acres of disturbance for all quarry-related activities (FERC 2018). The quarry location would be accessible from existing access roads and would be mostly inundated by the reservoir once construction has been completed. Comparatively, the Final EIS quarry, if utilized, would be located on approximately five acres of Denver Water property and 24 acres of National Forest System lands, with a total disturbance area of about 56 acres.

During construction, use of the Osprey Point Quarry site would involve benched quarrying work with 40-foot vertical and 20-foot horizontal benches to a total height of approximately 150 to 160 vertical feet. Upon refilling Gross Reservoir to its new maximum water elevation of 7,406 msl, 0 to 55 feet of vertical quarried highwall, covering an area of up to 3 acres in size, would mostly remain visible above the water line. Any remaining portions of the exposed highwall would be regraded to reduce vertical walls and cliffs along the reservoir edge and would be rough-graded to drain back towards the reservoir. In comparison, the Final EIS quarry site would require 375 vertical feet of quarrying, and about 250 vertical feet of that, covering an area of about 13 acres, would remain visible after the reservoir is refilled to its new maximum elevation.

Denver Water anticipates one blast per every one to three days at the quarry during the excavation process. The granite rock material would then be processed into sand and gravel for use at the dam. Trucks would be utilized to transport the sand and gravel to the dam location. Concrete would be made onsite at a batch plant. These activities are described in more detail below.

Denver Water would locate stockpile areas for the Osprey Point Quarry at the quarry, the dam, or along the existing Gross Dam Road connecting the Osprey Point Quarry to the dam site (Figure 1-2). Denver Water's preliminary evaluations show that there is sufficient stockpile area within or adjacent to the Osprey Point Quarry and/or west of the dam site. Tentative stockpile areas for the Final EIS quarry have been identified, one adjacent to the Final EIS quarry and one located west of the dam.

[1] The Final EIS used information from Denver Water's preliminary site investigations, which estimated that 426,000 cubic yards of aggregate material could be obtained from the Final EIS quarry site on land managed by the Forest Service, with the remaining 370,000 cubic yards of aggregate to be trucked in from offsite locations. Subsequent site investigations found that all of the aggregate material needed could be obtained on-site from either the Final EIS quarry or a quarry located at Osprey Point.

Access to the Osprey Point Quarry site would be from the existing Gross Dam Road leading to the existing boat ramp. The existing access road would also serve as the main haul route for transporting finished aggregate material to the concrete batch plant at the dam site.

Temporary Concrete Batch/Production Plant

Denver Water would construct a temporary concrete batch/production plant at Gross Dam and include equipment to handle, store, and mix aggregate, cement, water, and fly ash to produce concrete. The plant would include one standard 8-cubic-yard concrete mixer for RCC and one standard 12-cubic-yard concrete mixer for conventional concrete. Approximately six 100-horsepower diesel engines and engine-generator sets were assumed to power the concrete plant equipment in previous studies, including the Corps' EIS. As a voluntary noise minimization effort, Denver Water intends to power the batch plant with line power from the onsite hydroelectric power plant.

Approximately 7,200 truck deliveries during the two-year construction period would be needed for delivery of cement and fly ash. Cement and fly ash cannot be stockpiled due to the particle size; therefore, cement and fly ash would be stored on-site in silos. Denver Water is anticipating roadway improvements for cement and fly ash deliveries to minimize impacts. More information on roadway improvements is provided below.

Aggregate Processing Plant

Denver Water would also construct an aggregate processing plant, consisting of one 300-horsepower and six 150-horsepower diesel engines to crush rock. Denver Water has identified two potential spoil areas (unsuitable for construction aggregate), located due north and south of the dam site (Figure 1-2). Spoil areas may contain excavated materials and other materials not used for dam construction. Post-construction, spoil areas would be situated entirely below the new high-water line. Some spoils would be used to re-contour and reclaim any portion of the quarry above the new high-water line or other areas needing reclamation.

Tree Removal

Pursuant to FERC Order Article 423, within one year of the date of FERC's Order and after conferring with certain governmental stakeholders, including Boulder County, Denver Water must submit a Tree Removal Plan for FERC's review and approval. Denver Water will provide the draft Tree Removal Plan to Boulder County for review and comment in accordance with the terms of FERC's Order.

Denver Water has completed preliminary outreach to agencies and concept development for a Tree Removal Plan. Several options for tree removal and disposal of material were evaluated. This preliminary effort, which included input from Boulder County and the USFS, will be expanded on to develop the final Tree Removal Plan.

Permanent Roadway and Trail Improvements

Gross Dam Road

Denver Water would relocate portions of the existing Gross Dam Road in two locations near the planned saddle dam approximately 1 mile south of Gross Dam to support access to the relocated Osprey Point

Quarry and Haul Road Recreation Area. The relocated road would be comprised of the same material and size as the existing road - a gravel surface and a disturbance area of approximately 30- to 50-feet wide by 500-feet long.

Access to the dam would be available using the existing Gross Dam access roads. However, minor road relocations would be necessary at the north and south dam abutments because of future inundation. These two road segments would be abandoned and relocated: approximately 1,500 feet of the north abutment access road would be relocated to the east at an elevation 100 feet higher than the existing access road, and approximately 1,500 feet of the south abutment access road would be relocated south of the existing Gross Dam access roads. Both relocated road segments would be gravel surfaced and approximately 25 feet wide.

Denver Water would design Gross Dam Road for two-way tractor trailer hauling (which would require a 25 mile-per-hour speed limit and a turning radius adequate for semi-trailer trucks). Denver Water would also widen a few curves as shown in the design drawings (Exhibit 1, Figure 26 and Exhibit 4). Denver Water does not plan to pave Gross Dam Road and plans to maintain Gross Dam Road during construction activities and restore the road base to preconstruction conditions.

State Highway 72 and Gross Dam Road Intersection Improvements

Denver Water is planning for intersection improvements at SH 72 and Gross Dam Road and has met with the Colorado Department of Transportation (CDOT). A preliminary assessment of the interchange has provided three alternatives. Of the alternatives, CDOT indicated a preference for a new intersection and will be further evaluated through the design process with CDOT. Denver Water will coordinate with the Boulder County Transportation Department to obtain an access permit.

Denver Water would transfer the non-CDOT roadway right of way (ROW) at this intersection to Boulder County once the improvements have been made.

Miramonte Multi Use Trail Improvements

Denver Water would rebuild a multi-use trail for Miramonte because the existing trail would be in the quarry and the inundation area (Figures 1-1 and 1-2).

Temporary Construction Roadways and Facilities/Staging Areas

Denver Water would obtain construction access using existing roads or the previously described relocations. In addition, Denver Water would construct temporary access roads to provide hauling access between the quarry, stockpile areas, and the dam site. These roads include (1) temporary widening of the Gross Dam Road from the Osprey Point Quarry to the dam and (2) an access road from the Gross Dam Road to the saddle dam site. The additional disturbance width would be 30–50 feet, and the roads would have a gravel surface.

If the Final EIS Quarry is developed instead of the Osprey Point Quarry, temporary access roads would include a haul road between the Final EIS Quarry site/stockpile area and the stockpile area located west of the dam.

Temporary Support Facilities/Staging Areas

Denver Water has identified several temporary staging areas at the reservoir site, including areas near the hydroelectric plant along South Boulder Creek downstream from the dam and one area at the southwestern end of the dam (Figure 1-2). Final location of staging areas will be determined in the final design phase.

Tree Removal and Disposal Landing Areas

The primary site access to the west side of the Project would be via FS 359 (Winiger Ridge Road) and FS 97 (Lazy Z Road or Haul Road). Portions of both roads would be improved to bring in harvesting equipment, support equipment, and transport residue/biomass. A short and steep existing jeep trail connects these two roads and would be improved for truck transportation of biomass. Portions of Gross Dam Road would be used for site access to helicopter landing sites.

Public Safety Measures During Construction

South of Gross Dam to Osprey Point Quarry and east to the Gross Dam Headquarters will be closed to the public during construction for public safety. On reservoir boating would be allowed with restrictions. The South Boulder Creek reservoir stem may be temporarily closed for quarry operations and blasting and the main dam site are will also be restricted. On reservoir access will be controlled with boat barriers and on reservoir security patrols.

Operation of the Dam, Reservoir, and Surrounding Lands, including Recreation Facilities and Amenities

Once dam construction is complete, Denver Water will begin storing an additional 72,000 acre-feet of water in the reservoir by increasing diversions of its existing water rights on the West Slope and from South Boulder Creek during average and wet water years. The 5,000 acre-foot Environmental Pool will be filled with water rights owned by the cities of Boulder and Lafayette and will be solely from South Boulder Creek. The elevation of Gross Reservoir will rise by 124 feet, from 7,282 to 7,406 feet msl. This will increase the surface area of the reservoir from 418 to 842 acres, holding a maximum storage volume of 118,811 acre-feet. Water is released into South Boulder Creek downstream of the dam, and water supply flows are diverted to the South Boulder Diversion Canal for delivery to Ralston Reservoir, raw water customers, and the Moffat Water Treatment Plant. Flow released from the Environmental Pool will continue downstream and will be diverted at existing diversion structures operated by the cities of Boulder and Lafayette. Denver Water's reservoir operations will not change; however, the amount of water being delivered to, stored in and released from Gross Reservoir will increase. Similarly, the generation of power will increase, thereby displacing the need for other power sources such as fossil-fueled facilities and avoiding power plant emissions.

Mitigation

Denver Water has committed to more than 60 different mitigation and enhancement projects with a total cost of more than $20 Million. Denver Water is collaborating with numerous stakeholders to preserve the aquatic environment on a cooperative basis. In addition, a sampling of commitments that Denver Water has developed in response to community and neighborhood input is included in Exhibit 6. The Project

would comply with applicable Boulder County Building Code and Boulder County Public Health Department regulations and would obtain necessary Boulder County permits. Additional federal and state permits and approvals are listed below in Table 5. Mitigation projects within Boulder County are included in Table 6.

Table 5:
Federal and State Environmental Permits and Approvals Required to Construct and Operate the Project

Permit/Approval	Purpose	Applicable Project Component	Status
Federal			
U.S. Army Corps of Engineers (Corps) Permit to Discharge Dredged or Fill Material (Clean Water Act Section 404 Permit)	Authorizes placement of fill or dredged material in waters of the United States (U.S.) including adjacent wetlands.	All surface-disturbing activities affecting waters of the U.S., including wetlands, such as construction of a dam, reservoir, diversion structure, roads and pipeline crossings.	Denver Water obtained a Record of Decision (ROD) in July 2017 and a 404 Permit in September 2017.
U.S. Forest Service (USFS) Federal Land Policy and Management Act of 1976	Authorizes occupancy, use, rights, or privileges of USFS land. The authorization is granted for a specific use of the land for a specific period of time.	Additional USFS lands needed for Project facilities at Gross Reservoir.	Denver Water and the USFS entered into an Off-License Agreement in September 2016.
Federal Power Act (Section 4e) Authority	Authorizes the USFS to impose conditions within a FERC license.	Conditions may be imposed by the USFS to address new Project modifications within the FERC project boundary at Gross Reservoir.	Section 4e Conditions were part of the September 2016 Off-License Agreement between Denver Water and the USFS and the conditions were submitted to FERC for inclusion in Denver Water's hydropower license.
U.S. Fish and Wildlife Service Endangered Species Act (Section 7) Compliance	Protects threatened and endangered species.	Any activity potentially affecting listed or proposed threatened or endangered species, such as the Preble's meadow jumping mouse.	A Biological Opinion was issued by the USFWS to address impacts associated with Denver Water operations in December 2013.
Migratory Bird Treaty Act	Protects migratory birds.	All surface-disturbing activities affecting migratory birds, such as burrowing owls and raptors.	Denver Water will comply with the Migratory Bird Treaty Act.
Fish and Wildlife Coordination Act	Compliance with the Corps' obligations under the Fish and Wildlife Coordination Act	All surface-disturbing activities affecting fish and wildlife in the Project area.	Completed in October 2016. In February 2016, the USFWS approved the FWCA Report prepared by the Corps acknowledging that the Corps' responsibilities under FWCA had been met.
U.S. Department of the Interior—Advisory Council on Historic Preservation Cultural Resource Compliance (Section 106 of the National Historic Preservation Act of 1966, as amended [NHPA])	Protects cultural and historic resources; coordinated with the Colorado State Historic Preservation Officer (SHPO).	All ground-disturbing activities.	Denver Water is signatory to two Programmatic Agreements. The first is with the Corps et al (October 2015) and the second is with FERC et al (September 2018).

Table 5:
Federal and State Environmental Permits and Approvals Required to Construct and Operate the Project

Permit/Approval	Purpose	Applicable Project Component	Status
Federal Energy Regulatory Commission (FERC) Hydropower License Amendment	Authorizes construction at Gross Dam and an increase in water levels in Gross Reservoir, which are features of the Gross Reservoir Hydroelectric Project (FERC Project No. 2035).	All properties or facilities related to the FERC hydropower license.	FERC issued a Supplemental EA in February 2019 concluding with staff recommending approval of Denver Water's amendment application. FERC issued its final Order amending the hydropower license in July 2020.
State of Colorado			
Colorado State Engineer's Office, Division of Water Resources Permit to Construct Facility (Dam) Reservoir Storage Permit Dam Safety Permit	Authorizes dam and reservoir construction and reviews dam safety.	Dam and reservoir construction and operation.	To be submitted prior to construction activities
Colorado Department of Public Health and Environment, Air Pollution Control Division Land Development Permit (Fugitive Dust Control Plan)	Protects air quality from dust and airborne particulates resulting from construction activities over 25 acres in size or 6 months in duration.	All ground-disturbing construction activities.	To be submitted prior to construction activities
Air Pollutant Emissions Notice (APEN)	The APEN reporting threshold for criteria pollutant, particulate matter less than 10 microns in diameter (PM10) is 2 tons per year (uncontrolled rate) for emissions sources in attainment areas (the Project is an attainment area). If the Project were to emit 5 (or more) tons per year of PM10 (uncontrolled rate), then an air quality permit would be needed.	Concrete batch plant.	To be submitted prior to construction activities
Colorado Department of Public Health and Environment, Water Quality Control Division General Permit for Stormwater Discharges Associated with Construction Activity	Controls the discharge of stormwater pollutants associated with construction activities.	All ground-disturbing construction activities disturbing more than 1 acre.	To be submitted prior to construction activities
Clean Water Act Section 401 Water Quality Certification	Ensures that activities authorized under Section 404 meet State water quality standards and do not degrade water quality.	All activities subject to the Section 404 Permit from the Corps.	Denver Water was issued its 401 Certification in June 2016.
Construction Dewatering Permit	Ensures that dewatering of groundwater from a construction site does not impair the receiving waters.	Dewatering during excavation and placement of fill for the dam.	To be submitted prior to construction activities

Table 5:
Federal and State Environmental Permits and Approvals Required to Construct and Operate the Project

Permit/Approval	Purpose	Applicable Project Component	Status
Office of Archaeology and Historic Preservation, Colorado State Historic Preservation Officer (SHPO)	Determines significance of cultural resources potentially affected by ground disturbing activities.	All ground-disturbing activities.	Denver Water is signatory to two Programmatic Agreements (see above).
Colorado Water Court System Water Rights	Legal appropriation of water in the State of Colorado.	Surface water and/or groundwater used by the Project.	Denver Water currently holds conditional water rights for an expanded Gross Dam and Reservoir.
Colorado Water Conservation Board, Wildlife Commission, and Colorado Parks and Wildlife Colorado Revised Statutes (CRS) 37-60-122.2	Develops the official state position on mitigation of impacts to fish and wildlife resources.	All activities potentially affecting fish and wildlife resources.	Denver Water received approval of its Fish and Wildlife Mitigation Plan in June 2011.

Table 6:
Mitigation Measures for the Project

Summary of Project Impact	Required Mitigation	Enforcement Mechanism
Gross Reservoir		
Water Quality		
Minor to moderate short-term decrease in water quality in Gross Reservoir due to organic matter decay, including increases in methylmercury, as a result of filling the expanded reservoir. No long-term adverse impacts anticipated.	Denver Water will monitor mercury in fish tissue in Gross Reservoir with assistance from CDPHE and CPW. If the fish tissue analysis indicates that a revised Fish Consumption Advisory (FCA) is required, Denver Water will work with CDPHE and CPW to provide public education, including the posting of revised FCA signs at Gross Reservoir.	401 Certification Condition 16 adopting mitigation identified in the 2011 Fish and Wildlife Mitigation Plan (FWMP) developed by Denver Water and approved by CPW and CWCB.
	Denver Water will monitor general water quality parameters (nutrients, organic carbon, metals, major ions, temperature, and chlorophyll a) in Gross Reservoir. Monitoring results will be submitted annually to CDPHE.	401 Certification Condition 13 adopting mitigation identified in the 2011 FWMP developed by Denver Water and approved by CPW and CWCB.
	Denver Water will minimize water quality impacts from organic matter by removing vegetation in the inundation area according to a Tree Removal Plan. The Tree Removal Plan will deter5mine preferred removal and disposal methods through consultation with the USFS, the Colorado State Forest Service, Boulder County, Jefferson County, and Gilpin County. A final plan will be prepared and filed with the FERC for approval prior to land clearing activities. Pursuant to USFS Section 4(e) Condition 27, Denver Water will compensate the USFS for merchantable timber and will collaborate on best methods to remove timber on National Forest System (NFS) lands. During development of the Tree Removal Plan, Denver Water will explore ways by which its tree removal operations or the material can provide benefit to the local community (e.g., firewood). The Tree Removal Plan would	USFS Section 4(e) Condition 27 (Tree Removal Plan) from the Denver Water/USFS Settlement Agreement adopting mitigation identified in the 2011 FWMP developed by Denver Water and approved by CPW and CWCB. Mitigation required by the FERC for the amended License to consult with other parties in addition to the USFS in developing the Tree Removal Plan.

Table 6:
Mitigation Measures for the Project

Summary of Project Impact	Required Mitigation	Enforcement Mechanism
	also include consideration of avoidance and minimization of associated nuisance factors such as noise, light, and obnoxious odors. The 401 Certification acknowledges Denver Water's commitment to prepare a Tree Removal Plan "to remove as much organic matter as practicable from the inundation area" as a measure to preclude additional methylation or diminish the present level of methylation of mercury in Gross Reservoir.	
Geology		
Expansion of Gross Reservoir may increase stress on faults at or near the reservoir site and result in negligible seismic activity. However, the water loads at Gross Reservoir would not change the water content in faults at depth, and, thus, increased earthquake activity from lubricated faults is not anticipated. The dam raise and reservoir expansion may increase the potential for reservoir-induced seismicity, but not at substantial levels.	Denver Water will perform detailed geotechnical and seismic FERC License studies, as required by FERC, as part of final design and during construction. Denver Water will design the dam expansion in accordance with FERC engineering guidelines for the Evaluation of Hydropower Projects, the Colorado Rules and Regulations for Dam Safety and Dam Construction, and current engineering practices. Potential issues related to seismicity will be addressed through the geotechnical and seismic studies. The Project will be subject to a series of design reviews by several organizations including Colorado State Engineer's Office, FERC Division of Dam Safety and Inspection, and an independent Board of Consultants review panel made up of expert dam engineers approved by FERC. These reviews will ensure that the structure is designed and constructed to be safe and structurally sound.	Geologic studies are required by FERC to design the dam.
Unavoidable loss of geological resources and alteration of topography due to quarry activities.	If the Osprey Point Quarry is developed on Denver Water land (which is an impact minimization effort), Denver Water will prepare a Quarry Operation Plan to include quarry development and operation activities and a Quarry Reclamation Plan to include quarry mitigation techniques for areas above the new normal water line, if any. Denver Water will consult with Boulder County and the Mine Safety and Training Program arm of the Colorado Division of Reclamation, Mining, and Safety to develop quarry operation procedures and with the Corps, Boulder County and the Colorado Division of Reclamation, Mining, and Safety to develop reclamation measures for Denver Water land. Denver Water will submit the final plans to FERC. If the Final EIS Quarry is developed on NFS lands, Denver Water will prepare a Pit Development and Reclamation Plan to include quarry operation and reclamation and will obtain a USFS Mineral Materials Permit. The Pit Development and Reclamation Plan will be developed in consultation with USFS and the Colorado Division of Reclamation, Mining, and Safety and will be filed with the FERC prior to ground-disturbing or construction activities associated with pit development on NFS lands. Denver Water will also obtain a Reclamation Permit, which requires a reclamation plan, from the Colorado Division of	For the Osprey Point Quarry: Corps 404 Permit condition to develop a quarry operation plan and reclamation plan for Denver Water land. Mitigation to be specified in the Quarry Operation and Reclamation Plans required by FERC Order Article 424. For the Final EIS Quarry: USFS Section 4(e) Condition 26 (Pit Development and Reclamation Plan) from the Denver Water/USFS Settlement Agreement and FERC Order Article 422(a). USFS Mineral Materials Permit. Colorado Division of Reclamation, Mining, and Safety Reclamation Permit.

Table 6:
Mitigation Measures for the Project

Summary of Project Impact	Required Mitigation	Enforcement Mechanism
	Reclamation, Mining, and Safety (only required for the Final EIS Quarry on federal land).	
Soils		
Impacts to 465 acres of soils related to the expansion of the dam and reservoir and related facilities, including the quarry. Temporary impacts to 89 acres during construction; may result in temporary minor erosion and sedimentation.	Denver Water or its contractor will acquire a State General Permit for Stormwater Discharges Associated with Construction Activities. As required under this permit, Denver Water will prepare a Stormwater Management Plan that will specify BMPs and inspection requirements to reduce pollutants in stormwater runoff from the construction sites. BMPs will be used to address erosion control, stockpiling of materials, dust control, revegetation, materials handling, fuel containment, etc.	Anticipated State General Permit for Stormwater Discharges Associated with Construction Activities.
	Denver Water will develop an Erosion Control and Reclamation Plan addressing ground disturbance on NFS lands associated with the Project.	USFS Section 4(e) Condition 19 (Erosion Control and Reclamation) from the Denver Water/USFS Settlement Agreement and FERC Order. USFS Section 4(e) Condition 28 (Reclamation and Revegetation Seed Mixes and Mulch Materials) from the Denver Water/USFS Settlement Agreement and FERC Order Article 422(a).
Vegetation		
Permanent impact due to removal of approximately 456 acres of vegetation, including forest vegetation, from construction and inundation. Permanent impacts to sensitive habitats from inundation, including 71.3 acres of Winiger Gulch Potential Conservation Area (PCA) (3.8 percent of total PCA area) and 243.4 acres of Winiger Ridge Environmental Conservation Area (ECA) (7 percent of total ECA area). Noxious weeds may invade drawdown area and temporary disturbance areas. Loss of 3.9 acres of Arapaho and Roosevelt National Forests (ARNF) plant communities (river birch/mesic forb, foothills riparian shrub, and thinleaf alder/mesic forb riparian	Denver Water will convey the 539-acre Toll Property to the USFS to be administered and protected as part of the Roosevelt National Forest as mitigation for resource values that will be lost on Denver Water and NFS lands due to inundation and construction-related ground disturbance. The 539 acres of private, forested lands will be protected and accessible to the public through its addition to the National Forest. The Toll Property parcels are surrounded by the Roosevelt National Forest and contain diverse vegetation types (forest, grassland, fens, wet meadows, pond, stream, and riparian habitat). The property will protect two PCAs: Mammoth Gulch PCA with Very High Biodiversity Significance due to the occurrence of a unique iron fen plus imperiled woodland species and the Middle and South Boulder Creek PCA with High Biodiversity Significance due to the occurrence of a globally vulnerable forested fen and shrubland community. The Toll Property also preserves valuable wildlife habitat including elk and mule deer summer range and migration corridors, potential habitat for lynx (federally threatened and state endangered species), habitat for boreal toad (state endangered and USFS sensitive species), and a wide range of habitats for small mammals and birds. (See also Wetlands mitigation.)	Denver Water/USFS Settlement Agreement.
	Denver Water will minimize impacts to vegetation on NFS lands through implementation of a new Erosion Control and Reclamation Plan and a new Road Maintenance Plan. Denver Water will revegetate and reclaim NFS lands with seed mixtures and mulch materials approved by the USFS.	USFS Section 4(e) Condition 19 (Erosion Control and Reclamation) from the Denver Water/USFS Settlement Agreement and FERC Order Article 422(a). USFS Section 4(e) Condition 10 (Use of Roads on National Forest System Lands)

Table 6:
Mitigation Measures for the Project

Summary of Project Impact	Required Mitigation	Enforcement Mechanism
shrubland) of local concern due to inundation. Moderate impact due to loss of biodiversity, but not substantially affecting overall distribution or abundance. Minor impact due to a loss of about 1 acre (0.1 percent) of old growth ponderosa pine on the Roosevelt National Forest due to inundation.		from the Denver Water/USFS Settlement Agreement and FERC Order Article 422(a). USFS Section 4(e) Condition 28 (Reclamation and Revegetation Seed Mixes and Mulch Materials) from the Denver Water/USFS Settlement Agreement and FERC Order Paragraph H.
	Denver Water will develop an Invasive Plant and Noxious Weed Species Management Plan for NFS lands in consultation with the USFS.	USFS Section 4(e) Condition 17 (Invasive Species Management) from the Denver Water/USFS Settlement Agreement and FERC Order Article 422(a). USFS Section 4(e) Condition 30 (Cost Collection and Participating Agreement regarding weed control) from the Denver Water/USFS Settlement Agreement and FERC Order Paragraph H.
	Denver Water will develop a new Fire Management and Response Plan to reduce the risk of wildfires at and near Gross Reservoir.	USFS Section 4(e) Condition 20 (Fire Management and Response Plan) and FERC Order Article 422(a).
Wetlands and Other Waters of the U.S.		
Total impacts to Waters of the U.S., including wetlands and Other Waters of the U.S., equals 5.78 acres. This includes: Permanent impacts to 2.24 acres of Corps jurisdictional wetlands surrounding Gross Reservoir and 0.21 acres of temporary impacts. Permanent impacts to 3.54 acres of Corps jurisdictional Other Waters of the U.S. and 0.50 acre of temporary impacts to Other Waters of the U.S.	Denver Water will mitigate the permanent loss of jurisdictional wetlands through the use of credits from a Corps-approved wetland bank (Four Mile Creek Wetland Mitigation Bank) according to the Corps 404 Permit.	Corps 404 Permit condition.
	Denver Water will also mitigate the permanent loss of wetlands through preservation (through USFS protection and administration of NFS lands) of approximately 43 acres of high-quality wetlands and fens within the 539-acre Toll Property through its conveyance to the USFS. (See also Vegetation mitigation.)	Denver Water/USFS Settlement Agreement.
	Denver Water will establish a 5,000-AF Environmental Pool in Gross Reservoir to augment flows during low flow periods, thereby benefiting 17 miles of aquatic habitat in South Boulder Creek from Gross Dam to its confluence with Boulder Creek. The Environmental Pool will enhance flows in South Boulder Creek below Gross Reservoir and provide flows in the lower section of South Boulder Creek, which currently goes dry at times due to diversions by other water users.	Corps 404 Permit condition. 2010 Intergovernmental Agreement (IGA) between Denver Water and the cities of Boulder and Lafayette. The Environmental Pool was mandated by the FERC Order.
	Denver Water will also mitigate the permanent loss of waterways through preservation (through USFS protection and administration of NFS lands) of approximately 5.7 miles of streams, including a portion of South Boulder Creek, within the 539-acre Toll Property through its conveyance to the USFS.	Denver Water/USFS Settlement Agreement.
Riparian Habitat		
Permanent impact to 4.08 acres of riparian habitat due to reservoir inundation and	Denver Water will mitigate the permanent impact to riparian habitat through the preservation (through USFS protection and administration of NFS lands) of approximately 253 acres of riparian woodland at Mammoth Gulch and Middle	Denver Water/USFS Settlement Agreement.

Table 6:
Mitigation Measures for the Project

Summary of Project Impact	Required Mitigation	Enforcement Mechanism
0.04 acres of temporary impact.	and Upper South Boulder Creek within the 539-acre Toll Property (which are designated as Colorado Natural Heritage Program [CNHP] PCAs) through its conveyance to the USFS.	
Wildlife		
	Denver Water will mitigate permanent impacts to wildlife habitat through the preservation (through USFS protection and administration of NFS lands) of 539 acres of diverse wildlife habitat, including elk and mule deer summer range and migration corridors, potential habitat for lynx (federally threatened and state endangered species), habitat for boreal toad (state endangered and USFS sensitive species), and a wide range of habitats for native wildlife such as coyote, American marten, weasel, elk, moose, mule deer, snowshoe hare, broad-tailed hummingbird, red-naped sapsucker, warbling vireo, and other small mammals and birds.	Denver Water/USFS Settlement Agreement.
	Denver Water will replace the two existing osprey nest platforms at Gross Reservoir and conduct pre-construction raptor surveys.	USFS Section 4(e) Condition 21 (Raptor Protection Measures) from the Denver Water/USFS Settlement Agreement and FERC Order Paragraph H.

Table 6:
Mitigation Measures for the Project

Summary of Project Impact	Required Mitigation	Enforcement Mechanism
Long-term impact to habitat due to loss of 465 acres of vegetation; Big Game: Elk—minor impact to severe winter range and winter concentrations areas; moderate impact to migration corridors. Mule deer, mountain lion, black bear – minor/minimal effect on habitats. General—displacement of big game during construction activities; habitat fragmentation and change in movement patterns due to inundation of South Boulder Creek and Winiger Gulch; potential collisions along haul roads. Other Small and Medium-sized Mammals: Impacts related to habitat loss; disturbance from construction activities; fragmentation of habitat. Raptors and Other Migratory Birds: Construction activities may cause impacts during nesting; increased reservoir surface area will benefit waterfowl. USFS Management Indicator Species: Elk—minor to moderate; deer—minor; pygmy nuthatch, hairy woodpecker and mountain bluebird—moderate locally but minor impact of regional populations; golden-crowned kinglet, warbling vireo, Wilson's warbler—negligible; Rocky mountain bighorn sheep and boreal toad—no impact.	Denver Water will contact the USFWS, Office of Migratory Birds for permitting requirements prior to the removal or destruction of any nests.	Corps 404 Permit condition adopting mitigation identified in the 2011 FWMP developed by Denver Water and approved by CPW and CWCB.

Table 6:
Mitigation Measures for the Project

Summary of Project Impact	Required Mitigation	Enforcement Mechanism
Special Status Species		
State-listed Species: Bald eagle, American peregrine, Townsend's big-eared bat, northern leopard frog)—negligible to minor impacts; temporary, minor, indirect impacts to some species due to construction noise and land disturbance. USFS Region 2 Sensitive Species: Minor to moderate effects to one pair of northern goshawk; negligible to moderate effects to flammulated owls; negligible effect to American three-toed woodpecker, olive-sided flycatcher; effects relate to displacement during construction and loss of habitat. CNHP Species: Species presence has not been documented; possible effect to dwarf shrew due to loss of habitat and construction disturbance; unlikely to affect three species of mollusk. ARNF Plant Species of Local Concern: Loss of about 5 acres of occupied habitat of seven species - Dewey sedge, Sprengel's sedge, tall blue lettuce, and false melic, wild sarsaparilla, enchantress' nightshade, Maryland sanicle.	Denver Water will mitigate permanent impacts to sensitive species through the preservation (through USFS protection and administration of NFS lands) of 539 acres of diverse wildlife habitat types as described above.	Denver Water/USFS Settlement Agreement.
	Denver Water will develop a Special Status Plants Relocation Plan to address impacts to special status plants on NFS lands.	USFS Section 4(e) Condition 22 (Special Status Plants Relocation Plan) from the Denver Water/USFS Settlement Agreement and FERC Order Article 422(a).

Table 6:
Mitigation Measures for the Project

Summary of Project Impact	Required Mitigation	Enforcement Mechanism
Aquatic Biological Resources		
Short-term increases in methylmercury in the water could also result in increased accumulation in fish tissue. Moderate beneficial effect to reservoir fishery due to additional reservoir habitat. Potential spread of aquatic invasive species.	Denver Water will monitor mercury in fish tissue in Gross Reservoir with assistance from CDPHE and CPW. If the fish tissue analysis indicates that a Fish Consumption Advisory (FCA) is required, Denver Water will work with CDPHE and CPW to provide public education, including the posting of FCA signs at Gross Reservoir.	401 Certification Condition 13 adopting mitigation identified in the 2011 FWMP developed by Denver Water and approved by CPW and CWCB.
	Denver Water will develop an Aquatic Invasive Species Monitoring Plan, including guidelines for conducting inspections of construction-related equipment for the presence of invasive plant and noxious weed species.	USFS Section 4(e) Condition 17 (Invasive Species Management) from the Denver Water/USFS Settlement Agreement and FERC Order Article 422(a).
Potential spread of aquatic invasive species.	Denver Water will ensure heavy equipment used for the Project was not previously used in another stream, river, lake, pond, or wetland, unless one of the following procedures is implemented to prevent the spread of invasive aquatic species. These practices are also necessary after Project completion, prior to this equipment being used in another stream, river, lake, reservoir, pond, or wetland. a. All mud and debris will be removed from equipment (tracks, turrets, buckets, drags, teeth, etc.) and equipment will be sprayed/soaked with an industrial cleaner and water. Treated equipment must be kept moist for at least 10 minutes; or b. All mud, plants, and debris will be removed from equipment (tracks, turrets, buckets, drags, teeth, etc.) and equipment will be sprayed/soaked with water greater than 140 degrees Fahrenheit for at least 10 minutes. All hand tools, boots, and any other equipment that will be used in the water will be cleaned using one of the above options. Water will not be moved from one body to another. Equipment must be dry before use.	Corps 404 Permit condition
Transportation		
Temporary transportation-related impacts during construction activities (4 to 5 years), including passenger vehicle delays due to temporary closures and additional traffic volume. Temporary fugitive dust impacts along unpaved Gross Dam Road and from road maintenance during construction.	In consultation with Jefferson County, Boulder County, CDOT, the USFS, and the local community, Denver Water will prepare a Traffic Management Plan to manage construction traffic in a way that minimizes construction traffic impacts. Denver Water will submit the final Traffic Management Plan to the FERC prior to land-disturbing activities. The Traffic Management Plan will include various measures that Denver Water will implement, e.g., restricting the time or days for truck traffic and asking that contractors encourage carpooling to the work site. The Traffic Management Plan will also include road maintenance measures. For example, during construction, Denver Water or its contractor would be responsible for maintaining all of Gross Dam Road (CR 77S). Denver Water is committed to being responsible for any paving or other measures necessary to correct any damage caused by project-related activities and will continue to do so during construction. After construction has ended, Denver Water will meet with	Mitigation to be specified in the Traffic Management Plan required by FERC Order Article 425.

Table 6:
Mitigation Measures for the Project

Summary of Project Impact	Required Mitigation	Enforcement Mechanism
	CDOT and Boulder and Jefferson counties to address any road damage resulting from construction-related activities. It is Denver Water's intention to restore county roads to their pre-construction conditions should damage occur during construction activity at Gross Reservoir. The Traffic Management Plan will also consider development of necessary road improvements. The Traffic Management Plan will include goals from Boulder County regulations that are applicable to affected Boulder County roads, which are: to ensure that community traffic needs are met and that desirable community patterns are not disrupted. The Traffic Management Plan will also include consideration of avoidance and minimization of associated nuisance factors such as noise, light, and obnoxious odors.	
	Denver Water commits to restricting trucks hauling materials associated with mass concrete placement from using Flagstaff Road or Crescent Park Drive. Denver Water will provide public notices for Project-related road closures and timelines for construction activities associated with the Project.	Mitigation to be specified in the Traffic Management Plan required by FERC Order Article 425.
	Denver Water will make any necessary road improvements. Road maintenance of State and County roads: Boulder County maintains Gross Dam Road (CR77S) from SH 72 to the railroad tracks, and Denver Water maintains Gross Dam Road from the railroad tracks to Flagstaff Road. During construction, Denver Water or its contractor will be responsible for maintaining all of Gross Dam Road. Road maintenance measures will be included in the Traffic Management Plan described above. The roadways of particular interest are SH 72 from SH 93 to the turnoff for Gross Dam Road and Gross Dam Road from SH 72 to the railroad tracks.	CDOT permit condition and mitigation to be specified in the Traffic Management Plan required by FERC Order Article 425.
	Prior to construction, Denver Water or its contractor will obtain and comply with necessary CDPHE air quality permits, including developing a Fugitive Dust Control Plan. The Fugitive Dust Control Plan will outline specific steps to be taken to minimize the generation of fugitive dust and will include control measures such as watering unpaved roads or applying chemical stabilizers, as necessary. Speed limits will be posted and enforced.	Anticipated CDPHE air quality permits.
	Denver Water will develop a Road Maintenance Plan for use, maintenance, reconstruction, and relocation of roads on NFS lands that are used for Project purposes, including portions of Miramonte Trail and Gross Dam Road that will need to be relocated. This plan will include cost sharing of USFS road maintenance and will also address road maintenance for non-USFS roads that are on NFS lands.	USFS Section 4(e) Condition 10 (Use of Roads on National Forest System Lands) from the Denver Water/USFS Settlement Agreement and FERC Order Article 422(a).

Table 6:
Mitigation Measures for the Project

Summary of Project Impact	Required Mitigation	Enforcement Mechanism
Transportation congestion	To minimize semi-trucks on SH 72 and Gross Dam Road during school bus hours or rush hour, Denver Water will establish a staging area near the intersection of SH 72 and SH 93 (Figure 1-3). Trailers containing cement and fly ash will be staged at the lot and dedicated and trained project drivers will transport trailers during non-school bus periods to reduce traffic congestion.	Mitigation to be specified in the Traffic Management Plan required by FERC Order Article 425.
Air Quality		
Short-term air quality impacts related to construction activities, including vehicle exhaust, engine combustion emissions, and ground disturbance leading to short-term increases of particulate matter less than 10 microns in diameter (PM10) and gaseous pollutants (NOX, CO, SO2, and VOCs).	Prior to construction, Denver Water or its contractor will obtain and comply with the necessary CDPHE air quality permits, including developing a Fugitive Dust Control Plan and obtaining a permit for concrete batch plant emissions.	Anticipated CDPHE air quality permits.
Noise		
Short-term, moderate noise impacts related to construction activities, blasting, concrete batch plant, traffic, tree removal, etc.	Denver Water will comply with applicable noise ordinances.	Applicable ordinances.
	Denver Water will use engineering and administrative controls, which may include modifying the equipment or the work area to make it quieter, substituting existing equipment with quieter equipment, retro-fitting existing equipment with mufflers, modifying back-up alarm systems, and/or shutting down noisy equipment when not needed.	Mitigation to be specified in the Tree Removal Plan (FERC Order Article 423), Quarry Operations and Reclamation Plan (FERC Order 424), and Traffic Management Plan (FERC Order Article 425) required by the FERC Order.
	Denver Water will implement confined charge blasting for dam construction to minimize noise. Blasting will occur only during daylight hours, and a seismograph will be used to monitor ground motions and air pressure (noise) vibrations produced from the blasting operations to ensure that acceleration thresholds are not exceeded.	Mitigation to be specified in the Quarry Operations and Reclamation Plan (FERC Order 424).
Recreation		
Six of nine developed recreation sites are located in the new inundation area. Temporary impacts to recreational access and the recreation experience due to temporary restrictions and closures during construction and to traffic congestion. Boating opportunities would be enhanced by a larger reservoir surface area. Fishing opportunities would benefit from increased shoreline access.	Denver Water will relocate those recreation facilities above the new normal water line of Gross Reservoir in accordance with the required addendum to the Recreation Management Plan (RMP) required by FERC Order Paragraph N and applicable USFS Section 4(e) conditions. Any existing or planned trails that will be affected by construction activities will be replaced in-kind. Recreation opportunities will be unchanged under the RMP.	Pursuant to FERC Order Paragraph N, updated Recreation Management Plan to be filed with FERC within one year of FERC's Order, after consulting with certain governmental stakeholders, including Boulder County. USFS Section 4(e) Condition 24 (Recreation Management) from the Denver Water/USFS Settlement Agreement.
	Denver Water intends to keep recreation facilities open as much as possible during construction without compromising public safety or construction progress. Denver Water will post notices about temporary restrictions and closures. Emergency access to Gross Reservoir will be maintained at all times.	

Table 6:
Mitigation Measures for the Project

Summary of Project Impact	Required Mitigation	Enforcement Mechanism
Land Use		
Acquisition of 12 acres of private land to accommodate the proposed expansion of the FERC Project Boundary	Denver Water completed the process to acquire 12-acres of land from Miramonte. Denver Water will submit to the FERC a copy of the final agreement and documentation showing proof of property rights transfers, including a license granted to Miramonte by Denver Water to use a private multi-use trail within the FERC Project Boundary as an emergency access road.	Denver Water acquired the property in February 2020.
Visual Resources		
Visual impacts from the permanent facilities, including the expanded reservoir, enlarged dam, auxiliary spillway, relocated recreation facilities, and quarry site. Short-term visual effects from ground disturbance, stockpile and staging areas, and temporary lighting for nighttime construction.	For all visual resource impacts on NFS lands, Denver Water will continue to comply with existing FERC License Article 414 for visual resource protection. Prior to ground-disturbing or construction activities on NFS lands, Denver Water will file with the FERC an addendum to its Article 414 Visual Resources Protection Plan (developed in consultation with the USFS and approved by the FERC on May 22, 2003). The Visual Resources Management Plan will address visual effects from developing an on-site quarry, including reclamation treatments and measures for re-shaping and revegetating disturbed areas to blend with surrounding visual characteristics of the landscape. For the Osprey Point Quarry, which is not on NFS lands, Denver Water will prepare a Reclamation Plan to address visual effects with measures similar to those described above for any portions of the quarry above the new high water line.	Pursuant to FERC Order Article 422(a), update to be filed with FERC 90 days before ground-disturbing activities. 404 Permit condition to develop a Reclamation Plan for Denver Water lands if the Osprey Point Quarry is developed. Mitigation to be specified in the Quarry Operations and Reclamation Plans required by FERC Order Article 424.
	On Denver Water lands, all staging areas and temporary disturbances above the new high water line will be restored to approximate pre-existing conditions following construction. The majority of the reclamation work will be completed during the last year of construction when quarry operations have finished.	Mitigation to be specified in the Quarry Operations, Reclamation, and Traffic Management Plans required by FERC Order Articles 424 and 425.
	Parking for construction workers will occur primarily on Denver Water land at appropriate locations (e.g., stockpile and staging areas). Yard lights used for nighttime lighting of facilities will be downcast, thereby minimizing upward diffusion of light at the construction site.	Mitigation to be specified in the Quarry Operations, Reclamation, and Traffic Management Plans required by FERC Order Articles 424 and 425.
Cultural Resources		
Impacts to Gross Dam and Resumption Flume, which are both historic sites.	Denver Water entered into a Memorandum of Agreement (MOA) with the FERC and the Colorado SHPO that requires Denver Water to develop and implement a Historic Properties Management Plan (HPMP) to manage and protect cultural resources. The HPMP will include requirements for notifying the FERC of unanticipated discoveries, procedures to be followed in the event of an emergency at the Project, and reporting requirements for informing the FERC of the execution of the Treatment Plan. The Project was evaluated already under Programmatic	MOA between Denver Water, the FERC, and the Colorado SHPO. And, a MOA between Denver Water, the Corps, and the Colorado SHPO.

Table 6:
Mitigation Measures for the Project

Summary of Project Impact	Required Mitigation	Enforcement Mechanism
	Agreements (PAs) between the Corps, USFS and SHPO and between the FERC, SHPO, and USFS (Exhibit 7).	
	Denver Water will comply with existing License Article 415, which specifies the steps necessary to protect archaeological or historic sites within the FERC Project Boundary.	FERC License Article 415.
Impacts from tree removal	An additional archaeological site is present in the tree removal area and could be impacted if improvements are needed to an existing roadway. Denver Water will avoid or mitigate this site, as needed, in coordination with the USFS.	Mitigation to be specified in the Tree Removal Plan required by FERC Order Article 423.
South Boulder Creek		
Water Quality		
Short-term change in water quality due to anticipated increase in organics in Gross Reservoir after inundation. Water temperatures will be colder downstream of Gross Reservoir. No impacts anticipated upstream of Gross Reservoir.	Denver Water will monitor continuous stream temperature at four locations in South Boulder Creek (one location upstream of Gross Reservoir and three locations downstream).	401 Certification Condition 6.
	Denver Water will monitor concentrations of metals and hardness at three locations in South Boulder Creek (two locations upstream of Gross Reservoir and one location downstream).	401 Certification Condition 14 and Condition 15.
	Denver Water will monitor temperature and dissolved oxygen (DO) in the Gross Reservoir outflow consistent with the existing FERC-approved DO Monitoring Plan (which was completed under Article 402) for 3 years after construction of the Project is complete. The purpose of the monitoring is to ensure that stream flows downstream from the Project maintain adequate temperature and DO levels.	FERC License Article 402 DO Monitoring Plan. 401 Certification Condition 6 and Condition 12.
Channel Morphology		
Negligible to moderate increase in sediment transport and supply due to increase in flow upstream of the reservoir, which may result in localized bed and bank erosion. Flow regulation of Gross Reservoir would reduce peak flows downstream of reservoir, thereby making additional erosion less likely.	At least 1 year prior to the initial fill of the enlarged reservoir, Denver Water will file with the FERC a revised South Boulder Creek Channel Stability and Monitoring Plan developed in consultation with the USFS and CPW.	USFS Section 4(e) Condition 25 (Channel Instability and Bank Erosion) from the Denver Water/USFS Settlement Agreement and FERC Order Article 422(a).

Table 6:
Mitigation Measures for the Project

Summary of Project Impact	Required Mitigation	Enforcement Mechanism
Aquatic Biological Resources		
Minor adverse impact to fish and macroinvertebrates upstream of Gross Reservoir due to flow increases. Moderate adverse impact to fish and/or macroinvertebrate communities in Forsythe Canyon, Winiger Gulch, and South Boulder Creek due to inundation. Colder water temperatures downstream of Gross Reservoir would be less favorable for trout growth. Overall minor beneficial impacts to fish and macroinvertebrates downstream from Gross Reservoir due to increases in winter flows and reductions in runoff flows.	Denver Water will mitigate for impacts to aquatic biological resources through habitat restoration of a 1.9-mile reach of South Boulder Creek according to the compensatory mitigation outlined in the Final Mitigation Plan.	Corps 404 Permit condition.
	Denver Water will establish a 5,000-AF Environmental Pool in Gross Reservoir to augment flows during low flow periods, thereby benefiting 17 miles of aquatic habitat in South Boulder Creek from Gross Dam to its confluence with Boulder Creek. The Environmental Pool will enhance flows in South Boulder Creek below Gross Reservoir and will provide flows in the lower section of South Boulder Creek, which currently goes dry due to diversions by other water users.	Corps 404 Permit condition adopting mitigation identified in the 2011 FWMP developed by Denver Water and approved by CPW and CWCB. 2010 Intergovernmental Agreement (IGA) between Denver Water and the cities of Boulder and Lafayette. The Environmental Pool is mandated by FERC as it is included in the design of the Project.
	Denver Water will monitor the health of aquatic macroinvertebrates at three sites downstream from Gross Reservoir.	401 Certification Condition 12.
Recreation		
The Corps considered the impact on whitewater boating major due to inundation of the Right in My Backyard rapid upstream of Gross Reservoir. Beneficial (minor to moderate) impacts on boating in upper South Boulder Creek due to increased flows. Negligible effect on boating below Gross Reservoir. Minor impact on the quality of fishing upstream of Gross Reservoir due to a potential reduction in fish habitat.	Although this particular whitewater site may be impacted, this is not a recreation opportunity identified in the existing RMP. Despite the effect of inundation on this rapid, the Corps EIS concludes that there will be beneficial (minor to moderate) impacts on boating in upper South Boulder Creek due to increased flows.	Pursuant to FERC Order Paragraph N, updated Recreation Management Plan to be filed with FERC within one year of FERC's Order, after consulting with certain governmental stakeholders, including Boulder County. USFS Section 4(e) Condition 24 (Recreation Management) from the Denver Water/USFS Settlement Agreement.

Denver Water has included the activities in Table 7 as examples of Denver Water's planned enhancement actions to demonstrate the full beneficial outcome of the Project. Denver Water will continue to seek opportunities to benefit the stakeholders and communities near the Project during the remaining phases of design and construction.

Table 7:
Enhancement Measures

Enhancement Measure	Benefitted Stakeholder
Emergency assistance following flooding: In the fall of 2013, Denver Water crews used heavy equipment to restore access to private residences damaged by flooding in Coal Creek Canyon. These restoration activities included replacing culverts and conducting stream channel work and grading and roadway work to allow for the passage of snow removal trucks. Denver Water also provided bottled water to the local community immediately following the flooding to assist those within the community whose ground water wells were impacted by the flooding.	Coal Creek Canyon community
Fencing, installation of signage and gates to discourage public access to Miramonte's private land adjacent to Gross Reservoir. Replacement of existing access with a multi-use trail, and a fuel break.	Miramonte Land Corporation, LLC
Temporary lease of non-potable water for fishery restoration project upstream of Gross Reservoir: In 2012, Denver Water and The Flyfisher Group entered into a Temporary Lease Agreement for non-potable water from Gross Reservoir for a fishery, wetland, and riparian habitat restoration project adjacent to South Boulder Creek at The Flyfisher Group's Lincoln Hills and Boulder Ranch properties upstream of Gross Reservoir.	The Flyfisher Group
Denver Water entered into a 5-year temporary water lease to provide up to 100 AF of augmentation water to Eldorado Artesian Springs, Inc. to allow it time to find a permanent supply of augmentation water. This water lease allows Eldorado Artesian Springs, Inc. to pump 12 wells that provide water for commercial bottling, water to fill a swimming pool, water for irrigation of up to 2 acres within the town of Eldorado Springs, and water to supply residences in Eldorado Springs for domestic uses.	Eldorado Artesian Springs, Inc.
From Forests to Faucets Program: Since 2010, Denver Water has contributed funding to the USFS under an agreement with USFS, Colorado State Forest Service, and the Natural Resources Conservation Service, for forest thinning and other forest health measures to protect watersheds and minimize forest fires on National Forest System lands, including lands near Gross Reservoir.	USFS
Voluntary funding to counties for wildfire response: In August 2014, Denver Water finalized an agreement with the Colorado Division of Fire Prevention and Control to participate in the Emergency Fire Fund. This fund is used by the counties as reimbursement for responding to wildfires.	Boulder, Clear Creek, Douglas, Eagle, Grand, Jefferson, Park and Summit counties
	Property owners adjacent to Gross Reservoir
USFS Off-License Agreement: Through settlement with the USFS during the consultation period for the Project, Denver Water and the USFS developed an Off-License Agreement setting forth mitigation and enhancement projects to be implemented by Denver Water to improve resources on NFS lands used for Denver Water's water supply collection system.	USFS
Temporary Water Lease for Gilpin County construction-activity dust suppression: Under a Temporary Water Lease Agreement in 2006 and renewed in 2010, Denver Water provided Gilpin County with non-potable water for dust suppression during the county's construction activities.	Gilpin County

Public Involvement and Stakeholder Outreach

Denver Water has maintained active engagement with the public and stakeholders throughout the planning for this project including formal public comment periods for Corps Scoping (2003), the Initial Consultation Document for FERC (2008), the Corps' Draft EIS (2009), the Fish and Wildlife Mitigation Plan and Fish and Wildlife Enhancement Plan for CPW and CWCB (2011), FERC's SEA (2018), and numerous meetings with stakeholders and interested parties. Throughout the permitting process, Denver Water has conducted numerous stakeholder outreach activities, many of which will continue through the end of the Project. The following sections describe some of these outreach activities. Additional information regarding stakeholder outreach can be found in Exhibit 6.

Research

To understand the needs of the community, Denver Water has engaged in a variety of research activities, beginning in 2014. These include stakeholder interviews, public availability sessions and a community survey. As the project moves forward, we plan to continue conducting this type of outreach to ensure we are soliciting feedback from a wide variety of constituents who may be affected by the Project.

Stakeholder interviews

In August and September 2014, a Denver Water team member met with 25 individuals who live, work, own property or provide services in the Coal Creek Canyon area. The purpose of the meetings was to better understand awareness and perceptions about the Project, as well as to obtain feedback on minimizing construction impacts and solicit suggestions about the most effective ways for Denver Water to communicate about the project to keep residents, businesses and other interested parties informed .

Public availability sessions

In October 2015, Denver Water staff hosted two availability sessions, eight hours each, with the local community at the Coal Creek Canyon Improvement Association Hall. The availability sessions provided information about the Project and an opportunity to listen to the local community. More than 100 community members attended to talk with representatives about the Project and provide comments to the Project team. These remarks were collected and resulted in a host of mitigation strategies committed to by Denver Water as described in Table 6.

Recreation surveys

Over Memorial Day weekend in 2016, Denver Water conducted public outreach to more than 200 reservoir visitors via a survey. Project representatives also conducted recreation outreach and collected surveys in both the summers of 2018 and 2019. During those surveys, Denver Water received responses from 440 recreators to gauge their awareness of, and concerns about, the Project. Between 2018 and 2019, survey results have shown an increase in Project awareness, as well as a decrease in overall concerns among recreators. These on-site outreach and survey activities will continue during future summer recreation seasons, when COVID-19 social distancing guidelines are no longer required. A summary of recreator comments and Denver Water's responses are provided in the Good Neighbor Handout provided in Exhibit 6.

Community survey

In January 2018, more than 2,000 neighbors in and around Coal Creek Canyon were mailed a survey created by Corona Insights, with input from the Coal Creek Canyon Improvement Association Board. Corona Insights received more than 550 completed surveys from this research effort and found that neighbors' top concerns were environmental, traffic and safety. The final report was shared with stakeholders through the project website and an e-newsletter. The final report is included in Exhibit 6. The results were also shared with Denver Water and design engineer team members with instructions to address community concerns and develop plans to minimize public inconvenience. The information gained through this survey has also informed how Denver Water communicates with neighbors, ensuring we are clearly and regularly updating them on issues they care about.

Community events

Community cookouts

Since October 2017, Denver Water has hosted five community cookouts for the public to meet with project representatives, view project materials, ask questions and enjoy a burger. Denver Water typically hosts these events to kick off the outreach season and another cookout to close out the summer. These cookouts typically draw between 60 and 90 attendees. Denver Water looks forward to continuing to engage with community members during these events that will continue through the construction phase.

Events

The Gross Reservoir Expansion Project team has participated in 13 community-focused events since 2017. These include a booth at the annual Coal Creek Canyon Mountain Fest, various Denver metro events and a contractor opportunity fair in Boulder. Denver Water representatives spoke with more than 700 attendees during these events and future plans call for continued participation.

One-on-one/group outreach

Office hours

Denver Water opened the public information yurt at Gross Reservoir on October 4, 2017. The yurt is a public-facing space filled with project information, an interactive TV display, a large-scale 3D model and take-away materials for visitors.

Since opening, Denver Water staff have held more than 600 "office hours" at the yurt and have interacted with more than 600 visitors to the yurt, which is open between three and six days each week from April to October. When the yurt is closed for the winter season, Denver Water holds office hours at Coal Creek Coffee each week. Since starting these coffee shop hours in November 2017, Denver Water has spent more than 260 hours and had coffee with more than 140 individuals. Office hours at both the public information yurt and Coal Creek Coffee continue to be valuable opportunities to talk directly with stakeholders about the Project in an informal setting.

When the COVID-19 social distancing guidelines began in March 2020, Denver Water paused all in-person activities to ensure the safety of staff and the public. In July 2020, the Project team began hosting virtual office hours to maintain availability to the public. Community members and stakeholders can book

a virtual meeting with a project representative through the Project website. In the first month of offerings we met with five individuals to answer questions and discuss concerns about the Project, and to continue to build relationships with the neighbors around Gross Reservoir.

Emails and phone calls

The Project team has a project specific email, phone number and contact form listed on the Project website and all collateral materials, which allows stakeholders to ask questions and provide feedback. These contact methods are continually monitored, and stakeholders typically receive responses within one to two business days. Since creating these contact methods in 2016, Denver Water has received and responded to more than 1,100 emails and phone calls.

Community presentations

Since late 2017, project team members visited more than 45 different community organizations such as Rotary, Kiwanis, school groups and others to share project information and updates with their members. Denver Water has talked with more than 1,400 individuals through these opportunities, which enable us to share facts about the Project and collect feedback. Due to social distancing restrictions, Denver Water is currently conducting community presentations virtually.

Tours

In 2018 and 2019, the Gross Reservoir Expansion Project hosted 13 tours of the reservoir site for more than 280 members of various stakeholder groups. The current tour program is on hold through 2020 due to social distancing guidelines. The tours are a great opportunity for the public to visit the public information yurt and to see the Project site with team members. Tours will continue to be provided to various groups throughout the Project.

Local organization coordination

Coal Creek Canyon Improvement Association board meetings

The Coal Creek Canyon Improvement Association (CCCIA) is a community organization focused on helping residents in the area. Project team members have met with the CCCIA board on a couple occasions to share Project information, understand potential impacts to the CCCIA Hall and hear feedback from members. At one of these meetings, Denver Water donated an AED medical device as a show of good faith and our commitment to making safety our number one priority. The coordination between CCCIA and Denver Water has opened two-way communications channels with a leadership group within Coal Creek Canyon.

Coal Creek Canyon Fire Protection District and Boulder County Sherriff

Project team members meet periodically with the Coal Creek Canyon Fire Protection District Fire Chief and Boulder County Sherriff Deputies. The meeting in April 2018 reviewed initial site development plans for the project and how access for first responders may be affected. The meeting in May 2019, addressed site development and impacts to access, as well as preliminary tree removal information, recreation plans during construction and truck hauling safety. Denver Water continues to keep these organizations current with relevant information and will incorporate their feedback as part of our commitment to Project safety.

Information sharing

Website

Denver Water launched grossreservoir.org, a Project-specific website with resources for all stakeholders, in 2016. Since the launch, the website has had more than 37,400 visitors and more than 130,000 pageviews. The most viewed pages include “About the Project,” “Progress and Schedule” and the interactive GIS Map. Between 2017 and 2019, there was an 89 percent increase in pageviews. The website is regularly updated with information and materials to ensure stakeholders are receiving the most up-to-date information. It also includes several channels for visitors to provide feedback, such as an online comment form, staff contact information and the opportunity to sign up for virtual office hours.

E-newsletter

Since 2016, the Gross Reservoir Expansion Project has sent 25 e-newsletters to project stakeholders on an opt-in list with 1,486 subscribers. The newsletters include topics such as project milestone announcements, permitting and planning updates, links to recent media coverage and summaries of on-site activities. Denver Water sees an average open rate of more than 40 percent, which is more than twice the industry average. Denver Water will send e-newsletters throughout the duration of the project to keep stakeholders and neighbors apprised of project updates and potential project-related disruptions.

Social media and publications

The Gross Reservoir Expansion Project team has worked with various organizations to develop news articles, contributed articles in industry publications, and published stories via DenverWaterTAP.org. Since 2016, Denver Water has placed numerous articles across these platforms reaching more than 500,000 individuals. Denver Water’s social media team has shared project stories and updates to reach millions of individuals through their Facebook, Twitter, Instagram and YouTube channels.

Mountain Messenger advertisements

Beginning in May 2018 and through present, the Project has placed monthly advertisements in the Mountain Messenger, a Coal Creek Canyon community newsletter sent to more than 2,500 homes throughout the community. These ads notify readers of upcoming community events and cookouts, as well as our regular and virtual office hours.

Outdoor signs

In 2017, four large outdoor signs were installed at key locations surrounding Gross Reservoir, including Haul Road/Osprey Point Recreation Area, the Public Information yurt, North Shore parking lot and the right abutment of Gross Dam. These outdoor signs provide reservoir visitors project information, photos and anticipated changes to the various locations. The signs were updated in 2020 to remain consistent with current project accomplishments and will continue to be updated to keep visitors informed about the Project as construction progresses.

Article 8, Section 206, Relationship with Other Requirements

8-206.A, Overlap with County Requirements

Table 8 lists the current status of the county permits required for the Project.

Table 8:
County Environmental Permits and Approvals Likely Required to Construct and Operate the Project

Permit/Approval	Purpose	Applicable Project Component	Status
County			
Land Use Department—Building Safety Grading Permit	Authorizes construction activities.	All ground-disturbing facilities.	To be submitted after final design element is released from design team.
Floodplain Development Permit	Authorizes construction within a floodplain.	Diversion structure.	To be submitted after final design element is released from design team.
Utility Construction Permit	Authorizes construction within County ROWs.	Construction affecting County ROWs.	To be submitted after final design element is released from design team.
Stormwater Quality Permit	Addresses BMPs during construction	All ground-disturbing activities	To be submitted after final design element is released from design team.
Access Permits	Authorizes development of a new access from County ROWs	Accesses from SH 72 and Magnolia Drive	To be submitted after final design element is released from design team.
Oversize/Overweight Permit	Authorizes oversized and overweight loads on State and County Roads	Transport of large machines and equipment to and from construction site.	To be submitted after final design element is released from design team.
Land Use Department Building Permit	Authorizes construction of Project facilities.	Temporary construction offices.	To be submitted after final design element is released from design team.

8-206.B, Federal or State Review and Approval Processes

Table 5 of this application lists the current status of the federal and state permits required for the Project. Denver Water respectfully asserts that the federal and state review and approval processes addressed the potential impacts of the Project, and requests that the County rely on those reviews. The Project was evaluated as part of the National Environmental Policy Act (NEPA) process for the Corps. Denver Water applied for and received a FERC hydropower license amendment for Gross Reservoir. FERC published the Final SEA for Denver Water's FERC License Amendment Application in February 2019 and the FERC issued its Order in July 2020.

Article 8, Section 308, Specific Designations, Activities of State Interest, Major Extensions of Existing Domestic Water and Sewage Treatment Systems

8-308.A, Activities of State Interest

During the pre-application conference, Boulder County staff indicated that the Project would require a 1041 permit based on Section 8-308.A.2, Major extensions of existing domestic water and sewage treatment systems. Boulder County Land Use Code Section 4-514.S.1. defines *Water Tank or Treatment Facility* as: A facility, excluding community cisterns, with a capacity of 5,000 gallons or more for purifying, supplying, and holding water. The Project does not meet the definition of *Water Treatment Facility* because it does not involve "purifying" water. The Project would store raw water in an expanded Gross Reservoir.

Article 8, Section 401, Specific Water and Sewage Treatment Activities Requiring Permits

During the pre-application conference, Boulder County staff indicated that the Project would require a 1041 permit based on Section 8-401.D, Expansion of any existing reservoir for a municipal or industrial or domestic treated water use. As noted above, the Project does not involve expansion of an existing reservoir for a "treated water use." The Project would store raw water in an expanded Gross Reservoir.

Article 8, Section 406, Determination of Whether a Proposed Activity or Development Must go Through the Permit Process

On October 12, 2018, Denver Water sought a determination from Boulder County's Director of Land Use that the Project is exempt from Boulder County's Land Use Code Article 8—Location and Extent, Areas and Activities of State Interest based on the Zoned Land Exemption (Exhibit 8). The Land Use Director denied this exemption request on October 22, 2018, determining that Boulder County Land Use 8-400 applies to Denver Water's project. Denver Water appealed that determination to the Board of County Commissioners, and a hearing was held on March 14, 2019. At that hearing the Board of County Commissioners upheld the determination of the Land Use Director. Denver Water appealed that decision to the Boulder County District Court, which upheld the Board's determination. Denver Water then appealed that determination to the Colorado Court of Appeals.

While that litigation was pending, on July 8, 2019, Denver Water attempted to submit its Areas and Activities of State Interest (1041) permit application to the Boulder County Community Planning & Permitting Department, which refused to accept the application for processing at that time, pending completion of the litigation. Denver Water maintains that Boulder County had a duty to process the 1041 permit application while the lawsuit was pending.

Before completion of the litigation, in July 2020, FERC issued its final Order amending the hydropower license for the project and directing Denver Water to proceed with construction according to certain deadlines and requirements. Given the deadlines and requirements in FERC's Order, and given Boulder County's unwillingness to process our 1041 permit application while an appeal of the litigation was pending, Denver Water had no choice but to move to dismiss the pending appeal to clear the way for consideration of our 1041 permit application.

By submitting this application, Denver Water does not waive its rights to assert any legal or factual position or challenge to the applicability of Boulder County's 1041 authority. At the same time, Denver Water submits this application in good faith with the aim of obtaining a 1041 permit with which Denver Water can and will comply. Denver Water respectfully requests that Boulder County expeditiously process this application. Any delay in Boulder County's consideration of this 1041 permit application would jeopardize Denver Water's ability to comply with federal permits and the FERC Order and compromise Denver Water's ability to plan for project construction consistent with its schedule, the deadlines in the FERC Order, and the needs of its customers.

Article 8, Sections 502–506: Application Procedures and Submittal Requirements

The following applicable sections of the Boulder County Land Use Code are addressed herein:

- 8-502, Application Fee
- 8-503, Waiver of Submission Requirements
- 8-504, Intergovernmental Agreements
- 8-505, General Process
- 8-506, Pre-application Conference

8-502, Application Fee

This 1041 permit application includes the required nonrefundable deposit fee of $750 payable to Boulder County. Denver Water has completed and signed the fee agreement (see Exhibit 3).

8-503, Waiver of Submission Requirements

As explained in the Introduction of this 1041 permit application and as shown in Exhibit 8, Denver Water sent e-mail correspondence to Boulder County Land Use staff on May 31, 2019, requesting a waiver of several sections of Article 8 of Boulder County's Land Use code that Boulder County staff indicated apply to this Project during the pre-application process (Exhibit 8). Denver Water did not receive a response to that request.

Denver Water hereby renews its waiver request with respect to the following sections:

> **8-308.A.4.; 8-507.D.3.; 8-511.E**: These provisions apply to projects involving "site selection and construction of major facilities of a public utility." As indicated by Boulder County staff at the pre-

> application meeting, this Project involves an expansion of an *existing* domestic water system under 8-308.A.2., not "site selection and construction" of a major facility of a public utility. Additionally, 8-210.AG defines "Major facility of a public utility" to mean "telephone utilities," "electrical utilities," and "natural gas or other petroleum" facilities, but does not mention water utilities or their associated facilities. Similarly, 8-403, Specific Public Utility Activities Requiring Permits, does not mention water utilities or their associated facilities. Accordingly, none of the requirements applicable to the siting and construction of a major facility of a public utility are relevant to a decision on this application.

Despite Denver Water's renewal of its waiver request, this 1041 permit application attempts to address all specific sections of Article 8 that Boulder County staff identified as applying to the Project during the pre-application process. Denver Water hopes this approach of providing as complete an application as practicable will facilitate Boulder County's review.

8-504, Intergovernmental Agreements

Denver Water and Boulder County staff previously negotiated a proposed Intergovernmental Agreement (IGA), which was presented to the Board of County Commissioners in December 2012. Public hearings were held regarding the proposed IGA in December 2012 and January 2013. Following the public hearings, the Board of County Commissioners took no action on the proposed IGA (Exhibit 9).

8-505, General Process

Denver Water is committed to completing in good faith the steps outlined in Boulder County's Land Use Code for 1041 permitting.

8-506, Pre-Application Conference

On April 5, 2019, the Boulder County Land Use and Transportation Departments held a pre-application conference with Denver Water to describe the requirements for the application. Denver Water followed the pre-application conference guidelines under this section of the Land Use Code, and Denver Water shared notes from this meeting (provided in Exhibit 8) with Boulder County on April 18, 2019. Denver Water requested the Pre-Application Conference form from Boulder County and will sign the form when provided. As a follow-up to the pre-application conference, Denver Water requested meetings with Boulder County Floodplains, Parks and Open Space, and Public Health Departments and another meeting with the Transportation Department. Denver Water also asked the Land Use Department to advise whether meetings with any additional departments were advised. On June 20, 2019, Boulder County Parks and Open Space staff met with Denver Water regarding this 1041 permit application. As of the date of this 1041 permit application, Boulder County has not yet scheduled any additional meetings.

Article 8, Section 507, Application Submittal Requirements

8-507.A, Application

Denver Water respectfully asserts that this 1041 permit application meets the criteria for completeness, consistent with the requirements of Section 8-507.

8-507.A.1.a, Application Form

Denver Water completed the application form, which is included in Exhibit 3. The form designates the agents for Denver Water, exhibits appropriate signatures, and includes all necessary information. This 1041 permit application also includes the fees, maps, plans, and reports required by these regulations.

8-507.A.1.b, Signature indicating Applicant's Concurrence with All Submissions and Commitments

Denver Water concurs with the submissions and commitments made by our designated agent, Mr. Jeff Martin, Program Manager for the Project.

8-507.A.1.c, Written Description of the Project

A written description of the project is provided in the Project Description section at the beginning of this 1041 permit application.

8-507.A.1.d, Examination of Mineral Estate Owners and Lessees

A review of the Boulder County Comprehensive Plan, Mineral Resource Areas Map identified no mineral resource areas within the project boundary.

The following information regarding mineral estate owners and lessees was gathered and analyzed for Denver Water's License Amendment Application to the FERC (Attachment E-2).

As documented in Exhibit 3, Denver Water has performed an initial general claims review and examined the records of the Boulder County Clerk and Recorder for the existence of any mineral estate owners or lessees that own less than the full fee title in property within the property which is the subject of this Application. The claims review and records search identified the Federal government (U.S. Forest Service), Denver Water and a private land entity (Miramonte Land Corporation, LLC.) as the relevant stakeholders that retain mineral estate ownership within the Project boundary.

8-507.A.1.e, Mineral Estate Notification

Denver Water will send the U.S. Forest Service the required notices at least 30 days prior to the initial public hearing. The agreement with USFS is included in Exhibit 3. Denver Water will provide a signed certification to Boulder County after the notification is completed as required.

8-507.B, Professional Qualifications

Denver Water has utilized professional consultants to prepare technical (e.g., engineering, geology) reports for the Project. Qualifications, such as Professional Engineer status, are included on applicable design documents and other technical reports.

8-507.C, Consultants and Fees

Denver Water agrees to pay all reasonable consultant and referral agency fees as needed.

8-507.D, Application Requirements

8-507.D.1, Map and Plan Requirements

The maps included in Exhibit 1 meet the 1041 permit application requirements. A copy of Denver Water's current Integrated Resource Plan is included as Exhibit 2. In addition, Project-specific planning is documented in the Corps Final EIS and Record of Decision and FERC Final SEA and Order referenced throughout this 1041 permit application (Exhibit 5). Note that documents related to the Project can also be found here: https://grossreservoir.org/about-the-project/document-library/.

8-507.D.2, Requirements Applicable to Water and Sewage Treatment Activities

The Project does not involve "sewage" or "treatment activities", but would store raw water in an expanded Gross Reservoir. Information specific to the Project is provided in the following sections to support Boulder County's reviews.

8-507.D.2.a, Detailed Facility Plans

Exhibit 1, Figure 1-1, Site Plan, and Figure 1-2, Gross Reservoir Components, provide an overview of the Project, and Exhibit 1, Figure 25 through 27, are detailed design drawings. Denver Water's combined service area is shown in Figure 7-4.

The system capacity of Denver Water's collection system was evaluated by the Corps in the Final EIS, and the Moffat Project identified a 34,000 acre-feet per year (AF/yr) deficit in Denver Water's supply compared to projected demand. This shortfall would be met by 16,000 AF/yr of additional conservation and the 18,000 AF/yr Project (72,000 acre-foot [AF] expansion of Gross Reservoir). Denver Water has committed to implement the programs necessary to realize 16,000 AF/yr of conservation savings by 2030. (Denver Water's Board accelerated the conservation savings goal to 2016.)

8-507.D.2.b, Description of Water Treatment Systems within Denver Water Jurisdiction and Adjacent Communities

Exhibit 2, Denver Water's Integrated Resource Plan, includes a description of Denver Water's water collection system and treated water system.

8-507.D.2.c, Design Capacity and Distribution or Collection Network

Design capacity information is provided in Exhibit 10, Product Operation and Resource Utilization. Exhibit 10 provides information about both the hydroelectric and hydrological capacities of the current and expanded Gross Reservoir.

FERC also described the Moffat Collection System as part of their Final SEA (Section 3.1.2).

> *As part of the Moffat Collection System, Gross Reservoir is used to store and release native flows from upper South Boulder Creek, as well as water diverted from the West Slope of the Rocky Mountains through the Moffat Collection System's Moffat Tunnel. When Gross Reservoir storage is less than 12,000 acre-feet, there is a potential dam safety issue related to rocks and sediment possibly being transported to the outlet works and causing damage. In addition, the transported sediment could impact aquatic life in lower South Boulder Creek below the dam. For these reasons, the bottom 12,000 acre-feet of Gross Reservoir storage is a minimum pool that is not relied on for water supply purposes. To avoid spilling, Denver Water reduces West Slope importations as Gross Reservoir is about to reach full capacity. Gross Reservoir typically stores the most water in June during spring runoff.*
>
> *Denver Water indicates that expansion of the Moffat Collection System would generally result in the following changes in operation of the system:*
>
> - *Diversions via the Moffat Collection System would generally be higher during average and wet years (May through July) following a drought in order to fill the additional storage created at Gross Reservoir. During the winter months and during dry years, there would be little differences in diversions and operations in this part of the system.*
> - *More water would be stored in Gross Reservoir during periods of drought. Denver Water would draw more water from Gross Reservoir to meet demand in the first year of a drought, as it also would from its other reservoirs.*
> - *Denver Water would collect more native upper South Boulder Creek water for storage in Gross Reservoir.*
>
> *Denver Water would draw more water from Gross Reservoir for delivery to the Moffat Water Treatment Plant, particularly in the winter months, because the treatment plant would continue to operate at a minimum level during that time.*

8-507.D.2.d, Detailed Inventory of Total Commitments

The Project is one of the major elements of Denver Water's long-term supply plan. It will prevent future shortfalls during droughts and address the imbalance in the North-South collection system and the additional storage and supply will provide system resiliency to meet Denver Water's mission to serve the customers within Denver Water's combined service area with reliable, high quality water. Approximately 1.5 million people in the Denver Metropolitan area depend entirely upon Denver Water for their treated municipal, industrial and commercial water. In addition to treated water, Denver Water also provides recycled water and raw water to customers. Denver Water's Integrated Resource Plan (Exhibit 2) provides more detail on Denver Water's customer obligations. The Moffat Collection System currently supplies just 10 percent of Denver Water's overall reservoir storage capacity and 20 percent of its total water supply. The Project does not involve water taps or sewage services.

8-507.D.2.e, Source of Water Supply and Information on Converted Agricultural Water Rights

Denver Water currently holds all necessary water rights to fill the enlarged reservoir, with the exception of the water rights to be obtained and owned by the City of Boulder and/or the City of Lafayette for the purpose of storing water in the reservoir (the Environmental Pool). The main source of water for the expanded Gross Reservoir will be transmountain diversions through the Moffat Tunnel which will supplement Denver Water's water rights on South Boulder Creek.

No water from converted agricultural water rights in Boulder County will be used to fill the expanded Gross Reservoir.

8-507.D.3, Requirements as They Apply to Major Facilities of a Public Utility

Boulder County highlighted applicable sections of Article 8 during the pre-application conference. Staff did not highlight 8-308.A.4, the criteria involving "site selection and construction of major facilities of a public utility," but staff did highlight 8-507.D.3. Denver Water maintains that Section 8-507.D.3 does not apply because this Project involves an expansion of an *existing* domestic water system under 8-308.A.2., not "site selection and construction" of a major facility of a public utility. Additionally, the definition of "major facilities of a public utility" found at Section 8-210.AG includes only "telephone utilities," "electrical utilities," and "natural gas or other petroleum" facilities. The definition does not include water utilities or associated facilities. Similarly, 8-403, Specific Public Utility Activities Requiring Permits, does not mention water utilities. Despite Denver Water's request to Boulder County that these requirements be waived (see Section 8-503), information is provided in the following sections to support Boulder County's reviews.

8-507.D.3.a, Detailed Facility Plans

As described above under Section 8-507.D.2.a, Exhibit 1, Figure 1-1, Site Plan, and Figure 1-2, Gross Reservoir Components, provide an overview of the project, and Exhibit 1, Figures 25 through 27, are detailed design drawings.

8-507.D.3.b, Existing and Proposed Service in the Area to be Served

The Moffat Collection System is described above under Section 8-507.D.2.c. As described in Section 8-507.D.2.d, the Project is one of the major elements of Denver Water's long-term supply plan. It will prevent future shortfalls during droughts and address the imbalance in the North-South collection system. The Project does not involve direct service to customers.

Denver Water's mission is to serve the customers within Denver Water's combined service area with reliable, high quality water. Approximately 1.5 million people in the Denver Metropolitan area depend entirely upon Denver Water for their treated municipal, industrial and commercial water. In addition to treated water, Denver Water also provides recycled water and raw water to customers. Denver Water's Integrated Resource Plan (Exhibit 2) provides more detail on Denver Water's customer obligations.

8-507.D.3.c, Distribution Network

The Moffat Collection System is described above under Section 8-507.D.2.c. As described in Section 8-507.D.2.d, the Project is one of the major elements of Denver Water's long-term supply plan. It will

prevent future shortfalls during droughts and address the imbalance in the North-South collection system. The Project does not involve a distribution network.

8-507.D.4, Historical and Archaeological Resource Areas of Statewide Importance

Section 8-507.D.4 requirements of the Boulder County Land Use Code apply only to development located in Historical and Archeological Resource Areas of statewide importance. During Denver Water's pre-application meeting with Boulder County Parks and Open Space staff, staff noted the definition of this term in Section 8-210(AA) of the Land Use Code, "Historical or archaeological resources of statewide importance" means those resources officially included in the national register of historic places, designated by statute or included in an established list of places compiled by the state historical society, including but not limited to those designated by the Board in accordance with C.R.S. 30-11-107(1)(bb) as amended. No sites near the Project are listed in the National Register of Historic Places or meet these other criteria, and therefore the Project is not located in Historical and Archeological Resource Areas of Statewide Importance or an Archaeologically Sensitive Area as identified in the Boulder County Comprehensive Plan (see Figure 8 in Exhibit 1). As a result, this requirement does not apply.

8-507.D.5, Development in Natural Resource Areas of Statewide Importance

Section 8-507.D.5 requirements of the Boulder County Land Use Code apply only to development located in Natural Resource Areas of Statewide Importance. The Project is not located within any Natural Resource Areas of Statewide Importance (see resource figures in Exhibit 1). During Denver Water's pre-application meeting with Boulder County Parks and Open Space staff, however, staff noted the definition of this term in Section 8-210(AO) of the Land Use Code, "Natural resources of statewide importance" means and is limited to shorelands of major publicly owned reservoirs and significant wildlife habitats in which the wildlife species, as identified by the Colorado Division of Wildlife in a proposed area could be endangered, including species listed or being considered for listing under state or federal guidelines. Parks and Open Space staff indicated that they consider the shorelands of Gross Reservoir to apply and suggested that sections in this 1041 permit application that address shorelands and wildlife habitat would satisfy the requirements in this section.

8-507.D.5.a, Survey of Habitat of Applicable Species

Denver Water completed extensive field surveys for the Project from 2005 to 2010, including habitat assessments using aerial photography during 2005-2006 field visits and previous studies conducted in the Project area. Descriptions of habitat based on those surveys are included in Sections 8-507.D.7.b.iii, Terrestrial and Aquatic Animals and Habitat) and 8-507.D.7.b.iv, Terrestrial and Aquatic Plant Life of this 1041 permit application. Boulder County species of interest are listed in Exhibit 17.

8-507.D.5.a, Construction and Operations Plan with Analysis of Effects on Wildlife Species in Designated Wildlife Habitat

Denver Water has provided the federal and state approval documents for this Project in Exhibit 5. These documents include detailed descriptions of Project requirements to mitigate potential effects on wildlife species and habitat during construction and operations of the Project. Mitigation measures were identified

after in-depth analysis of the potential effects of Project construction and operations on wildlife species and habitat. Table 6 of this permit application summarizes those mitigation requirements.

8-507.D.6, Natural Hazard Areas

8-507.D.6.a, Floodplains

Figure 2 in Exhibit 1, Floodplain Overlay Districts, shows the project in relation to Boulder County Floodplain Overlay District maps. The Project includes areas within the Boulder County Flood Hazard Overlay District. Given the nature of the Project, this 1041 permit application includes extensive information on surface water, floodplains, channel morphology, and wetlands, and those topics present information that relates to floodplains. The sections below provide Project background information on Project effects related to hydrology and floodplains and then address the specific requirements for this section of the Boulder County Land Use Code.

The following information and analysis were gathered for preparation of Denver Water's License Amendment Application to the FERC (Exhibit E, Section 3.3.1). Note the discussion of the affected environment related to surface waters is presented below in Section 8-507.D.7.b.ii.B.

PROJECT EFFECTS (SURFACE WATER HYDROLOGY AND FLOODPLAINS)

This section describes the changes in surface water hydrology (stream flows, reservoir volumes, surface areas and levels, and floodplains) related to the Project.

Several issues related to surface water resources were raised during public scoping for the Moffat Collection System Project EIS, including:

- Impacts of changes in evaporative losses at Gross Reservoir
- Impacts of changes in the flow regime (quantity and timing of water) in South Boulder Creek
- Impacts of increased flows on the 100-year floodplain and stream channel along South Boulder Creek due to transbasin diversions via the Moffat Tunnel
- Impacts on other ongoing projects including the South Boulder Creek floodplain study.

As part of Denver Water's Moffat Collection System, South Boulder Creek water would be diverted and delivered to Gross Reservoir using existing collection infrastructure. Existing facilities would be used to deliver water from the enlarged Gross Reservoir to the Moffat Water Treatment Plant (WTP), including the South Boulder Diversion Canal. In general, the majority of "new" water diverted to Gross Reservoir would be kept in storage until a dry year or sequence of below average years occur.

Gross Reservoir

Under the Project (with the Environmental Pool), Gross Reservoir's volume would increase by 77,000 AF to 118,811 AF. The water surface elevation would increase by 124 feet, and the surface water area at the new normal water elevation would nearly double, from approximately 418 acres to 842 acres.

From April through November, the annual pattern of fluctuation in Gross Reservoir's water level and storage volume would be similar to that at full use of the existing system: the reservoir would be at its

lowest at the end of April, would reach its highest level in August, and would be drawn down through the fall and winter. The Moffat WTP does not operate during the winter months, so the content of Gross Reservoir increases on average from December through February. However, under the Project, Gross Reservoir's content would drop steadily by approximately 4,000 AF per month during these months, primarily because the Moffat WTP would be operating at a minimum of 30 million gallons per day (mgd). Differences in reservoir content under the Project would be greatest in wet years following a drought, when the enlarged capacity of Gross Reservoir would be able to fill.

The average end-of-month reservoir storage content would be greatest at the end of July at 106,000 AF and lowest at the end of April at 72,000 AF for the expanded Gross Reservoir (FERC 2016). In dry years, monthly reservoir content during summer months would be lower than average because the reservoir would be drawn on more heavily during a drought, whereas, in wet years, monthly reservoir content during summer months would be higher than average.

Increases in modeled water surface elevations over the 45-year study period due to operation under the Project range from approximately 94 to 126 feet, and there would be no months in which the water surface elevation would be lower than the existing system at full use (Corps 2014). For the 5 dry years modeled (1950, 1954, 1963, 1977, and 1981), increases in water surface elevation range from approximately 99 to 131 feet, again with no months in which the water surface elevation would be lower than with the existing system at full use (Corps 2014). For the 5 wet years modeled (1949, 1970, 1973, 1983, and 1984), increases in water surface elevation range from approximately 106 to 136 feet, also with no months in which the water surface elevation would be lower than with the existing system at full use (Corps 2014). Under the Project, the average annual evaporative loss would be approximately 1,000 AF compared with approximately 500 AF with the existing system at full use.

South Boulder Creek

South Boulder Creek Stream Flow

Under the Project, additional Denver Water diversions through the Moffat Tunnel would occur in average and wet years and would be highly concentrated during the primary runoff months of May, June, and July. Typically, additional diversions would be greatest in wet years following dry year sequences.

While flows in South Boulder Creek upstream of Gross Reservoir would increase on average, there would be no change in the maximum flows experienced in this reach because the capacity of South Boulder Creek above Gross Reservoir is limited to approximately 1,200 cfs. During high runoff, Denver Water must limit Moffat Tunnel deliveries to meet this constraint. From Gross Reservoir to the South Boulder Canal Diversion Canal, changes in flow reflect Gross Reservoir operations. In general, flows would be higher during winter months as water is moved out of Gross Reservoir and into Ralston Reservoir in response to the WTP load shift from the southern WTPs to the Moffat WTP. Increases in outflow from Gross Reservoir would generally be greatest in dry years because Denver Water would typically draw more water from its North System storage as a drought begins. Flows during the summer would be lower on average because the 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.

For the purpose of analyzing changes in surface water hydrology in South Boulder Creek, modeled diversions and stream flows were analyzed at the South Boulder Creek at Pinecliffe gage and at the gage below Gross Reservoir. Changes along South Boulder Creek are described with respect to two sections of the creek: (1) from Moffat Tunnel to Gross Reservoir and (2) from Gross Reservoir to the South Boulder Diversion Canal.

In the South Boulder Creek reach upstream of Gross Reservoir, changes in flow are equivalent to changes in Moffat Tunnel deliveries. Average annual flows at the Pinecliffe gage would increase by 10,300 AF (9 percent) and 14,400 AF (13 percent) in wet years. There would be no change in dry year flows. Flow increases would occur primarily in May, June, and July, which corresponds to the months when additional diversions through the Moffat Tunnel would be greatest. There would be virtually no flow increases from late summer through early spring except in infrequent, very wet years. There would be no increase in flows in dry years because Denver Water already diverts the maximum amount physically and legally available through the Moffat Tunnel under its existing water rights without additional storage in the system. Monthly average flows would increase by a maximum of 106.0 cfs (17 percent) in June. Monthly wet year average flows would increase by a maximum of 152.9 cfs (32 percent) in June (Corps 2014).

From Gross Reservoir to the South Boulder Creek Diversion Dam, changes in flow reflect Gross Reservoir operations. In general, flows would be consistently higher from October through February and April, as water would be moved out of Gross Reservoir and into Ralston Reservoir for delivery to the Moffat WTP. Under the Project, the Moffat WTP would operate at a minimum of 30 mgd during the winter; therefore, more water would be released from Gross Reservoir during these months in response to the treatment load shift. In April, water would be proactively released from Gross Reservoir in anticipation of the runoff and to stage as much water as possible close to the Moffat WTP. Releases from Gross Reservoir during a drought would depend on storage conditions in Denver Water's North and South systems and hydrologic conditions. Increases in outflow from Gross Reservoir would be greatest in dry years because Denver Water would draw more water from its North System storage under the Project as a drought begins. In advanced stages of a drought, Denver Water's South System reservoirs would have more water and would be drawn on more intensely. Thus, changes in stream flow in August, for example, would differ depending on storage conditions in Denver Water's North and South Systems and on hydrologic conditions. Flows in March and from May through August would be lower on average because the Foothills and Marston WTPs would meet a greater portion of the overall demand during these months under the Project, and, as a result, Gross Reservoir releases would decrease.

Average, dry, and wet year average annual outflows from Gross Reservoir under the Project would increase by 9,900 AF (8 percent), 15,000 AF (17 percent), and 15,300 AF (14 percent), respectively, over the existing system at full use. Monthly average flow changes would range from a decrease of 76.3 cfs (27 percent) in May to an increase of 92.0 cfs (904 percent) in January. Monthly dry year average flow changes would range from a decrease of 48.1 cfs (14 percent) in June to an increase of 88.1 cfs (1,122 percent) in January. Monthly wet year average flow changes would range from a decrease of 54.6 cfs (27 percent) in May to an increase of 88.5 cfs (719 percent) in January (FERC 2016).

Flows below the South Boulder Diversion Canal would generally decrease on average because Denver Water would divert more native South Boulder Creek water, either to storage at Gross Reservoir or under

its direct diversion right at the South Boulder Diversion Canal. These additional diversions, which would occur only in wet years during peak runoff in May and June, would reduce flows below the canal.

South Boulder Creek Native Stream Flow

The average annual Moffat Tunnel delivery to South Boulder Creek is 91.5 cfs with the existing system at full use and 105.8 cfs under the Project, which are 157 percent and 181 percent of the native flow, respectively. The greatest increase in flow added to this river segment would be in June, when the average Moffat Tunnel delivery would be 345.4 cfs with the existing system at full use and 451.3 cfs under the Project compared to an average native flow of 274.5 cfs. The greatest percentage increase in flow would be in September, when the average Moffat Tunnel delivery is approximately 76 cfs, which is 425 percent of the native flow under both the existing system at full use and the Project. While, the amount of water added to South Boulder Creek from the Moffat Tunnel is significant, the section of South Boulder Creek above Gross Reservoir has been modified to accommodate up to 1,200 cfs at the Pinecliffe gage.

South Boulder Creek Daily Flow Changes

The flow duration curve developed for the Pinecliffe gage indicates that flow increases resulting from the Project would occur primarily at higher flow rates. The flow duration curve for outflow from Gross Reservoir indicates that flow decreases would occur primarily at higher flow rates, while flow increases would occur primarily at lower flow rates.

Modeling of flows in South Boulder Creek shows the percentage of days that flows would increase or decrease under the Project compared with the existing system at full use. About 70 percent of the time there would be little or no flow change from May through July at the Pinecliffe gage. The maximum daily flow reduction at the Pinecliffe gage would be 268 cfs in June; daily increases in flow would range up to 833 cfs. Below Gross Reservoir, flow increases up to 99 cfs would occur about 73 percent of the time, and flows increases from 100 to 199 cfs would occur about 3.6 percent of the time. Likewise, flow decreases up to 99 cfs would occur about 12 percent of the time, and flow decreases from 100 to 199 cfs would occur about 4.9 percent of the time. The maximum daily flow reduction below Gross Reservoir would be 489 cfs in March (Corps 2014).

South Boulder Creek Peak Flow Changes

Modeling of the changes in the magnitude and timing of the peak flow for an average year indicates that, under the Project, the peak flow at the Pinecliffe gage would increase by 117 cfs, and the peak flow below Gross Reservoir would decrease by about 65 cfs. The timing of the peak flow would shift 1 day later at the Pinecliffe gage and 18 days later below Gross Reservoir compared with the existing system at full use. The magnitude of the wet year peak flow would increase by 252 cfs at the Pinecliffe gage and 26 cfs below Gross Reservoir. The timing of the wet year peak flow would shift 14 days later at the Pinecliffe gage and 13 days earlier below Gross Reservoir.

South Boulder Creek Floodplain

Between the East Portal of Moffat Tunnel and Gross Reservoir, the channel has been improved to accommodate a flow of 1,200 cfs, and Denver Water operates the Moffat Tunnel such that this limit,

including natural flows, is not exceeded. As a result, the only annual flood flows that increase significantly under the Project relative to the existing system at full use are below approximately 920 cfs. During a major, rare flood event that exceeds channel capacity, the Moffat Tunnel would not be diverting water, and there would be no increase in floodplain boundaries that could be attributed to the Project. Floods can occur in this stream reach due to local snowmelt or precipitation but not due to changes in the Moffat Collection System.

Gross Reservoir is currently not operated to provide flood control along South Boulder Creek, and that would not change under the Project. However, an enlarged Gross Reservoir would generally be able to capture flows that would be spilled by the existing reservoir. As a result, annual flood flows below Gross Reservoir would consistently be lower under the Project than under the existing system at full use. For estimated recurrence intervals of 2 years or more, this reduction would be approximately 8 to 12 percent of the existing system at full use annual flood flow, which indicates that the floodplain extent would decrease under the Project.

In 2009, the City of Boulder completed a study of the floodplain along South Boulder Creek below Gross Reservoir beginning at Eldorado Springs. The study assumed that Gross Reservoir was full during the design storm, i.e., that it provided no attenuation of the peak flows. Given that assumption, there would be no change to the floodplain below Boulder Canyon that can be attributed to the Project. It is possible that an enlarged Gross Reservoir would result in reductions in the floodplain size due to its ability to capture additional South Boulder Creek flows.

Conclusions supported by the Corps in its review of surface water effects related to the Project are addressed in the Corps ROD (Section 2.2, pages 5-6) as follows.

> *The Applicant's Preferred Alternative [the Project] would nearly double the surface area of the existing Gross Reservoir from 418 to 842 acres. Segments of streams that currently flow into Gross Reservoir would thus be inundated with water as part of the enlargement.*
>
> *The 2014 Final EIS for enlargement of the Moffat Collection System reviewed effects on water quantity and flows in Sections 5.1.1 and 5.4.1. The proposed dam raise would allow storage in Gross Reservoir to increase from 41,811 to 118,811 acre-feet, an increase of 77,000 acre-feet. The normal maximum water elevation would increase from 7,282 to 7,406 feet msl, and the surface area of the reservoir would increase from 418 acres to 842 acres. These figures include storage of the 5,000-acre-foot Environmental Pool.*
>
> *The Final EIS found that, from April through November, the annual pattern of reservoir fluctuation in level and content would be similar to that of the existing reservoir. The reservoir would be at its lowest at the end of April, reach its highest level in August, and would be drawn down through the fall and winter. Reservoir contents increase on average from December through February, because, under the existing system, the Moffat Water Treatment Plant does not operate in the winter months. However, under the enlarged system, Gross Reservoir contents would drop steadily by about 4,000 acre-feet per month during the winter mostly because the treatment plant would be operating at a minimum of 30 million gallons per day. Differences in reservoir volume*

under the enlarged system would be greatest in wet years following a drought, when the enlarged capacity of Gross Reservoir would allow more water to be stored. Average monthly storage would be greatest after enlargement of the system at the end of July (about 102,500 acre-feet), and lowest at the end of April (about 69,500 acre-feet). In dry years, monthly storage during summer months would be lower than average because the reservoir would be drawn on more heavily during a drought. In wet years, monthly storage during summer months would be higher than average. Increases in modeled reservoir surface elevations for the enlarged system compared with the existing reservoir ranged from approximately 94 to 126 feet, with no months in which the elevations would be lower than under existing system. For five modeled dry years, increases in reservoir surface elevations ranged from approximately 99 to 131 feet. For the five modeled wet years, increases in elevations ranged from approximately 106 to 136 feet.

Under the enlarged system, the average annual evaporative loss would be approximately 1,000 acre-feet compared with approximately 500 acre-feet with the existing reservoir.

As summarized in Final EIS appendices H-7 and M-1, average annual reservoir inflows in South Boulder Creek as measured at the Pinecliffe gage, operated by the Colorado Division of Water Resources and located approximately 2.5 miles above Gross Reservoir, would increase, after enlargement of the system, from 108,752 acre-feet to a calculated 119,036 acre-feet, a difference of approximately 9 percent. Monthly average flow rates at the Pinecliffe gage would increase by a maximum of 119.9 cfs (20 percent) in June and decrease by a maximum of 1.2 cfs (3 percent) in November. In dry years, monthly average flows would increase by a maximum of 16 cfs (11 percent) in July and decrease by a maximum of 2.4 cfs (8 percent) in November. In wet years, monthly average flows would increase by a maximum of 175.3 cfs (39 percent) in June and decrease by a maximum of 2.5 cfs (6 percent) in November.

According to Appendix H-7 of the Final EIS, enlargement of the system would increase average annual outflows from Gross Reservoir downstream to South Boulder Creek from 114,079 acre-feet to a calculated 123,757 acre-feet, a difference of approximately 8 percent. As explained in Final EIS Appendix M-2, releases from the Environmental Pool under the off-license Intergovernmental Agreement would essentially re-time downstream releases, slightly changing average downstream flows at certain times for environmental mitigation purposes. During mid-April through June, flows would be decreased at times when extra reservoir storage capacity is available. From July through March, flows would be increased to meet instream flow targets. On average, this operation would result in decreases in flows of up to 12 cfs in May, and increases in flows of up to 4 cfs December through March. Flows would be decreased more in wet years than dry years. The maximum decrease in flows due to the new Environmental Pool operation was estimated to be 75 cfs, and the maximum increase would be 7 cfs.

The Final EIS determined that, overall, enlargement of the Moffat Collection System would have beneficial effects on the storage of water and its availability for municipal use, and on instream flows downstream of the dam under most conditions. The only aspect of Denver Water's amendment that was not addressed in the Final EIS is the proposed change to license Article

403, which involves ramping rate limits for flows downstream of Gross Dam. Therefore, we address effects of the proposed change in ramping rates below.

Storage of the Environmental Pool under the off-license agreement also would provide additional beneficial effects on the aquatic species in Gross Reservoir, because the additional storage would provide more area and volume to sustain these organisms, thus providing more habitat. In South Boulder Creek downstream of the Denver Water diversion, the changes in flow with the Environmental Pool would also provide beneficial effects on aquatic life. The Environmental Pool would slightly reduce peak runoff flows and slightly increase low winter flows. Both of these changes in the stream hydrology are common mechanisms for increasing habitat availability for aquatic organisms.

Summary of Floodplain Effects

The 100-year storm discharge from the Project would be slightly less than with the existing system at full use due to the greater attenuation potential of the reservoir. However, the new spillway would result in a greater discharge than the existing spillway at the same water level. Denver Water would perform an analysis of impacts to the 100-year floodplain during the final design of the Project. At this time, however, Denver Water has determined that the 100-year discharge would be less than 5,000 cfs, and that that the future 100-yr floodplain (with the completed Project) would be similar to the existing floodplain and is well within the typical margin of error for a hydraulic model. A comparison of the existing reservoir and raised reservoir spillway rating curves is provided in Exhibit 11.

Conclusions supported by the FERC in its review of the Project impacts (Final SEA, Section 8.0, page 87) were as follows.

We [FERC] did not identify any elements of Denver Water's proposal which would cause effects to water quantity and flows in the Gross Reservoir Project area to exceed the levels identified in the 2014 Final EIS. This includes Denver Water's proposal to add a 5 cfs tolerance to the ramping rate requirements of license Article 403, which would not significantly affect water quantity or flows.

MITIGATION (SURFACE WATER HYDROLOGY AND FLOODPLAINS)

Mitigation measures related to surface water hydrology and floodplains were addressed in Denver Water's License Amendment Application to the FERC (Exhibit 5) in Table 5.1-1.

Per the Corps 404 Permit condition adopting mitigation identified in the 2011 FWMP developed between Denver Water and CPW, the 2010 Intergovernmental Agreement (IGA) between Denver Water and the cities of Boulder and Lafayette, and mandated by FERC because it was included in the Project design in the approved FERC license amendment: Denver Water will establish a 5,000-AF Environmental Pool in Gross Reservoir to augment flows during low flow periods, thereby benefiting 17 miles of aquatic habitat in South Boulder Creek from Gross Dam to its confluence with Boulder Creek. The Environmental Pool will enhance flows in South Boulder Creek below Gross Reservoir and provide flows in the lower section of South Boulder Creek, which currently goes dry due to diversions by other water users.

Per the Denver Water/USFS Settlement Agreement, Denver Water will also mitigate the permanent loss of waterways through preservation (through USFS protection and administration of National Forest System [NFS] lands) of approximately 5.7 miles of streams, including a portion of South Boulder Creek, within the 539-acre Toll Property through its conveyance to the USFS.

The FERC's analysis evaluated the effects of all mitigation measures (Final SEA, Section 3.1.5.3) and concluded as follows.

> *Through an off-license Intergovernmental Agreement signed by Denver Water and the Cities of Boulder and Lafayette on February 24, 2010, a 5,000-acre-foot Environmental Pool would be stored in Gross Reservoir for use in augmenting flows for downstream aquatic habitat during low-flow periods. The Environmental Pool would be filled with water provided by the cities of Boulder and Lafayette. The Intergovernmental Agreement would replace the off-license Denver-Boulder Agreement, which currently governs storage and release of a 2,500-acre-foot Environmental Pool.*

8-507.D.6.a.i, Application for a Floodplain Development

Section 8-206.A lists county permits considered necessary for the Project including a Floodplain Development Permit. Denver Water has requested that the Boulder County Land Use Department schedule a meeting with County Floodplain staff and intends to apply for this permit.

507.D.6.a.ii, Flood Hazard Impact Report

FLOOD HAZARD CRITERIA DEVELOPMENT

Gross Dam is regulated by the FERC and the Colorado State Engineer's Office (SEO). The existing Gross Dam is classified as a large, high hazard dam by the SEO. [2] Similarly, FERC characterizes the dam as having a high hazard potential. When complete, the raised Gross Dam would carry the same designation as a large, high hazard dam.

Dams and their accompanying spillways are required to safely manage an inflow design flood (IDF) selected based on the dam's size and hazard classification. Due to the high hazard designation, the Gross Dam and spillway are required to safely manage the probable maximum flood (PMF) resulting from the probable maximum precipitation (PMP). The PMP is generally defined as the theoretically greatest depth of precipitation for a given duration that is physically possible over a drainage basin at any specific time of year. The IDF for the raised Gross Dam is identified as the PMF.

The PMF magnitude was developed in cooperation with the FERC and SEO. The development process and resulting PMF hydrograph are documented in the Gross Reservoir Hydroelectric Project—Site Specific Probable Maximum Precipitation and Inflow Design Flood Study (Stantec, 2017).

[2] The definition per the Colorado Office of State Engineer–Division of Dam Safety is as follows: "A high hazard dam is a dam for which loss of human life is expected to result from failure of the dam. Designated recreational sites located downstream within the bounds of possible inundation should also be evaluated for potential loss of human life."

Given magnitude of the PMF, the raised Gross Dam will be capable to safely managing other typical design storms including the 100-yr and 500-yr return period events.

507.D.6.a.iii, Qualifications for Flood Hazard Maps or Reports

Maps and reports addressing flood hazard areas for the project were prepared by registered Colorado Professional Engineers or hydrologists.

8-507.D.6.b, Geologic Hazard Areas

Figure 3-1 in Exhibit 1, Geologic Hazard and Constraint Areas, provides a map showing the Boulder County Comprehensive Plan Geologic Hazard and Constraints near the Project. Figure 3-2 provides a geologic map for the Project. Mitigation measures for geology and soils are summarized in the Project Description above. More detailed geotechnical studies, mitigation measures, and recommendations are provided in Exhibit 12 including a Geotechnical Data Report. Given the nature of the Project, this 1041 permit application includes extensive information on geology and geohazards. The sections below provide Project background information on geology and then address the specific requirements for this section of the Boulder County Land Use Code.

The following geologic information and analysis was gathered for Denver Water's License Amendment Application to the FERC (Section 3.3.5).

AFFECTED ENVIRONMENT (GEOLOGY AND GEOLOGIC HAZARDS)

Topography

Gross Reservoir is located on the eastern slope of the Colorado Rocky Mountain Front Range in South Boulder Creek Canyon. Boulder Creek Canyon is rugged and contains narrow, V-shaped valleys with steep slopes (50 percent and greater in places) and small areas of relatively flat topography. Numerous near-vertical cliffs, up to a few hundred feet high, exist at the site. Ridges and higher areas have more gentle slopes and some relatively small flat areas. Stream valley bottoms are steep, narrow, and filled with boulders.

Lithology

Lithology refers to the general physical character and description of rocks. Bedrock at Gross Reservoir consists almost entirely of Precambrian Boulder Creek granodiorite as shown in Figure 3-2 in Exhibit 1. The granodiorite is a pink, medium- to coarse-grained, hard, and strong intrusive igneous rock that crops out over large areas of Gross Reservoir. South Boulder Creek Canyon has near-vertical cliffs hundreds of feet high composed entirely of this granodiorite. Areas of highly weathered and decomposed granodiorite occur in high areas on the canyon slopes and along ridges above the canyon. Locally, the decomposed granodiorite extends tens of feet into the bedrock and is typically weathered to greater depths along joints and shears. Numerous corestones (a portion of the rock mass that remains unweathered) occur within the decomposed granodiorite where rock located between joints and shears does not weather as rapidly as the surrounding non-decomposed granodiorite. The result is large, rounded, and relatively unweathered blocks of granodiorite or corestones surrounded by the soil-like decomposed granodiorite. In some areas, the decomposed rock has been eroded and carried away, leaving behind surfaces covered by large boulders or corestones.

Some areas around Gross Reservoir contain a relatively thin cover of soils, colluvium, talus, and alluvium. The soils at Gross Reservoir are typically gravelly, stony, and cobbly sandy loams, often only a few inches thick, that grade into the underlying highly weathered and decomposed bedrock. Colluvial deposits have formed in areas where weathered materials accumulate; these consist of the same soils described above, but with variable amounts of large, boulder-sized rock fragments. Talus deposits are similar to colluvium but consist mostly of gravel to large, boulder-sized rock fragments and sand-sized matrix materials. Relatively small alluvial deposits of sands and gravels accumulate in stream valley bottoms and often interfinger with colluvium on adjacent valley slopes.

Geologic Structures

Geologic structures at Gross Reservoir include faults, shears, joints, veins, and dikes. Faults and shears typically consist of a zone of often intensely fractured rock that surrounds one or more clayey to breccia-filled gouge zones. Two of the largest geologic structures located within the reservoir, the Livingston and Copeland faults, are related to the Rogers Fault (all of which are not considered to be active seismic faults), which is a northwest trending, steeply dipping fault with a trace length of approximately 20 miles (Gable 1972, Wells 1967). The rock mass at Gross Reservoir also contains numerous smaller faults and shears that formed during numerous mountain-building periods that occurred since the Precambrian granodiorite was emplaced. The rock is also jointed, with variable orientations, but typically with two nearly vertical joint sets and one low angle joint set. Thus, the rock mass has a blocky appearance due to the three-dimensional, interconnected jointing that allows the rock to part into blocks. Areas consisting of massive rock outcrops often also contain exfoliation joints that form parallel to the surface of the outcrop and extend a few feet to tens of feet into the rock mass. Exfoliation weathering produces large tabular blocks of rock that separate from the rock mass and may slide off steeper slopes. The rock mass contains numerous, often quartz-filled veins that range from strong to weak and may form discontinuities. Dikes composed of pegmatite, granodiorite, and quartz monzonite also formed as the granodiorite was repeatedly intruded. The youngest intrusive dikes are Tertiary in age.

Geologic Resources

Potential gravel and rock resources associated with bedrock outcrops exist at Gross Reservoir but are not currently being exploited because other similar sources of gravel and rock are located much closer to markets in cities along the Front Range. These geological resources will be used as a local source of borrow for sand- and gravel-sized aggregate required for the roller-compacted concrete construction of the dam raise.

Geologic Hazards

Geologic hazards at Gross Reservoir include erosion and rock fall potential. The Rogers Fault is not considered to be potentially active (Kirkham and Rogers 1981).

The rim of Gross Reservoir consists of weathered granodiorite which, with the overlying colluvium, soils, and rock fragments, is prone to erosion. Within the reservoir area, rock fall potential is present at numerous granodiorite outcrops located along and above the rim of the reservoir. The nearly vertical cliffs (300 to 400 feet high) and loose material at the dam site create rock fall potential due to ice wedging, blasting, sliding, etc.

The Geotechnical Data Report, Geotechnical Design Report, and Rockfall Mitigation Plan, all provided in Exhibit 12 and completed in 2018, provide recent information, investigations, and recommendations about geologic hazards.

Seismicity

Gross Reservoir occurs in Seismic Zone 1, which means that there is a one-in-ten chance that an earthquake with an active peak acceleration level of 0.1 g (one-tenth the acceleration of gravity) would occur within the next 50 years. However, the Livingston Sheer Zone and Fault, the Copeland Fault, and the Rogers Fault are not mapped as potentially active and, therefore, are unlikely to create earthquake activity near Gross Reservoir (Kirkham and Rogers 1981).

PROJECT EFFECTS (GEOLOGY AND GEOLOGIC HAZARDS)

Direct impacts to geologic resources at Gross Reservoir include the loss of mineral resources used as borrow material for construction of the dam raise. Indirect, permanent geologic impacts at Gross Reservoir include erosion, slope failure and reservoir rim instability, rock fall, and landslides due to operation of the facility.

Moderate direct impacts to geologic resources at Gross Reservoir include the loss of mineral resources such as sand, gravel, and bedrock used as borrow material for construction of the dam raise. All the borrow material would be produced on site in a quarry Southwest of the dam (Osprey Point Quarry). In addition, there would be a loss of accessibility to some unmined gravel and rock resources due to reservoir inundation. Denver Water prepared a Final Quarry Location Report: Impact Minimization and Avoidance Measures for the Project in September 2018. The report concludes that the Project would result in unavoidable loss of geologic resources (i.e., bedrock, sand, and gravel deposits) and alteration of topography associated with the use of borrow materials, which would be a permanent impact. Overall, the Project would result in the unavoidable adverse impact of loss of geologic resources and alteration of topography associated with the use of borrow materials. The results of the recent technical studies confirmed the feasibility of mining 100 percent of the aggregate on-site. The volume of geologic resources is estimated at 796,000 cubic yards; however, the surface area would be minimized. Based on the most recent analyses in the report, landslide or seismicity issues would not compromise dam safety or other quarry construction-safety issues due to the siting of the quarry at Osprey Point.

Fluctuating water levels associated with operation of Gross Reservoir under the Project would create changes in the stresses in the slopes of the shoreline. The nature of impacts to the shoreline and exposed reservoir bottom would be determined by the substrate, its stability and texture, the slope of the shoreline, and reservoir's water level. Effects to shoreline character and stability are also discussed in Section 8-511.B.5.h of this 1041 permit application.

Analysis of geologic materials around the existing reservoir indicates that much of the soil and underlying weathered to highly weathered and decomposed granite (i.e., Precambrian Boulder Creek granodiorite) is subject to erosion. The highly weathered granite consists of medium- to coarse-grained, sometimes clayey material that tends to lose cohesive strength when wet. Wave action would likely erode this material from the toes of slopes and cut benches along the reservoir rim, which may lead to slope failure

and resulting reservoir rim instability. Wave-cut benches would tend to form more rapidly in areas of the reservoir rim exposed to greater wave action, such as ridges. As water levels in the reservoir fluctuate in response to operational changes, the alternating moisture content of the reservoir slopes may increase reservoir rim instability.

Reservoir rim instability associated with slope failures may result in landslides. However, because highly weathered granite is relatively free draining, if landslides do occur at Gross Reservoir, they are expected to be relatively small, local features. Therefore, it is not anticipated that a landslide would involve sufficient volume to create a wave that could overtop the dam or would significantly reduce the storage volume of the reservoir.

The Geotechnical Data Report, Geotechnical Design Report, and Rockfall Mitigation Plan, all provided in Exhibit 12 and completed in 2018, include the more recent information, investigations, evaluation of effects, and recommendations with regard to geologic hazards.

Seismicity

The scoping process for the Moffat Collection System Project EIS identified increased earthquake activity potential from water-lubricated faults due to increased storage at Gross Reservoir as a potential geological impact of the Project.

In general, reservoirs with depths greater than 300 feet may potentially induce seismicity. Increased seismic activity associated with water-lubricated faults is typically related to the load of a reservoir on an area that creates changes in stress at depths of at least a few miles. The water loads at Gross Reservoir would not change the water content in faults at depths of a few miles, thus increased seismic activity from lubricated faults is not anticipated. However, stress on the faults located at or near the reservoir site may increase and result in negligible seismic activity. In summary, the dam raise and expansion of Gross Reservoir may increase the potential for reservoir-induced seismicity, but not at substantial levels. Potential issues related to seismicity will be addressed through geotechnical and seismic studies in the design and construction phases.

Intermittent blasting by explosives such as Ammonium Nitrate Fuel Oil (ANFO) would occur during the early phases of construction as aggregate supplies are needed for construction of the dam raise. Blasting would be designed specifically for Gross Dam and would create ground vibrations and land motion appropriate for the dam structure to sustain. A seismograph will be used to monitor the blasting operations to ensure that acceleration thresholds are not exceeded. The land motion created from blasting recedes rapidly from the source (i.e., the dam) and would be insufficient to collapse wells or cause other damage near the Project.

Conclusions supported by the FERC in its review of the Project impacts (Final SEA, page 45) were as follows.

> *Overall, effects on geology and soils under an approval of Denver Water's license amendment would not be significant enough to cause effects determined in the Final EIS for the project area to be exceeded.*

Regarding the comment on the Commission's public notice that earthquake potential of enlargement of the reservoir needs to be analyzed, we note that seismicity was addressed in the 2014 Final EIS, and in Denver Water's response to comments. The project is located in a seismically inactive area and a significant earthquake is unlikely near the project. Further, as stated in the Final EIS, due to geology in the area and the depth of faults beneath the reservoir, the proposed enlargement of the reservoir would, at most, have a negligible impact on seismicity, and seismic studies would be conducted in the design and construction phases.

MITIGATION (GEOLOGY AND GEOLOGIC HAZARDS)

The following mitigation measures for geology were gathered for Denver Water's License Amendment Application to the FERC (Exhibit 5) in Table 5.1-1.

If the Final EIS Quarry is developed on NFS lands, Denver Water will prepare a *Pit Development and Reclamation Plan* to include quarry operation and reclamation and will obtain a USFS Mineral Materials Permit. The *Pit Development and Reclamation Plan* will be developed in consultation with USFS and the Colorado Division of Reclamation, Mining, and Safety and will be filed with the FERC prior to ground-disturbing or construction activities associated with pit development on NFS lands. Denver Water will also obtain a Reclamation Permit, which requires a reclamation plan, from the Colorado Division of Reclamation, Mining, and Safety (only required for the Final EIS Quarry on federal land).

Denver Water will prepare a *Quarry Operation Plan* to include quarry development and operation activities and a *Quarry Reclamation Plan* to include quarry mitigation techniques for areas above the new normal water line, if any, for the Osprey Point Quarry. Denver Water will consult with Boulder County and the Mine Safety and Training Program arm of the Colorado Division of Reclamation, Mining, and Safety to develop quarry operation procedures and with the Corps, Boulder County and the Colorado Division of Reclamation, Mining, and Safety to develop reclamation measures for Denver Water land above the new high water line (7,406 feet). Denver Water will submit the final plans to FERC for approval.

The FERC's analysis evaluated the effects of all mitigation measures (Final SEA, pages 44-45) and concluded as follows.

Denver Water's implementation of its Stormwater Management Plan, Erosion Control and Reclamation Plan, Quarry Operation Plan and Quarry Reclamation Plan, and its compliance with Forest Service 4(e) conditions 19 (Erosion Control and Reclamation), 26 (Pit Development and Reclamation Plan), and 28 (Reclamation and Revegetation Seed Mixes and Mulch Materials), would significantly reduce effects to geology and soils in the project area. Effects to geology and soils from tree removal, reservoir enlargement, and relocation of recreation facilities would also be reduced through Denver Water's implementation of a Tree Removal Plan. Denver Water would finalize the plan in consultation with agencies and compliance with the Forest Service 4(e) conditions. Denver Water would file the final plan with the Commission, including evidence of consultation and rationale for why any agency recommendations were not included in the final plan, and copies of agency approvals where necessary. Effects on local soils would also be reduced through the Erosion and Sediment and Control Plan Denver Water would have to file

with the Commission's San Francisco Regional Office. Land- disturbing work associated with the amendment would not be allowed to begin until the plan is approved by the Regional Office.

8-507.D.6.b.i, Geology Report

In support of the Project, Denver Water has thoroughly investigated the Gross Reservoir site to characterize geologic and geotechnical conditions including but not necessarily limited to rockfall potential, landslide potential, and seismicity.

The existing Gross Dam site was extensively investigated during the design and construction phases from 1945 to 1955. Since completion of the existing facility, six separate exploration programs were completed between 1976 and 2018 to further assess the dam site and adjacent areas. The data collected between 1945 and 2018 aided in the overall characterization of soil and bedrock conditions at the dam site. Table 10 summarizes these previous investigations.

Various surface and subsurface data collection techniques were employed in completing the investigations. These techniques include geologic reconnaissance and mapping, exploratory borings, test pits, test trenches, geophysical surveys, downhole geophysics, and laboratory material testing. The most recent exploration program completed in 2018 consisted of geologic reconnaissance, 22 seismic refraction tomography lines, eight test pits, three test trenches, seven exploratory borings, and downhole seismic surveys.

Table 10:
Summary of Previous Geologic/Geotechnical Investigations

Source	Gross Dam Phase	Description	Applicability to GRE Project	Methods
Wahlstrom (1945)	Planning	Geologic reconnaissance	Dam site	N/A
Bilisoly (1947)	Original design	Drilling	Foundation in valley	11 NX core holes (NX is a standard core drilling size)
		In situ testing		Water loss (packer-type) testing in 8 holes
Wahlstrom (1948)		Geologic mapping/trenching	Dam site	Trenching reported to excavate through surface deposits to rock
Wahlstrom (1952) [in Denver Water, 1955b]	Construction	Geologic mapping	Upper left abutment shear zone	N/A
		Drilling		14 NX core holes
Vanderwilt (1952a)		Geologic observations	Foundation excavation	Rock and discontinuities descriptions
Lippold (1952a)		Geologic observations	Foundation excavation	Minor faults/seepage in valley bottom
Vanderwilt (1952b)		Geologic observations	Foundation excavation	Fractures in biotite granite with schist and gneiss inclusions
Lippold (1952b)		Geologic observations	Foundation excavation	Fault in valley bottom, shear zones in upper left and mid right abutments
Denver Water (1954)		Geologic mapping	Foundation excavation	Detailed mapping of rock types and discontinuities
Wahlstrom (1955)		Geologic report	Foundation	Detailed rock type and joints and faults descriptions

Table 10:
Summary of Previous Geologic/Geotechnical Investigations

Source	Gross Dam Phase	Description	Applicability to GRE Project	Methods
Denver Water (1955a)		As Constructed Drawings	Foundation	Test pit (no logs available); summary drill hole logs, plan locations of drill holes, and geologic sections
Denver Water (1955b)		Final construction report	Foundation	Consolidation and curtain grouting descriptions; construction photographs of foundation excavation and treatment
Harza (1985)	Raise feasibility	Geologic mapping	Downstream raise footprint	N/A
		Drilling		12 NX core holes, detailed logs
		In situ testing		Water pressure (packer-type) testing in 11 holes
Fugro Consult. (2016)		Geophysical survey	Foundation	Shear wave velocity by interferometric multichannel analysis of surface waves (ISMAW)
Stantec (2018)	Raise Design	Drilling	Foundation	8 NX core holes (Dam raise and Saddle Dam)
		In situ testing	Foundation	Water loss (packer-type) testing and downhole seismic
		Geologic mapping/trenching	Foundation, abutments	Trenching reported to excavate through surface deposits to rock; detailed mapping of rock types and discontinuities
		Geophysical survey	Foundation	Seismic refraction tomography (22 lines)
Woodward-Clyde Consultants (1976a and 1976b)	Operations	In situ testing	Dam site	Water loss (packer-type) testing in 8 holes
		Geologic mapping/trenching		Trenching reported to excavate through surface deposits to rock
		Geotechnical laboratory testing		Gradation, Atterberg limits
Harza (2000)		Geologic mapping	Right abutment	Rope access
Kumar & Associates (2003)		Geologic reconnaissance	Powerhouse rock slope	Qualitative rockfall potential/control assessment
		Drilling	Same overburden and rock types as at dam site	9 NX core holes
		Geotechnical laboratory testing		Natural moisture content, dry gradation, Atterberg limits, unconfined compression, electrical resistivity
		Geotechnical laboratory testing		Natural moisture content, dry gradation, Atterberg limits, unconfined compression, electrical resistivity

The extensive investigations allowed for a comprehensive characterization of the geologic and geotechnical conditions at the Project site. Areas of specific interest included: bedrock faulting, jointing, and consistency; rockfall potential, and landslide potential. Colorado registered geologists and geotechnical engineers reviewed the available information and developed site characterizations at the dam raise and appurtenant structure locations. Denver Water then applied these characterizations to the evaluation and design of the Gross Reservoir Expansion.

In addition, seismicity at the site was carefully assessed through development of a Seismic Hazard Assessment (Stantec, 2017). The seismic hazard was evaluated using the FERC Engineering Guidelines for the Evaluation of Hydropower Projects (FERC, 2014). The regulatory process for seismic hazard evaluation defined by the FERC specifies that both probabilistic and deterministic evaluations be conducted.

Denver Water's risk objective for Gross Dam was to select ground motions at or above the 10,000-year return period from a probabilistic seismic hazard analysis. The maximum credible earthquake (MCE) ground motions were also estimated using deterministic seismic hazard analysis, following the FERC guidelines. The level of seismic hazard selected by Denver Water exceeds the SEO requirements, which require that high hazard dams be designed for the MCE "or for an earthquake with a minimum of 5,000-year return frequency." The design criteria states that the 84th percentile be used as the design response spectrum for a M 6.75 at a distance of 20 km, which envelopes the 10,000-year return period.

For additional information, Denver Water's FERC License Amendment Application includes two additional reports related to soils and geology. Attachment E-4 Final Quarry Location Report Moffat Collection System Project—September 2016 provides a summary of the findings from the preliminary engineering evaluations completed by Denver Water, which would considerably reduce the quarry and trucking impacts identified in the Corps Final EIS. Attachment E-5 Analysis of Quarry Areas for the Proposed Gross Reservoir Expansion—April 2016 provides a summary of the information and impact analyses related to the Gross Reservoir Expansion quarry that was included in the Corps' NEPA evaluation for the Moffat Collection System Project, and which may be used by the USFS for its preparation of the environmental documentation necessary for the mineral materials disposal permit. In addition, Exhibit 12 includes three geotechnical reports prepared in 2018 by Professional Geologists.

Exhibit 12 provides Denver Water's Geotechnical Data Report for the dam prepared in 2019 and the Geotechnical Design Report for site development activities prepared in November 2018 for the Project. The latter document describes the investigations, evaluations, analyses and design recommendations in support of the ongoing design of site development features and improvements that are part of the Site Development construction package. The objective of the Site Development construction work is to prepare the overall site for the future dam raise work, allowing that work to proceed in an expeditious manner with most general site construction preparation improvements completed. The geotechnical recommendations support civil design of planned improvements at selected reaches of Gross Dam Road and rock cuts and possible soil fill at the staging areas.

Exhibit 12 also provides Denver Water's Rockfall Mitigation Plan prepared in November 2018. This document includes investigations of rockfall hazard areas. This document is part of the Basis of Design Memorandum for the Site Development construction package in preparation for raising Gross Dam. The objective of this Rockfall Mitigation Plan is to provide an in-progress status of the investigations, analyses, and preliminary designs of rockfall mitigation features.

Based on professional judgement of the site topography, rockfall potential assessment has been limited to the eastern slope of the access road downstream of the dam. This area has steep slopes and regular vehicle and pedestrian traffic below.

Based on current field investigations, slope stability assessments and alternatives analyses, several mitigation measures have been recommended for the eastern slope, including three rockfall barriers; further detailed field inspections as part of Site Development construction work of potential source areas; and selective rock scaling, rock removal and installation of rock retention netting, rock bolts or dowels, if indicated during detailed inspection. Design recommendations for the planned permanent and temporary excavated rock slopes associated with other selected site development features are provided in the Site Development Geotechnical Design Report, also included in Exhibit 12.

Exhibit 12 also provides Denver Water's Geotechnical Data Report for the dam. The purpose of this report is to present geological and geotechnical characterizations of conditions in support of the development of the Project.

Exhibit 12 provides Denver Water's Geotechnical Design Report and includes geotechnical recommendations for the following Project components:

- Access Road Improvements (cut slopes and fill slopes)
- High Rock Cuts at Potential Staging Areas
- Major Fills at Potential Staging Areas (subgrade preparation, fill materials, fill slope inclinations, placement and compaction, and benching and set-back)

Exhibit 12 also provides Denver Water's Rockfall Mitigation Plan prepared in November 2018. Detailed mitigation design recommendations are provided in this document and generally include the following mitigation components:

- Inspection / Monitoring
- Rockfall Barriers
- Rockfall Drape / Rock Retention Netting
- Scaling
- Rock Bolting / Doweling
- Rock Removal

Denver Water prepared a Final Quarry Location Report: Impact Minimization and Avoidance Measures for the Project in September 2018. Post-construction mitigation and reclamation activities would be minimal for the Osprey Point Quarry since most or all of the quarry site would be inundated by the new reservoir. The uppermost benches would be regraded to reduce vertical walls and cliffs along the reservoir edge. The quarry would also be rough graded to drain back towards the reservoir as part of the site decommissioning. Denver Water is optimistic that the layout of the Osprey Point Quarry would allow for the entire quarry to be inundated by the new reservoir. Therefore, Denver Water would only mine above the new high-water line if required by material characteristics or quantities criteria. Quarry mitigation for any remaining exposed highwall would consider a range of reclamation alternatives and techniques, such as benching, rock sculpting (shaping the exposed rock to mimic a natural rock face), and selective planting to break up the scale of the exposed area and soften the contrasts with adjacent areas. The use of rock staining would also be considered, provided that its application would not create any water quality concerns.

8-507.D.7, Requirements Applicable to All Applicants

8-507.D.7.a, Project Need

The Corps presented information and analysis addressing the Project need in their Corps ROD (Section 3.0) as follows.

PROJECT PURPOSE AND NEED

For the purposes of NEPA, the Final EIS contains the following purpose and need statement:

> *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.*
>
> *As explained in the Corps' Final EIS for the Project, this purpose and need statement was developed from the following needs:*
>
> *Denver Water identified four needs in the Moffat Collection System that required resolution. These needs, presented to the public during the Moffat Project NEPA scoping period in 2003, 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 Water'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 manmade 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's 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.*
>
> *The Corps independently evaluated Denver Water's demand projections in 2004. In 2010, the Corps reevaluated Denver Water's demand to assess the validity of the need and found that*

18,000 AF of firm annual yield was still valid for the Moffat Project. The need for the Project and the Corps independent review of Denver Water's demand projections are discussed in Section 1.1 of the Moffat Project Final EIS.

Note that Denver Water's purpose and need accounted for existing and future water conservation, as described in the Final EIS:

The Moffat Project identified a 34,000 acre-feet per year (AF/yr) deficit in Denver Water's supply compared to projected demand. This shortfall would be met by 16,000 AF/yr of additional conservation and the 18,000 AF/yr Project (72,000 acre-foot [AF] enlargement of Gross Reservoir). Denver Water has committed to implement the programs necessary to realize 16,000 AF/yr of conservation savings by 2030.

Mandatory watering restrictions are designed for short-term reductions in water use and would not independently or reliably meet the required firm yield of 18,000 AF/yr. The expected savings from Denver Water's approved conservation plan were subtracted from the projected demand in calculating the need for 18,000 AF/yr of new reliable firm yield. Therefore, Denver Water has assumed future increases in conservation in its water demand projections as part of its Purpose and Need.

The effects of conservation measures and practices implemented by Denver Water through their conservation program are accounted for in the evaluation of project need. As shown in the Final EIS, active conservation is expected to reduce Denver Water's anticipated supply shortfall by 16,000 AF. Additionally, the savings associated with the natural replacement of older appliances and plumbing fixtures is included in the projections of future water demands for Denver Water.

Water supply is only a portion of Denver Water's need. The Purpose and Need of the Moffat Project is to develop 18,000 AF/yr of new, annual firm yield to the Moffat Treatment Plant and raw water customers upstream of the Moffat Treatment Plant. The proposed additional supply and reservoir storage address a projected shortfall in Denver Water's supply and an imbalance in Denver Water's water collection system. This imbalance has resulted in system-wide vulnerability issues, limited operational flexibility to respond to water collection system outages, and can seriously jeopardize Denver Water's ability to meet its present-day water needs. Failing to address any one of the issues would jeopardize Denver Water's ability to meet projected demand needs.

Denver Water also considered multiple alternatives involving water reuse among the alternatives considered to meet the Project's purpose and need. The Corps eliminated Alternative 6, Indirect Potable Reuse Project, and Alternative 7, Reusable Water, from consideration in the Final EIS because both alternatives included only reuse to meet the entire 18,000 AF/yr of the firm yield requirement and had high relative cost indices due to the cost of treating such a large volume at an Advanced Water Treatment Plant (AWTP). The Corps evaluated two alternatives in the Final EIS, Alternative 8a, Gravel Pit Storage and Gross Reservoir Expansion, and Alternative 10a, Deep Aquifer Storage and Gross Reservoir Expansion, that included indirect potable reuse to meet 5,000 AF/yr of the firm yield requirement. The

Corps' ROD concluded that the new infrastructure and construction that would be required under these alternatives would be more impactful and would affect a larger and more geographically dispersed area than the Project.

The purpose and need were supported by the FERC (FERC Final SEA) in its review of the Project impacts, stating:

> *Denver Water plans to expand the Moffat Collection System to increase collection and storage of raw water. As part of the planned expansion, Denver Water would need to increase the storage capacity of Gross Reservoir by raising Gross Dam 131 feet, to allow the storage of up to an additional 77,000 acre-feet of water. Therefore, Denver Water proposes to amend its license for the Gross Reservoir Project to reflect the proposed changes to the dam, reservoir, and related project facilities. Denver Water also proposes to amend certain requirements of its license related to the changes, and add a series of environmental protection, mitigation, and enhancement measures, which reflect modified or new mandatory conditions based on agreements it has reached with federal, state, and local resource agencies and other entities. The elements of Denver Water's license amendment are fully described in Section 3.0, Proposed Action and Alternatives.*

8-507.D.7.a.i, Population to be Served

Figure 7-1 in Exhibit 1, System Capacity and Service Area Plans and Maps, shows the Combined Service Area (CSA) for the project.

The population to be served was described in the Corps Final EIS (Section 1.3.2) as follows.

> *Denver Water serves treated water to the City and County of Denver and 65 suburban distributors within its Combined Service Area (CSA), which includes more than 300,000 accounts and approximately 1.3 million people.*

8-507.D.7.a.ii, Types of Users to be Served

The types of users to be served by the Project were described in the Corps Final EIS (Section 1.3.3) as follows.

> *Denver Water provides water to its customers within its CSA and to fixed-amount contracts outside its service area. Denver Water's CSA includes the City and County of Denver, plus the total geographic service areas of all its distributors, defined as those entities that rely solely on Denver Water's potable water for their water supply [included in this 1041 permit application as Figure 7-4 in Exhibit 1]. Within the CSA, Denver Water acts as a public utility, regardless of whether the customers served are located inside or outside of Denver. Total water demand within Denver Water's CSA amounted to about 249,000 AF in 2010, including distribution losses (Denver Water 2011). This represents about a 10% increase since the drought years 2002 and 2003.*

Approximately 1.3 million people (1.1 million treated water customers) in the Denver Metropolitan area depend entirely upon Denver Water for their treated municipal, industrial, and commercial water. In addition to treated water Denver Water also provides substantial amounts of recycled water and fixed amount raw water contracts. The IRP (Denver Water 2002a) provides more detail on Denver Water's customer obligations. Customers fall within three major categories:

- ***City and County of Denver****—By charter, Denver Water is required to provide an adequate supply of water to the people of the City and County of Denver "for all uses and purposes," through its ultimate buildout. About 52% of the public utility's customer accounts are within the City and County of Denver.*
- ***Suburban Distributors****—By the Colorado Constitution, Colorado State Statute, and the Denver Charter, Denver Water is obligated to provide water service to certain suburban users outside of the City and County of Denver, but within its CSA. For many of these users, the majority of which are cities or quasi-municipal water districts, Denver Water is the sole source of water. Denver Water's obligation under the distributor contracts is perpetual.*
- ***Fixed-Amount Contracts****—Denver Water is obligated to provide specified amounts of either potable or non-potable water under approximately 20 fixed-amount contracts. Most of these contracts are with municipal or quasi-municipal entities located outside the CSA. Several of the larger contracts specify delivery locations within the Moffat Collection System. Denver Water's obligation under these fixed-amount contracts is perpetual.*

8-507.D.7.a.iii, Design Capacity

See response to Section 8-507.D.2 and Exhibit 10. The additional storage and supply provided by this Project will provide system resiliency to meet Denver Water's mission to serve customers of Denver Water's combined service area reliable, high quality water by increasing supply, decreasing vulnerability, and increasing reliability. Now, more than ever, water providers must be prepared for ever-changing conditions within the watersheds. Drought and multiple forest fires have highlighted the need for a resilient water collection system that can adapt to the unexpected.

8-507.D.7.a.iv, Excess Service Capacity of Public Utility Facility

This application requirement does not apply because the Project involves expansion of an existing reservoir, not "a new water or wastewater treatment system or public utility facility." Denver Water nevertheless provides the following information for Boulder County's consideration.

The Project is one of the major elements of Denver Water's long-term supply plan. It will prevent future shortfalls during droughts and address the imbalance in the North-South collection system. As described in Section 8-507.D.7.a and the text below from the Corps ROD, the Project does not create excess service capacity but rather was developed in part to address existing reliability, flexibility and vulnerability issues and satisfy demands that are projected to exceed Denver Water's available supplies.

The Corps presented information and analysis addressing the Project need in their ROD (Section 3.3) as follows.

NEED

> *Denver Water developed an Integrated Resources Plan (IRP) in 1997, with an update in 2002 [included in this 1041 permit application as Exhibit 2], to analyze existing and future water supplies and customer demands. The Corps considered Denver Water's IRP in its evaluation of need for the Project. In 2010, the Corps reviewed Denver Water's updated water demand projections based on more recent population and demographic projections available from the Denver Regional Council of Governments, Colorado State Demographer's Office, and other relevant sources of demographic data. The 2002 IRP projected that Moffat Collection System supplies could meet projected demands until 2016; the 2010 updated demands are expected to start exceeding Denver Water's available supplies in the year 2022. The Corps independently evaluated the updated projections in 2010 and found them reasonable for use in the Final EIS.*
>
> *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: reliability, vulnerability, flexibility, and firm yield needs.*

Please see the *discussion at the beginning of this Section (8-507.D.7.a.) for a full description of the reliability, vulnerability, flexibility, and firm yield needs for the project.*

8-507.D.7.a.v, Long-Range Planning

Exhibit 2 presents Denver Water's long-range plan, which is Denver Water's master plan. The Corps ROD summarizes the extensive capital improvement estimating that Denver Water completed and the Corps reviewed throughout the Final EIS review process. Table 1 of the Corps ROD shows the Project capital costs, including $187.9M of total capital construction costs and $0.4M of annual operations and maintenance costs.

8-507.D.7.b, Environmental Impact Analysis

8-507.D.7.b.i, Land Use

8-507.D.7.b.i.A, Conformance with Local Governments Planning Policies and Master Plans

Boulder County has zoned the Project area as Forestry, which permits rural land uses that include reservoirs, conserve forest resources, protect the natural environment, and preserve open areas (Boulder County 2005b). The Project is compatible with the existing zoning designation, therefore impacts to zoning at or adjacent to Gross Reservoir are not anticipated.

Winiger Ridge (W1/2 of Section 19, T1S R71W; S1/2 of Sections 13 and 14 and N1/2 of Sections 22, 23, and 24, T1S, R72W) is listed as a Natural Landmark in the Boulder County Comprehensive Plan (1999). Winiger Ridge is shown on Figure 24, Exhibit 1, View Protection Corridors Map. A Natural Landmark is defined as a prominent landscape feature designated for scenic, visual, and natural resource values. Upper and lower South Boulder Creek, including lands surrounding Gross Reservoir, are classified in the

Boulder County Comprehensive Plan—Open Space Plan Map as "Open Streamside Corridors" (Boulder County 2012). The intent of the Open Streamside Corridors classification is to ensure that natural water courses remain free from development. Under the Project, no areas of the Winiger Ridge Natural Landmark would be inundated. The Project would not impact Boulder County Parks & Open Space properties.

Gross Reservoir and its vicinity are also included in the Magnolia Environmental Preservation Plan (MEPP) planning area, which encompasses approximately 22 square miles in the mountain region west of Boulder, from Boulder Creek on the north, South Boulder Creek on the south, the Peak-to-Peak Highway on the west, and Gross Reservoir on the east. Initiated in 1997, the MEPP is a referral entity for the Boulder County Comprehensive Plan regarding land use decisions for the rural area surrounding Magnolia Road. The MEPP sets forth goals for scenic and rural character preservation.

Consistency with land use development in the Comprehensive Plan was addressed in Section E-2 of Attachment E-2 of Denver Water's FERC License Amendment Application by a thorough review of each of the Comprehensive Plan maps, which are also included in Exhibit 1 of this 1041 permit application. Section 8-511.B.14 includes additional discussion of consistency with the Comprehensive Plan.

Denver Water has conducted an independent review of the Comprehensive Plan to evaluate the Project's consistency with the County's plans. As part of the review, Denver Water compared the Project area and potential impacts with the resource maps included in the Comprehensive Plan. Based on this comparison, Denver Water has concluded that the Project is consistent with the Comprehensive Plan.

8-507.D.7.b.i.B, Agricultural Productivity Capability (SCS classification)

Existing land uses within the Project area include Gross Dam and Reservoir and associated maintenance facilities and recreation. The nearest mapped significant agricultural lands are more than four miles from Gross Reservoir as shown in Figure 14 in Exhibit 1, Significant Agricultural Lands Map. Agricultural land uses would not be affected by the Project.

8-507.D.7.b.i.C, Existing Easements and Rights-of-Way for Associated Transmission, Distribution or Collector Networks

The Project does not involve transmission, distribution, or collector networks. Therefore, this section is not applicable.

8-507.D.7.b.i.D, Additional Right-of-Way or Easements for New or Expanded Transportation Facilities

Figure 26-2 in Exhibit 1, Additional Right-of-Way or Easements Map, shows road improvements and easements for the Project.

8-507.D.7.b.ii, Water Resources

8-507.D.7.b.ii.A, Flood Hazard Areas

Flood hazard areas are addressed in Section 8-507.D.6 of this 1041 permit application.

8-507.D.7.b.ii.B, Surface Waters

Exhibit 1, Figure 7-3, Collection System Components, provides a map showing surface waters. Given the nature of the Project, this 1041 permit application includes extensive information on surface water, water quality, and channel morphology. Section 8-807.D.6.a provided Project impacts related to hydrology and floodplains, and this section describes the affected environment for these resources. This section also addresses channel morphology to provide Boulder County with relevant information to evaluate the related standards for approval in Section 8-511 later in this 1041 permit application.

The following surface water information and analysis was gathered for Denver Water's License Amendment Application to the FERC (Exhibit 5, Section 3.3.1). Note the discussion of Project effects related to surface waters and floodplains was presented above in Section 8-507.D.6.a.

AFFECTED ENVIRONMENT (SURFACE WATERS)

Gross Reservoir

The existing Gross Dam spans South Boulder Creek, thereby impounding its waters and those of its small tributaries, Winiger Gulch and Forsythe Canyon. Water delivered to upper South Boulder Creek via the Moffat Tunnel as part of the Moffat Collection System are also stored in Gross Reservoir. Water is released from Gross Reservoir to downstream South Boulder Creek and subsequently diverted to the South Boulder Diversion Canal for delivery to Ralston Reservoir, raw water customers, and the Moffat WTP.

The land surrounding Gross Reservoir is generally forested, with steep slopes that are 50 percent or greater in places; much of the reservoir lies within the Roosevelt National Forest. The reservoir lies in a deeply incised valley and, when filled to capacity, has a surface area of 418 acres. The drainage area at Gross Dam is 92.8 square miles. Normal annual precipitation at Gross Reservoir is 20.5 inches.

The existing dam crest elevation is 7,290 feet. At a surface elevation of 7,282 feet (the normal water elevation), storage capacity of the reservoir is 41,811AF. Historical Gross Reservoir water surface elevations and storage volumes are depicted in Charts 1 and 2, respectively.

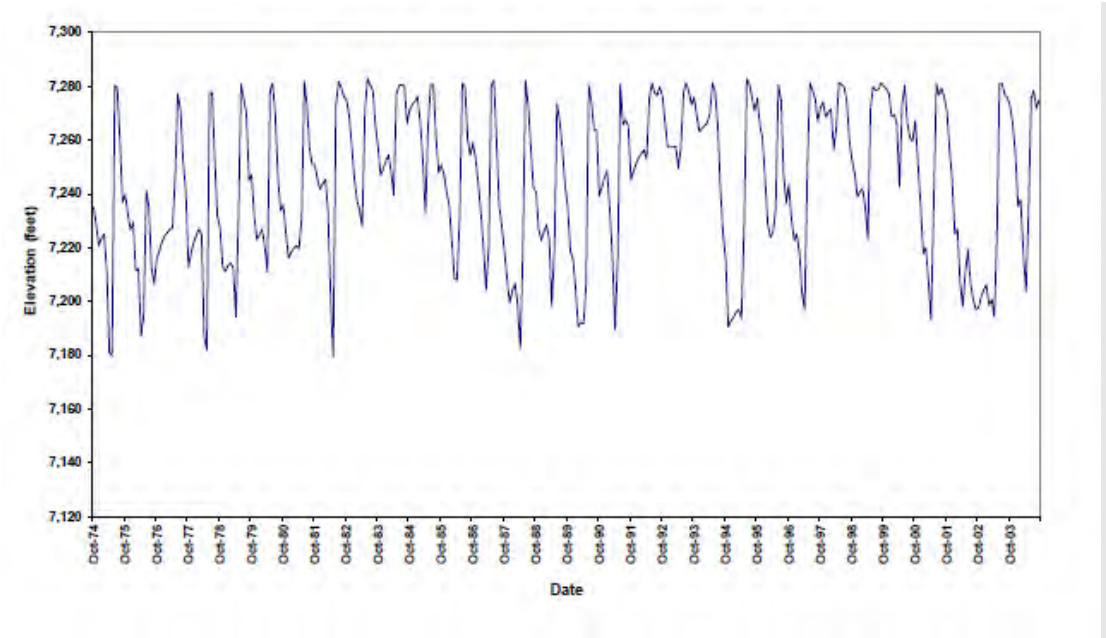

Chart 1: Gross Reservoir Historical End-of-Month Water Surface Elevation

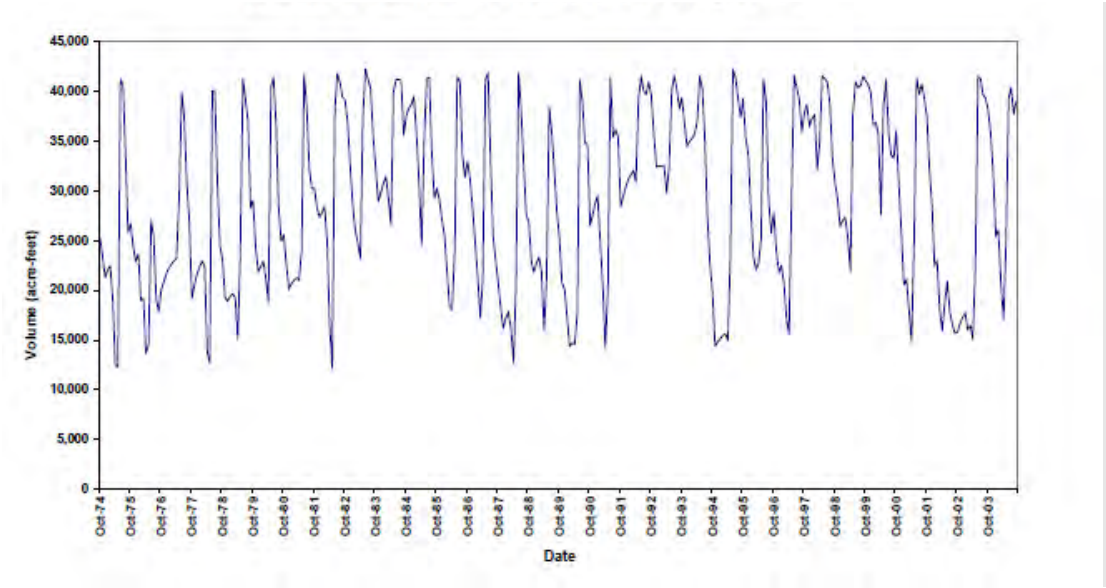

Chart 2: Gross Reservoir Historical End-of-Month Reservoir Storage Volumes

South Boulder Creek

Hydrology

South Boulder Creek is a tributary of Boulder Creek in the larger St. Vrain Creek Basin; the St. Vrain River flows into the South Platte River. South Boulder Creek drains the east side of the Continental Divide from Rollins Pass to James Peak, elevation 13,300 feet, and joins Boulder Creek on the plains east of Boulder at an elevation of approximately 5,175 feet.

Representative sampling sites and a reconnaissance site were selected to characterize the two affected stream reaches. The affected section of South Boulder Creek is from the East Portal of the Moffat Tunnel, into Gross Reservoir, to the South Boulder Diversion Dam about 3 miles west of Eldorado Springs. At this diversion dam, Denver Water diverts water to the South Boulder Diversion Canal for delivery to Ralston Reservoir, raw water customers, and the Moffat WTP.

The Project occupies land in the Roosevelt National Forest. There are no population centers other than the towns of Rollinsville and Pinecliffe. Both are located between the Moffat Tunnel East Portal and Gross Reservoir. There is relatively little water use within this reach; the Colorado SEO database shows a few small storage and diversion rights, several of which were apparently appropriated originally for ice making (CDWR 2005).

Numerous ditches divert water from South Boulder Creek where the stream leaves the foothills below Eldorado Springs. Historically, the South Boulder Creek ditches were established for irrigation, but, in recent decades, the municipalities of Louisville, Lafayette, and Boulder have purchased some of this agricultural water. The cities of Louisville and Lafayette each have pipeline diversions near Eldorado Springs.

Denver Water has water rights on South Boulder Creek, both at Gross Reservoir and on the South Boulder Diversion Canal, which are shown in Table 11. Releases from Gross Reservoir to the South Boulder Diversion Canal do not exceed 500 cfs, the capacity of the canal. Denver Water attempts to fill Ralston Reservoir by December 15, after which it typically shuts the diversion canal down until mid-March.

Table 11:
Denver Water South Boulder Creek Basin Water Rights at Existing Structures

Water Right	Appropriation Date	Amount
Gross Reservoir	May 10, 1945	41,811 AF
Gross Reservoir (conditional)	May 10, 1945	71,267 AF
South Boulder Diversion Conduit	January 1, 1930	461 cfs
South Boulder Diversion Conduit (conditional)	January 1, 1930	789 cfs

Notes: AF = acre-feet

Generally, these deliveries are made at a rate of 75 to 150 cfs. Denver Water has agreed to not divert South Boulder Creek water in the winter such that flows would fall below 7 cfs. However, by agreement with the Cities of Boulder and Lafayette, Gross Reservoir may release water from the 5,000-acre-foot environmental pool from November to April to maintain a flow of 7 cfs to the Boulder Creek confluence.

There is a Colorado Water Conservation Board (CWCB) minimum instream flow right on South Boulder Creek from the Gross Reservoir outlet to the South Boulder Creek near Eldorado Springs U.S. Geological Survey gage (Eldorado Springs gage) of 15 cfs from May through September and 6 cfs from October through April. Because this right is junior to Denver Water's storage and diversion rights, Gross Reservoir is not obligated to operate to satisfy the CWCB right.

South Boulder Creek Native Stream Flow

Native flows in upper South Boulder Creek from the East Portal of the Moffat Tunnel to Gross Reservoir are affected by Denver Water's transbasin diversions from the Fraser and Williams Fork rivers. Because there is relatively little water use within this reach of South Boulder Creek, hydrologic changes are due primarily to Moffat Tunnel deliveries. The average annual percentage of native flow added to this segment of South Boulder Creek is approximately 150 percent of the average annual native flow under current conditions. The average monthly percentage of flow added to this river segment is greatest during the fall and winter because native flows are typically lower during those months. In average years, the percentage of flow added to South Boulder Creek at the Pinecliffe gage ranges up to 419 percent in September.

Average monthly flows and Moffat Tunnel deliveries are 18.0 cfs and 75.5 cfs, respectively, in September. In wet years, the percentage of flow added to South Boulder Creek ranges up to 615 percent in September. Average monthly flows and Moffat Tunnel deliveries are 15.9 cfs and 97.6 cfs, respectively in September in a wet year. While the percentage of flow added to South Boulder Creek from the Moffat Tunnel is significant, the section of South Boulder Creek above Gross Reservoir has been modified to accommodate up to 1,200 cfs at the Pinecliffe gage (Corps 2014). During high runoff, Denver Water must limit Moffat Tunnel deliveries to meet this constraint. The Moffat Tunnel operates throughout the year, but, because there is very little storage on the West Slope Collection System, deliveries mirror natural runoff (i.e., they are highly concentrated during the runoff season and minimal in winter months).

The following water quality information and analysis, including water quality standards, for Gross Reservoir and South Boulder Creek was gathered for Denver Water's License Amendment Application to the FERC (Section 3.3.2). Note that Project impacts related to water quality are described below in Section 8-507.D.7.b.ii.c.

AFFECTED ENVIRONMENT (WATER QUALITY)

This section describes the affected environment for water quality in the Project area, including existing surface water quality conditions for Gross Reservoir and for South Boulder Creek downstream from the reservoir to the South Boulder Creek Diversion Canal. Available water quality information includes:

- Colorado Department of Public Health and Environment (CDPHE) Water Quality Control Commission (WQCC) Classification (CDPHE 2011b)
- State of Colorado's Section 303(d) List of Impaired Waters [303(d) List] and Monitoring and Evaluation List, per CDPHE Regulation 93 (CDPHE 2012a)
- Water quality data for various parameters (multiple sources)

- Location of wastewater treatment facilities and permitted discharge quantity into each basin (EPA 2010a)
- Potable water providers (EPA 2010b) that use surface water in each area.

The WQCC classifies stream segments according to “actual beneficial uses of the water.” WQCC classifications are defined as follows (CDPHE 2011a):

- Recreation Class E—Existing Primary Contact Use. These surface waters are used for primary contact recreation or have been used for such activities since November 28, 1975.
- Recreation Class P—Potential Primary Contact Use. These surface waters have the potential to be used for primary contact recreation.
- Recreation Class N—Not Primary Contact Use. These surface waters are not suitable or intended to become suitable for primary contact recreation uses.
- Recreation Class U—Undetermined Use. These are surface waters whose quality is to be protected at the same level as existing primary contact use waters but for which there has not been a reasonable level of inquiry about existing recreational uses and no recreation use attainability analysis has been completed.
- Agriculture. These surface waters are suitable or intended to become suitable for irrigation of crops usually grown in Colorado and which are not hazardous as drinking water for livestock.
- Class 1—Cold Water Aquatic Life. These are waters that (1) currently are capable of sustaining a wide variety of cold water biota, including sensitive species, or (2) could sustain such biota but for correctable water quality conditions.
- Class 1—Warm Water Aquatic Life. These are waters that (1) currently are capable of sustaining a wide variety of warm water biota, including sensitive species, or (2) could sustain such biota but for correctable water quality conditions.
- Class 2—Cold and Warm Water Aquatic Life. These are waters that are not capable of sustaining a wide variety of cold or warm water biota, including sensitive species, due to physical habitat, water flows or levels, or uncorrectable water quality conditions that result in substantial impairment of the abundance and diversity of species.
- Domestic Water Supply. These surface waters are suitable or intended to become suitable for potable water supplies. After receiving standard treatment (defined as coagulation, flocculation, sedimentation, filtration, and disinfection with chlorine or its equivalent) these waters will meet Colorado drinking water regulations and any revisions, amendments, or supplements thereto.

Stream segments in the Project area, with associated CDPHE regulations, are summarized in Table 12.

Table 12:
Stream Classifications in the Project Area

Basin	Stream Segment	CDPHE Stream Segment	CDPHE Stream Classification
South Boulder Creek	Mainstem of South Boulder Creek, including all tributaries and wetlands, from the source to the outlet of Gross Reservoir	Regions 3 and 4. Boulder Creek Segment 4a	Aquatic Life Cold 1
South Boulder Creek	Gross Reservoir	Regions 3 and 4. Boulder Creek Segment 15	Aquatic Life Cold 2
South Boulder Creek	Mainstem of South Boulder Creek, including all tributaries and wetlands, from the outlet of Gross Reservoir to South Boulder Road (except for small portions outside the Study Area)	Regions 3 and 4. Boulder Creek Segment 4b	Aquatic Life Cold 1

Source: (CDPHE 2011b)

The purpose of the CDPHE procedures and regulations for evaluating surface water quality is to ensure "the suitability of Colorado's waters for beneficial uses including public water supplies, domestic, agricultural, industrial, and recreational uses, and the protection and propagation of terrestrial and aquatic life. It is further intended to be consistent with the 1983 and 1985 goals and objectives of the Federal Act" (from Paragraph 31.2 of Regulation No. 31, CDPHE 2011a). As part of these procedures and regulations, CDPHE designates each stream segment as one of the following:

- **Outstanding Waters**—Waters that have the highest level of water quality protection. These waters have water quality better or equal to that listed in the regulations. These waters also are an outstanding natural resource such as a national park and the waters require protection beyond that provided by a reviewable designation. No stream segments potentially affected by the Project have this designation.
- **Use-Protected Waters**—Waters that do not warrant the special protection of outstanding waters or the anti-degradation review process. The level of water quality protection ensures that uses are maintained and protected. Use-Protected waters are allowed to degrade to the level of the water quality standards. No stream segments potentially affected by the Project have this designation.
- **Reviewable Waters**—Any water not designated as Outstanding or Use-Protected. This designation is intended to provide protection through a review of potential changes but also allows for changes when justified by economic or social need. All streams effected by the Project fall under this classification.

For Reviewable Waters, CDPHE has developed criteria for characterizing existing water quality, as well as for determining significant impacts to existing water quality. Specifically, existing water quality is defined and/or determined through the following parameters, per CDPHE documents (CDPHE 2001, CDPHE 2011a):

- CDPHE uses September 30, 2000, as the baseline date for water quality characterization. For purposes of this Project, existing water quality is based on data within the time period of 2000 to the time of the analysis (from 2007 to 2010, as noted below).

- Ambient water quality conditions are determined using the 85th percentile of representative data unless sufficient low flow data are available. If sufficient low flow data are available, then the 50th percentile of low flow data may be used. Data should be recent, within the last 5 years.
- For data to be considered sufficient, 15 or more samples should be available. Outliers should be handled by use of the 85th percentile and/or geometric mean, but professional judgment may also be used.
- Water quality data reported as “less than a numeric value”, “below detection limit (bdl)”, or “not detected” were converted to “0” for statistical purposes per CDPHE (CDPHE 2001). When the statistical result was “0,” that result is reported as “bdl.”
- The stream standard used for comparison to in situ water quality data was the chronic standard. The chronic standard is more stringent than the acute standard.
- For specific types of parameters, ambient water quality is determined through the following metrics (subject to availability of low flow data, as noted above):
    - Dissolved metals (85th percentile)
    - Total or recoverable metals (50th percentile)
    - Fecal coliform, Escherichia coli (E. coli) (geometric mean)
    - Dissolved oxygen (15th percentile)
    - pH (15th and 85th percentiles)
    - All others (85th percentile)

Ambient water quality is determined through the maximum weekly average temperature (MWAT) in a 3-year period, with the exclusion of values concurrent with maximum daily air temperatures greater than the 90th percentile of historical monthly temperature maxima for the chronic standard. The daily maximum (DM) is used for the acute standard, again with the exclusion of values concurrent with maximum daily air temperatures greater than the 90th percentile of historical daily temperature.

CDPHE Regulation 93 (CDPHE 2012a) provides the 303(d) List and the Monitoring and Evaluation List. The 303(d) List, Water-Quality-Limited Segments Requiring Total Maximum Daily Load (TMDL), “fulfills requirements of section 303(d) of the Federal Clean Water Act (CWA), which requires that states submit to the EPA a list of those waters for which technology-based effluent limitations and other required controls are not stringent enough to implement water quality standards” (CDPHE 2012a). The Monitoring and Evaluation List “identifies water bodies where there is reason to suspect water quality problems, but there is also uncertainty regarding one or more factors, such as the representative nature of the data. Water bodies that are impaired, but it is unclear whether the cause of impairment is attributable to pollutants as opposed to pollution, are also placed on the Monitoring and Evaluation List. This Monitoring and Evaluation List is a State-only document that is not subject to EPA approval” (CDPHE 2012a).

Water quality data were obtained in 2007 through both the U.S. Geological Survey (USGS) and Storage and Retrieval EPA Database (STORET) data searches. The statistical analyses are limited to data from 2000 to the present. The data were reviewed for statistical outliers prior to performing any statistical analyses. In cases where the value was recorded as “Non-Detect,” meaning below the detection level for that constituent, the data value was changed to a zero value to perform the statistical analysis (CDPHE 2001).

Existing water quality was characterized by comparing water quality data to the stream standards for the same locations. Hardness-based acute and chronic stream standards were calculated using the 15th percentile of hardness, and it was determined that use of the 15th percentile of hardness for a given sampling site provides a reasonable estimation of the lower values for hardness (which results in lower standards and conservative estimates). Additionally, use of the 15th percentile provides for consistency throughout the analysis.

Identification of potable water providers that use surface water or groundwater under the influence of surface water in potentially affected stream segments was done through EPA's Safe Drinking Water Information System (EPA 2009).

Wastewater treatment facilities and other long-term discharges with National Pollutant Discharge Elimination System (NPDES) permits were obtained from the EPA's Enforcement and Compliance History Online system (EPA 2010a).

Gross Reservoir

Gross Reservoir is within WQCC Segment 15 of the Boulder Creek Basin and is classified as Aquatic Life Cold 2, Recreation E, Water Supply, and Agriculture (CDPHE 2011b). Gross Reservoir is listed in CDPHE Regulation 93 on the Monitoring and Evaluation List for Aquatic Life Use due to mercury in fish tissue (CDPHE 2012a).

Water quality data for Gross Reservoir were obtained from Denver Water for two sampling sites, one near the inlet to Gross Reservoir and one near the dam (Denver Water 2009). The water quality data are summarized in Table 13, with the state standard shown where applicable. Gross Reservoir meets or exceeds state water quality standards.

Table 13:
Gross Reservoir Water Quality

Parameter	Statistics	Units	Value	Standard (Regulation 38)
Temperature	Maximum	° C	19.4 [101]	21.2
Dissolved Oxygen	15th Percentile	mg/L	9.9 [101]	7.0
pH	15th Percentile	SU	7.3 [101]	6.5
pH	85th Percentile	SU	7.9 [101]	9.0
Chlorophyll *a*	85th Percentile	µg/L	4.85 [6]	N/A
Secchi Depth	15th Percentile	meters	2.4 [6]	N/A
Conductivity	85th Percentile	µS/cm	62 [101]	N/A
Turbidity	85th Percentile	NTU	2.0 [88]	N/A

Notes: Numbers in brackets indicate the number of data points used in the calculation.

°C = degrees Celsius
µs/cm = microSiemens per centimeter
NTU = nephelometric turbidity unit
SU = standard unit
mg/L = milligrams per liter
µg/L = micrograms per liter
N/A = not applicable

Available data were reviewed to evaluate the current trophic state of Gross Reservoir. The EPA defines trophic state as an indication of the biological productivity of a lake, primarily in the form of algae (http://www.epa.gov/greatlakes/glossary/Glossary.html). Chlorophyll a concentrations in Gross Reservoir are generally low, ranging from 1.0 to 7.4 micrograms per liter (µg/L) in recent years, as shown in Chart 3 Gross Reservoir is currently a borderline oligotrophic/mesotrophic system, based on average summertime chlorophyll a concentrations compared to the Carlson Trophic Index (Carlson 1977).

Algae levels are low to moderate; chlorophyll a averages 3.6 µg/L. Water clarity, measured by Secchi disk depth, is moderate, averaging 3.4 meters, with a minimum of 2 meters. Based on equations relating phosphorus, chlorophyll a, and Secchi transparency, an average phosphorus concentration of 4 µg/L should yield an average chlorophyll a level of 2.1 µg/L and a maximum of 5.5 µg/L, with water clarity near 6.6 meters (Vollenweider 1982). At Gross Reservoir, fine inorganic particles may be present that would reduce water clarity, but only one slightly elevated turbidity value (11 nephelometric turbidity units [NTU]) was observed.

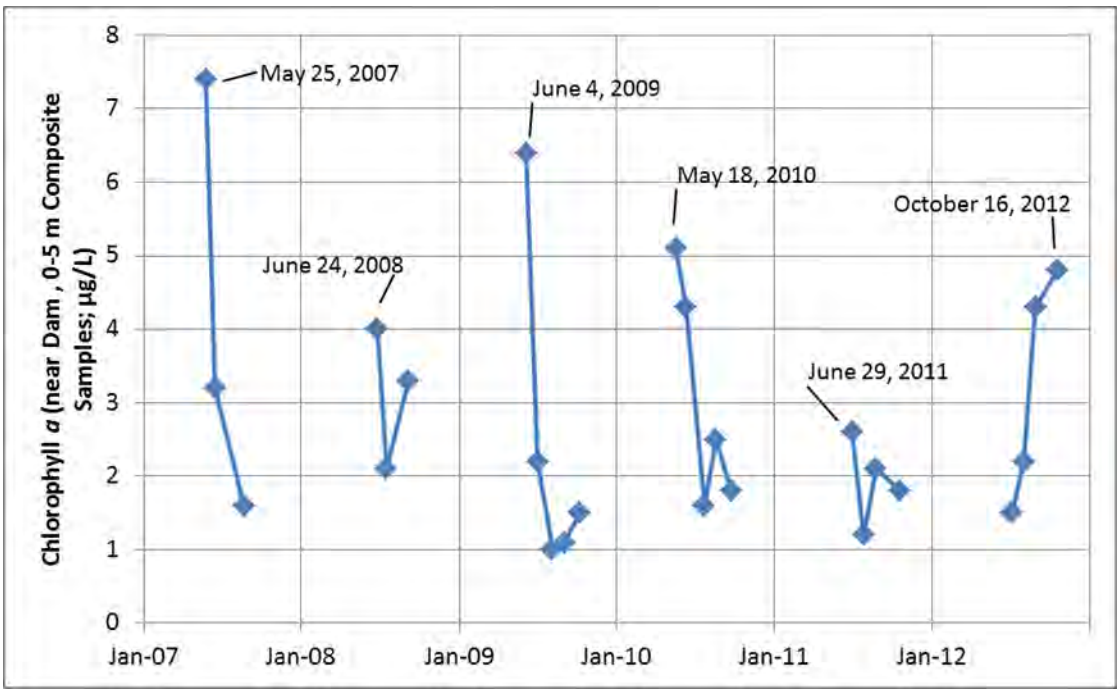

Chart 3: Chlorophyll a Concentrations Observed in Gross Reservoir, Peak Annual Concentration

Dissolved oxygen (DO) profile data are collected in Gross Reservoir; however, the profiles do not extend to the bottom of the reservoir at the location near the dam. Still, though the bottom of the profiles at this location tend to be tens of feet from the sediment-water interface, they are well within the hypolimnion and provide an indication of oxygen conditions at depth. The lowest concentration observed at the deepest point in the profile near the dam was 6.1 milligrams per liter (mg/L) on October 11, 2010, at a depth of 180 feet. Based on this and the relatively low productivity of the reservoir as indicated by low

chlorophyll a concentrations, it is assumed that low DO concentrations do not occur at the sediment-water interface.

When the reservoir is stratified, inflow waters enter the reservoir and move to the water column depth having a similar temperature and density. Simulated profiles of the water column adjacent to Gross Dam under current conditions are included in Chart 4. These profiles demonstrate summer stratification and fall turnover within the reservoir.

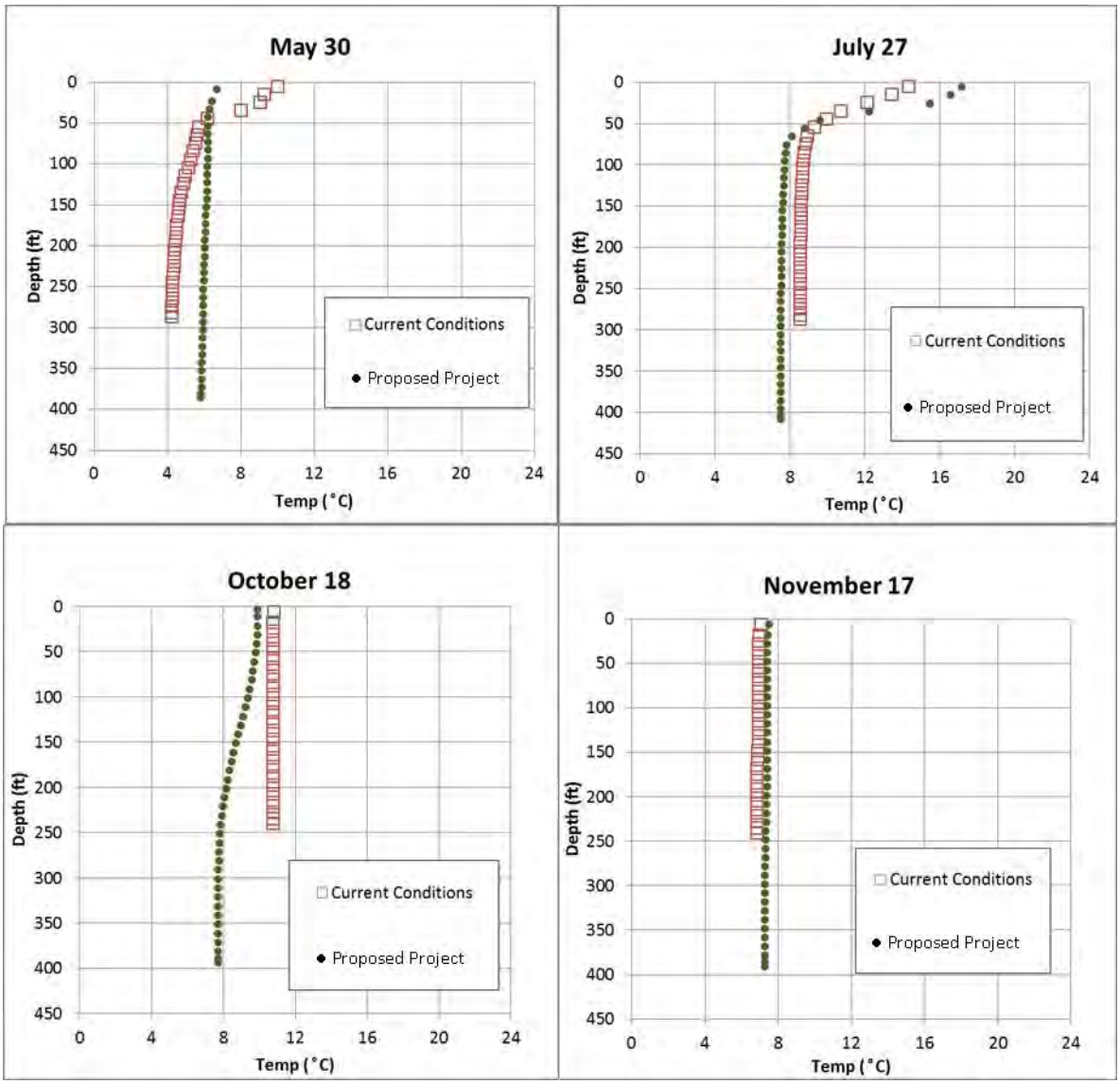

Chart 4: Simulated Profiles for 1971 with 2012 Meteorology, Gross Reservoir near Gross Dam

An analysis of observed upstream temperatures and continuous outflow temperatures indicates that reservoir outlet water tends to be cooler than inflow water (as measured at Pinecliffe) from roughly June through August/September (Hawley et al. 2013). The data also show that the reservoir tends to release water warmer than inflow water from September and October through early spring. This seasonal pattern reflects the effects of summer stratification and bottom withdrawals.

Gross Reservoir contains water of a quality suitable for virtually all uses. There is no evidence of deterioration in the hypolimnion during stratification, and minimum and maximum values for all assessed water quality variables are acceptable for a drinking water supply.

South Boulder Creek

The mainstem of South Boulder Creek in the Project area is designated WQCC Segments 4a and 4b of the Boulder Creek Basin (CDPHE 2011b). The Surface Water Classification for the mainstem of South Boulder Creek, including all tributaries lakes, reservoirs, and wetlands from the source to South Boulder Road, is Aquatic Life Cold 1, Recreation E, Water Supply, and Agriculture (CDPHE 2011b). No sections of the mainstem of South Boulder Creek are listed in the CDPHE Regulation 93 303(d) List or the Monitoring and Evaluation List (CDPHE 2012a).

Water suppliers that use South Boulder Creek include:

- Denver Water, including contract customers (via Gross Reservoir)
- Town of Erie (via South Boulder Canyon Ditch)
- City of Lafayette
- City of Louisville (at Eldorado Springs)
- San Souci Mobile Home Park (groundwater under the influence of surface water)
- Superior
- Eldora Mountain Resort

Of these water suppliers, only Eldora Mountain Resort diverts upstream of Gross Reservoir.

Wastewater dischargers to the mainstem of South Boulder Creek include:

- Union Pacific Railroad (UPRR) at the East Portal of the Moffat Tunnel, CO0047554, permitted discharge from the Moffat Railroad Tunnel of 0.5 mgd (upstream of Gross Reservoir)
- Eldorado Springs Wastewater Treatment Facility, CO047651, permitted discharge of 0.032 mgd (downstream from Gross Reservoir beyond the South Boulder Creek Diversion Canal)
- San Souci Mobile Home Park, COG588101, permitted discharge of 0.018 mgd.

Denver Water maintains water quality sampling sites above and below the Moffat Tunnel discharge to South Boulder Creek (Denver Water sample site WS-RL-018 and Denver Water sample site WS-RL-019, respectively). Data from these stations are included here because the upper site provides unaltered stream information and the downstream site provides information for the stretch of South Boulder Creek most likely to be potentially affected by the Project. Water quality data from these sites for 2005 to 2007

are shown in Table 14. Note that the downstream sampling site includes Denver Water deliveries through the Moffat Tunnel, plus UPRR permitted discharges from the Moffat Railroad Tunnel.

As indicated in Table 14, water quality measurements for many parameters are below detection limits. South Boulder Creek is within stream standards and drinking water standards, with few differences in measured water quality parameters upstream of and downstream from the Moffat Tunnel discharge to the stream.

Several constituents appear to differ between water in South Boulder Creek upstream and downstream from the Moffat Tunnel due to the influence of the imported water:

- Cadmium levels both upstream and downstream were very near the detection limit: four of nine upstream readings and five of nine downstream reading were below the detection limit. All samples are below the stream standard. Therefore, discharges from the Moffat Tunnel do not likely change cadmium concentrations significantly.
- As measured in “most probable number per 100 ml” (MPN/100 ml), the stream standard is 126. With geometric mean values of 0.8 and 2.1 MPN/100 ml the actual concentrations of E. coli at both locations are insignificant to the point of being negligible; the measured doubling in E. coli concentrations between South Boulder Creek upstream and downstream from the Moffat Tunnel is also likely not significant.
- Manganese is well below the stream standard at both locations. With 85th percentile values at less than 0.7 percent of the stream standard, the concentrations are insignificant, and the difference between upstream and downstream locations is likely not significant.
- Uranium is well below the drinking water standard of 30 µg/L at both locations, with 85th percentile values at less than 11 percent of the drinking water standard.

Table 14:
Water Quality Data for South Boulder Creek Upstream of and Downstream from Moffat Tunnel Delivery

Parameter	Statistic	Units	Above Moffat Tunnel[1]	Below Moffat Tunnel[2]	Standard[3]
Parameters with Stream Standards					
Arsenic, dissolved	85th Percentile	µg/L	bdl[4]	bdl	0.02 (total recoverable)
Boron, dissolved	85th Percentile	µg/L	2.0	2.0	750
Cadmium, dissolved	85th Percentile	µg/L	0.18	0.10	0.11
Chromium, dissolved	85th Percentile	µg/L	bdl	bdl	11[5]
Copper, dissolved	85th Percentile	µg/L	bdl	bdl	2
Dissolved oxygen	15th Percentile	mg/L	7.2	7.6	>7
E. coli	Geometric Mean	MPN/100 ml	0.8	2.1	126
Iron, dissolved	85th Percentile	mg/L	bdl	0.05	0.3
Lead, dissolved	85th Percentile	µg/L	bdl	bdl	0.36
Manganese, dissolved	85th Percentile	µg/L	1.6	6.4	925
Mercury, total	50th Percentile	µg/L	bdl	bdl	0.01
Nickel, dissolved	85th Percentile	µg/L	bdl	bdl	12

Table 14:
Water Quality Data for South Boulder Creek Upstream of and Downstream from Moffat Tunnel Delivery

Parameter	Statistic	Units	Above Moffat Tunnel[1]	Below Moffat Tunnel[2]	Standard[3]
pH	85th Percentile	SU	8.1	8.3	6.5-9.0
pH	15th Percentile	SU	7.4	7.3	6.5-9.0
Selenium, dissolved	85th Percentile	µg/L	bdl	bdl	4.6
Silver, dissolved	85th Percentile	µg/L	bdl	bdl	0.02
Temperature	Daily Maximum	º C	12	11	21.2
Zinc, dissolved	85th Percentile	µg/L	4.0	4.0	25
Parameters with Drinking Water Standards					
Aluminum, dissolved	85th Percentile	mg/L	0.03	0.10	0.05-0.2[4]
Antimony, dissolved	85th Percentile	mg/L	bdl[5]	bdl	0.006
Barium, dissolved	85th Percentile	µg/L	20	19	2,000
Beryllium, dissolved	85th Percentile	µg/L	bdl	bdl	4
Mercury, dissolved	85th Percentile	µg/L	bdl	bdl	2
Sodium, dissolved	85th Percentile	mg/L	1.8	3	20[6]
Thallium, dissolved	85th Percentile	µg/L	bdl	bdl	2
Fecal coliform	Geometric Mean	MPN/100 ml	27.9	29.5	TT[6]
Turbidity	85th Percentile	NTU	1.9	1.6	TT[6]
Uranium, dissolved	85th Percentile	µg/L	0.4	3.3	30
Parameters without Standards					
Alkalinity, total as $CaCO_3$	85th Percentile	mg/L	22	27	N/A
Antimony, total	50th Percentile	µg/L	bdl[3]	bdl	N/A
Barium, total	50th Percentile	µg/L	17	16	N/A
Boron, total	50th Percentile	µg/L	2	2	N/A
Calcium, dissolved	85th Percentile	mg/L	7	8	N/A
Cobalt, dissolved	85th Percentile	µg/L	bdl	bdl	N/A
Hardness as $CaCO_3$	85th Percentile	mg/L	30	28	N/A
Magnesium, dissolved	85th Percentile	mg/L	3.0	2.4	N/A
Molybdenum, dissolved	85th Percentile	µg/L	bdl	bdl	N/A
Phosphorus, total as P	85th Percentile	mg/L	0.02	0.02	N/A
Potassium, dissolved	85th Percentile	mg/L	0.4	0.7	N/A
Silicon, dissolved	85th Percentile	mg/L	2.6	4.4	N/A
Specific conductance	85th Percentile	µmhos/cm	60	69	N/A
Total Suspended Solids	85th Percentile	mg/L	bdl	bdl	N/A
Vanadium, dissolved	85th Percentile	µg/L	bdl	bdl	N/A

Table 14:
Water Quality Data for South Boulder Creek Upstream of and Downstream from Moffat Tunnel Delivery

Parameter	Statistic	Units	Above Moffat Tunnel[1]	Below Moffat Tunnel[2]	Standard[3]

Notes:
All calculations used nine sample points.
1 Denver Water sample site WS-RL-018, data from 2005 to 2007.
2 Denver Water sample site WS-RL-019, data from 2005 to 2007.
3 Stream standard is per Regulation No. 38. Where the standard is "TVS," a hardness of 17.6 mg/L (the 15th Percentile) was used in the TVS formula. Some parameters also have Drinking Water Standards set by CDPHE/EPA. Only Stream Standard is listed in this table. Drinking Water Standard as listed on the EPA's website and includes primary, secondary, and advisory standards.
4 Per the methodology, bdl was reported when statistic results in value of "0," per CDPHE website.
5 Stream Standard is for chromium VI, while data are for total dissolved chromium.
6 TT related to drinking water standards for testing, percent removal, and specific treatment methods.
CDPHE = Colorado Department of Public Health and Environment
EPA = U.S. Environmental Protection Agency

° C = degrees Celsius
ml = milliliters
µg/L = micrograms per liter
mg/L = milligrams per liter
µmhos/cm = micromhos per centimeter
NTU = nephelometric turbidity unit
$CaCO_3$ = calcium carbonate
Bdl = below detection limit
N/A = not applicable
MPN = most probable number
TT = Treatment Technique
TVS = table value standard
SU = standard unit

Historically, the average Moffat Tunnel releases contribute between 46 and 78 percent of the total stream flow at the SH 72 bridge (sampling site No. 124), which is downstream from the Moffat Tunnel discharge. By supplementing upper South Boulder Creek native flows, Moffat Tunnel water imports provide dilution for the UPRR discharge from the Moffat Railroad Tunnel.

AFFECTED ENVIRONMENT (CHANNEL MORPHOLOGY)

The characterization of existing conditions of streams within the Project area that may be affected by implementation of the Project provides the basis from which responses to potential flow alterations are compared in the analyses of environmental effects.

The channel morphology assessment considers a stream's ability to transport flows and sediment. Stream systems naturally adjust to achieve a balance between flow, sediment transport capacity, and sediment supply, process known as channel dynamics. A stream experiences changes in the bed elevation and bank alignment on a continual basis. Natural streams include areas where aggradation occurs and where degradation occurs. Aggradation is most common in lower-gradient areas and in areas where flow velocity is reduced. Examples typically include inside bends, behind larger flow obstructions such as logs and boulders, on bars, and upstream of any flow restrictions. Degradation, including bank erosion, is a natural process that typically occurs along outside bends and in locations where bed and bank materials are smaller and, hence, more prone to erosion. Stream channel dynamics may be affected by many factors, including land usage changes and increases or decreases in stream flow or sediment production.

Stream flows in the Project area have been altered historically as a result of water depletion and augmentation practices. Existing conditions were evaluated to define whether streams are currently stable or whether they are undergoing changes in response to flow variations. A stable stream system is one that conveys water and sediment while maintaining its general shape (width and plan form) over time without long-term trends of aggrading or degrading. Signs of an unstable stream subjected to flow reductions would typically be channel narrowing and bed aggradation that persist over an extended number of years, causing a long-term change in the overall stream morphology. Unstable streams that experience flow increases would typically show signs of excessive bed and bank erosion leading to channel widening and downcutting.

Existing channel conditions are described based on detailed field assessment at representative sites, evaluation of existing data at reconnaissance sites, and precursory field assessments at selected sites of special interest, including locations downstream from Denver Water's diversion points.

Gross Reservoir

Because Gross Reservoir does not itself involve channel morphology, geomorphological conditions within Gross Reservoir are not described.

South Boulder Creek

As part of the larger channel morphology analysis conducted to support the Corps Final EIS (Corps 2014), detailed data were collected at representative sites selected based on a preliminary level assessment of stream types, accessibility, stream flow data availability, site investigations, and diversion practices. The sites were selected to obtain specific information to represent similar stream types present in the affected drainage basin. Data obtained from the representative sites were also compared to existing information gathered at other reconnaissance sites to evaluate whether data obtained from the representative sites were typical of the basin.

To select representative stream sites, a desktop study was completed to determine the Level I Rosgen stream type of all affected stream segments that would experience average annual flow changes greater than 10 percent. These stream segments were selected to focus the selection of representative stream sites and field work in areas that would experience the greatest flow change.

The Rosgen stream classification system is a widely used technique that defines nine Level I stream types on the basis of geomorphic characteristics including channel slope, sinuosity, valley type, width/depth ratio, and entrenchment; Level I stream types are identified by letters as depicted in Chart 5 (Rosgen 1994). The classification system further integrates geomorphic pattern with predominant bed material to define 42 Level II stream types, identified by letters and numbers, such as B3, C3, and C4 (Rosgen and Silvey 1998). Numbers 1 through 6 are used to sequentially describe bedrock, boulders, cobble, gravel, sand, and silt and clay as the predominant bed material.

It should be noted that the Level I stream classifications completed for this assessment were defined based on desktop analysis of large regions where stream slope and sinuosity were determined. Entrenchment and width/depth ratios were not determined from this analysis, thereby limiting the detail of results. Stream types were therefore defined based primarily on slope. Detailed investigations completed

for evaluation of representative sites occasionally revealed slightly different stream types than described in topographic mapping.

Hydraulic data collected at each sampling site include stream discharge, velocity, channel geometry, and water surface elevations. The channel bankfull width and depth were calculated from survey data. A Hydrologic Engineering Centers-River Analysis System (HEC-RAS) hydraulic model was developed for each sampling site. The HEC-RAS hydraulic models were used to generate water surface profiles and other hydraulic output as a function of discharge for each site.

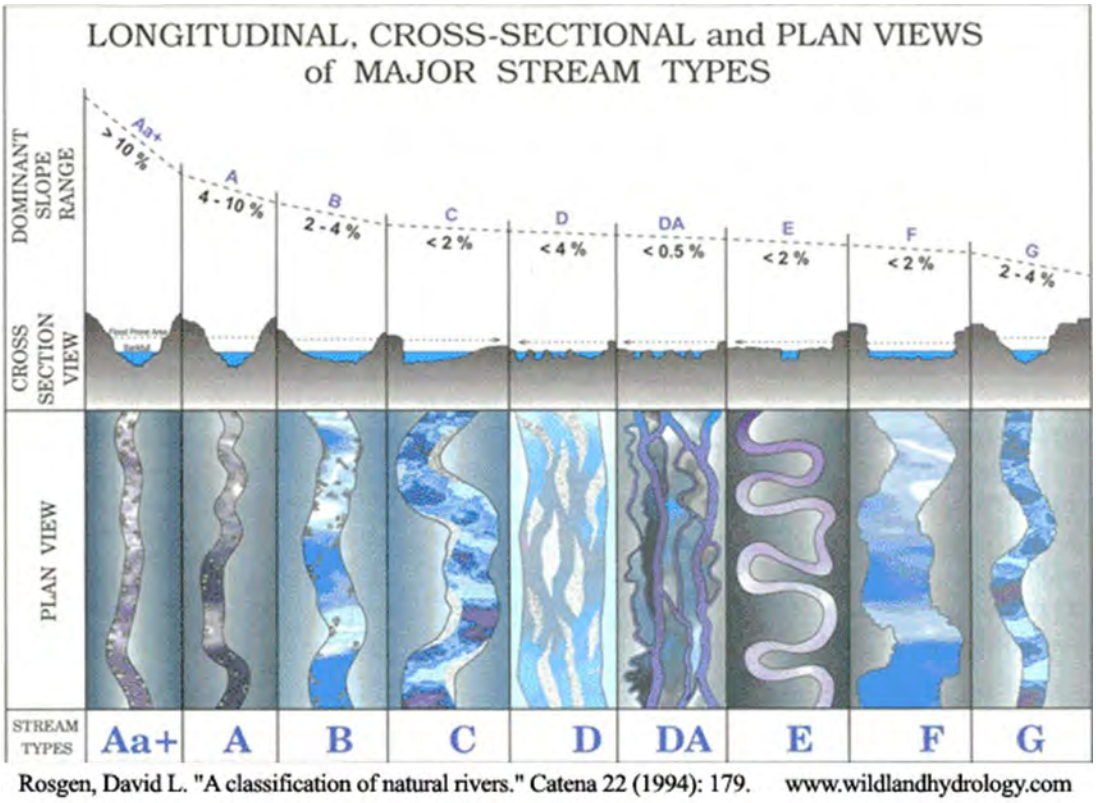

Chart 5: Stream Classification System

Surface sediment samples were collected using a variation of the Wolman pebble count method. A sediment sampling frame, which has been shown to reduce sampling bias, was utilized, with selected material measured using a gravelometer following procedures outlined in *Sampling Surface and Subsurface Particle-Size Distributions in Wadable Gravel- and Cobble-Bed Streams for Analysis in Sediment Transport, Hydraulics, and Streambed Monitoring* (Bunte and Abt 2001). The surface sediment samples were used to develop particle-size distributions for each site.

Using the Rosgen Level I classification, characteristics to be represented by sampling sites were determined. Representative sites were then selected on the basis of field observations, natural quality of

the site (similarities with other areas), hydraulic modeling potential, and accessibility as a means to obtain specific information for most of the stream types present in an affected drainage basin.

The affected South Boulder Creek stream reaches are from the Moffat Tunnel outflow downstream to Gross Reservoir and from Gross Reservoir downstream to the South Boulder Creek Diversion Canal.

The South Boulder Creek stream reach from the Moffat Tunnel outflow to downstream of Gross Reservoir is 16.1 miles long, and its slope varies from 0.013 to 0.052 feet per foot, as measured from 7.5 minute digital topographic maps. It is characterized as Rosgen Level I Stream Type A (14 percent), Stream Type B (12 percent), and Stream Type C (74 percent).

The affected South Boulder Creek stream reach from Gross Reservoir to the South Boulder Creek Diversion Canal is 8 miles long, and its slope is 0.091 feet per foot, as measured from 7.5 minute digital topographic maps. It is characterized as Rosgen Level I Stream Type A.

Two representative sites were selected on South Boulder Creek for surface sediment sampling and surveying: a Type F channel reach above Rollinsville (SBC1) and a Type B reach below Gross Reservoir (SBC3). Observed and measured characteristics of the SBC1 and SBC3 representative sampling sites are summarized in Table 15.

The following general observations were recorded at the representative sampling sites on South Boulder Creek above and below Gross Reservoir:

- Minimal amounts of fines were observed.
- Coarse sand to fine gravel is stored in the bed below Gross Reservoir (SBC3).
- Banks are generally stable with localized sloughing observed.
- The median grain size (170 mm, large cobble) is larger at the site above Gross Reservoir (SBC1) than at the site below Gross Reservoir (SBC3) (110 mm, small cobble).

South Boulder Creek above Gross Reservoir (Representative Sampling Site SBC1)

SBC1 is located on South Boulder Creek above Gross Reservoir approximately 2 miles upstream of Rollinsville.

The SBC1 site is 599 feet long with an average slope of 0.0180 feet/foot and a sinuosity of 1.00 over the length of the reach evaluated. Average bankfull width and depth at the site are 42.4 feet and 2.28 feet, respectively. The maximum bankfull depth is 3.66 feet. The bed material is predominantly cobble and boulders. Minimal amounts of sand are stored in the bed, and small quantities are stored along the banks where velocities were lowest. Moderate to considerable amounts of organic matter were observed on streambed sediments, particularly along the banks. Based on visual observations of the reach and predominant bed material, SBC1 is characteristic of a Rosgen F3 to F2 stream type.

The entire SBC1 reach is characterized by fast riffle-type flow. No woody debris was observed in the channel. The banks throughout the reach are predominantly vertical or very steeply sloped and are composed of cobbles and, in some places, bare soil. Banks are mostly vegetated by herbaceous species,

as well as willows and some coniferous trees. Throughout the reach, the banks were observed to be stable, with some localized instabilities. The reach is confined between the Moffat Tunnel Road and the UPRR tracks, with high terraces on both sides of the channel. This condition exists for the entire reach, and it is suspected that stream banks have been stabilized in the past. Banks are stable and vegetated.

Sediment sampling was conducted at four cross sections at the SBC1 site; all particles collected at the four cross sections were combined into one sample for the site. Because the reach is essentially uniform in water flow pattern, cross sections were selected at evenly spaced intervals throughout the reach. A total of 217 particles were collected, and, based on the particle size distribution, the median grain size was determined to be approximately 170 mm (large cobble; Table 15).

Table 15:
Attributes of Representative Sampling Sites on South Boulder Creek

Representative Sampling Site	Attributes									
	Rosgen Stream Type	Reach Length (feet)	Reach Slope (feet per foot)	Sinuosity	Bankfull Width (feet)	Average Bankfull Depth (feet)	Maximum Bankfull Depth (feet)	Entrenchment Ratio	Median Grain Size-d50 (mm)	Observations of Erosion
South Boulder Creek above Gross Reservoir (SBC1)	F3 to F2	599	0.0180	1.00	42.4	2.3	3.7	1.4	170	Minimal sand stored in bed with moderate amounts in banks. Banks are steeply sloped to vertical. Banks are generally stable with local sloughing observed.
South Boulder Creek below Gross Reservoir (SBC3)	B1 to B3	446	0.0258	1.08	61.8	2.0	3.3	2.3	110	Substantial coarse sand to fine gravel stored in the bed, but aggradation not likely. Banks are generally stable with local sloughing observed.

Notes:
Sinuosity calculated over the representative reach length only and may understate overall sinuosity.
mm = millimeter

South Boulder Creek above Gross Reservoir (Reconnaissance Site SBC-Recon 1)

A “reconnaissance” site on South Boulder Creek above Gross Reservoir and below Pinecliffe (SBC-Recon 1) was also evaluated. Data for SBC-Recon 1 are summarized in Table 16.

Table 16:
Attributes of Reconnaissance Site SBC-Recon 1 on South Boulder Creek above Gross Reservoir

Site Location	South Boulder Creek Basin				
	Site ID	Slope (feet per foot)	Bankfull Width (feet)	Median Grain Size-d50 (mm)	Stability Observations
South Boulder Creek below Pinecliffe	SBC-Recon 1	0.0246	N/A	N/A	Channel generally stable due to coarse bed material, vegetated banks, and past channel stabilization work.

Notes:
ID = identification
mm = millimeter
N/A = not applicable

The following general observations were recorded at the South Boulder Creek reconnaissance site:

- The channel is generally stable, in part due to past stabilization efforts.
- Banks are vegetated, and channel and bed materials are large.

South Boulder Creek below Gross Reservoir (Representative Sampling Site SBC3)

SBC3 is located on South Boulder Creek approximately 1 mile downstream from Gross Reservoir.

The SBC3 site is 446 feet long, with an average slope of 0.0258 feet/foot and a sinuosity of 1.08 over the length of the reach evaluated. Average bankfull width and depth at the site are 61.8 and 1.95 feet, respectively; the maximum bankfull depth is 3.25 feet. The bed material is predominantly cobble and boulders, with large areas of bedrock outcrops. Substantial amounts of coarse sand and fine gravel are present in the stream bed. No signs of long-term aggradation or degradation were consistently observed throughout the reach. Based on visual observations of the reach and predominant bed material, SBC3 is characteristic of a Rosgen B2 to B1 stream type in the upstream portion and a B2 to B3 stream type in the downstream portion.

The upstream half of the SBC3 reach is characterized by low gradient steps in bedrock punctuated by riffle flow, and the downstream half of the reach is characterized by a narrower low flow area through cobbles. Moderate amounts of woody debris were observed in the channel at the upstream extent of the reach. The right bank throughout the reach is predominantly grassy, gradually sloped, and adjacent to a riparian area. The left bank is generally steep below a hill slope vegetated by ponderosa pine trees. Throughout the reach, the banks were observed to be stable, with some localized instabilities consistent with an overall stable channel.

Sediment sampling was conducted at three cross sections at the SBC3 site; all particles collected at the three cross sections were combined into one sample for the site. Cross sections were selected according to reach characteristics representing flow through bedrock and cobbles. A total of 197 particles were collected, and, based on the particle size distribution, the median grain size was determined to be approximately 110 mm (small cobble).

Summary

Channel banks were noted to be generally stable in the two representative sites although localized bank erosion was noted. Coarse sand and fine gravel were observed to be stored in the bed at the representative site below Gross Reservoir, but aggradation was not noted at this or the site above Gross Reservoir. Bank stabilization efforts have occurred at some locations and have helped to stabilize banks on South Boulder Creek.

PROJECT EFFECTS (CHANNEL MORPHOLOGY)

Predicted changes in stream morphology resulting from the Project have been assessed by comparing the Project with the existing system at full use.

Detailed data were collected at representative sites selected on the basis of a preliminary level assessment of stream types, accessibility, stream flow data availability, site investigations, and diversion practices. Anticipated impacts were quantified using the numeric approaches outlined for the various parameters, as described below. Annual sediment transport capacity, sediment supply, the threshold for and frequency of Phase 2 sediment transport, the magnitude of peak flood events, and effective discharge were calculated for the Project compared with the existing system at full use to assess potential impacts.

Implementation of the Project would result in different flow conditions than would be experienced with the existing system at full use. Differences in flows have the potential to result in changes in stream morphology. Therefore, anticipated flows under the Project were evaluated for the channel morphology assessment. All calculations are based on the daily flow data derived from the 45 years of daily PACSM output. Daily data were compiled in a variety of ways as required for the specific calculations performed.

Gross Reservoir

The Project includes 77,000 AF of new storage in Gross Reservoir (with the Environmental Pool). Channel morphology would not be impacted by construction activities at Gross Reservoir, and, therefore, impacts to channel morphology associated with the Project component were not evaluated. Rather, analysis focused on potential impacts to channel morphology associated with flow changes in the downstream affected stream reach of South Boulder Creek.

South Boulder Creek

Annual Sediment Transport Capacity

Total sediment transport can be separated into two general classes: bedload and suspended load. Bedload is the portion of grains that are transported along or near the bed of the stream by sliding, rolling or “hopping.” Suspended load includes grains that are picked up off the bed and move through the water column. In many streams, grains sizes smaller than about one-eighth mm tend to always travel as suspended load, and grains coarser than about 8 mm always tend to travel as bedload. Grains between one-eighth mm and 8 mm travel as either bed load or suspended load (Wilcock et al. 2009).

References to sediment transport capacity (a stream’s ability to move sediment) in this analysis refer to bedload transport capacity only. While suspended load typically accounts for a majority of total sediment

load, bedload is the parameter that is most relevant for the evaluation of channel morphology in gravel-bed rivers (Schmidt and Potyondy 2004). Because suspended load was not calculated, the estimates of annual sediment transport capacity given here understate the actual total sediment transport capacity.

Bedload capacities are predicted to be reduced the most in areas where flow reductions are greatest and increase the most in areas with the largest increase in flows.

Annual bedload sediment transport capacity was determined at the representative sites for the affected reaches of South Boulder Creek (SBC1 and SBC3) using four transport equations. Calculations based on bedload exclude suspended sediment, which typically comprises a majority of the total sediment transported. Given the uncertainty in numeric results from any of the individual transport equations, comparing results derived from the four different equations is intended to provide an indication of the range of transport capacity expected under the Project. Results of annual bedload transport capacity for the Project and for the existing system at full use are presented in Table 17.

Large disparities in the calculated bedload transport capacity utilizing the different equations illustrate significant uncertainty in defining actual capacity. The following conclusions can be drawn from the calculated transport capacity results shown in the table:

- The order of magnitude of transport capacity calculated using the Parker (1990) and the Wilcock and Crowe (2003) equations are generally the same.
- Transport capacity calculated using the Yang equation is typically an order of magnitude greater than that calculated using the Parker or the Wilcock and Crowe equations.

Table 17:
Calculated Annual Bedload Transport Capacity of South Boulder Creek under the Project Compared with the Existing System at Full Use

Site	Equation	Existing System at Full Use (tons per year)	Project (tons per year)
SBC1	Parker	6	10
	W-C	12	20
	Yang	26,088	29,581
	MPM	187,714	197,204
SBC3	Parker	3,023	1,343
	W-C	374	178
	Yang	22,999	22,232
	MPM	506,938	573,402

Transport capacity calculated using the 1948 Meyer-Peter and Müller (MPM) equation is the largest, often exceeding values calculated using the Yang equation by an order of magnitude.

Transport capacity calculated using the Parker and the Wilcock and Crowe equations often produce results that are unreasonably low and that contradict observed conditions. Extreme examples of this, where results indicate that the stream has the capacity to move less than 15 tons per year (tpy) of

bedload, have been observed at other sites on South Boulder Creek that would not be affected by the Project. Were these results to be accurate, large amounts of sediment would be accumulating and bed deposition would have occurred, neither of which has been observed based on direct observation or results of aerial and gage data analysis. For these reasons, results of the Parker and the Wilcock and Crowe equations are believed to underestimate sediment transport for at least some locations.

Given the range of results obtained from this numeric analysis and the uncertainty associated with any one equation, it is difficult to accurately predict the absolute sediment transport capacity value at the representative sites. It is, however, possible to use the numeric data to determine the relative change in calculated transport capacity because the percent change is generally independent of the specific equation used. (In case sites where the percentage change predicted by the different equations results in a wider range of values, the wide range is usually attributable to one or more equations predicting a very low annual transport capacity.) The percent change in annual transport capacity was therefore calculated in relation to the capacity at the existing system at full use as a means of quantifying potential impacts.

Percent change was determined for each of the four transport equations as the ratio of transport capacity under the Project to the transport capacity for the existing system at full use. The range, mean, and standard deviation of the percent change from the different equations were also determined. This metric provides an indication of the change in transport capacity that is expected when the Project is compared with the existing system at full use.

Bedload transport capacity in South Boulder Creek above Gross Reservoir is predicted to increase by approximately 38 percent under the Project when compared to the existing system at full use given the predicted release patterns.

Bedload transport capacity in South Boulder Creek below Gross Reservoir is predicted to decrease by approximately 25 percent under the Project when compared to the existing system at full use given the predicted release patterns. The decrease in bedload transport capacity is the result of the way releases from the reservoir would be managed. Under the Project, reservoir releases would increase during low-flow periods and decrease during peak flow months when compared to the existing system at full use. A reduction in releases during peak months, when the majority of bedload transport occurs, is the cause of the decrease in transport capacity.

Calculated bedload transport capacities follow anticipated trends, i.e., bedload capacities are predicted to be reduced the most in areas where flow reductions are greatest and increase the most in areas with the largest increase in flows.

Sediment Supply

The bedload component of sediment supply is largely derived from sediment from within the channel that is mobilized in response to larger flow events. Changes in flow resulting from the Project would, therefore, be expected to change bedload sediment in the streams. Decreases in predicted flows would be expected to reduce bedload supply and increases in predicted flows would be expected to increase bedload supply.

Changes in sediment transport were estimated for the representative sampling sites using sediment supply equations and predicted flow duration data for the Project. The calculated sediment supply in South Boulder Creek upstream of Gross Reservoir is predicted to increase from approximately 3,500 to 4,000 tpy (approximately 15 percent) when compared with the existing system at full use. Calculated sediment supply in South Boulder Creek downstream from Gross Reservoir is predicted to increase from approximately 4,500 to 4,700 tpy (approximately 4 percent) when compared to the existing system at full use.

The calculated sediment supply of South Boulder Creek below Gross Reservoir under the Project does not follow anticipated trends related to flow changes, i.e., that supply is predicted to be reduced in areas of flow reduction and to be increased in areas of flow increase. Trends anticipated in sediment supply generally mimic predicted changes in bedload transport capacity because both are influenced by flow changes in the same way.

Phase 2 Sediment Transport

Sediment transport can be considered as having two phases. In Phase 1, sand and finer material is typically transported from within the channel bed armor, with transport occurring at a relatively low rate. During this phase, transport is typically limited by sediment supply (Schmidt and Potyondy 2004). During Phase 2 transport, sediment transport transitions to a much higher rate and includes sands and coarse gravel as the channel bed itself is disturbed by flows. Phase 2 sediment transport occurs when flows are great enough to mobilize the channel bed and transport bed-sized particles.

Phase 2 sediment transport has the greatest impact on channel morphology. The purpose of the Phase 2 transport analysis is to define the flows where the bed of the channel is disrupted, thus mobilizing the channel itself. The onset of Phase 2 sediment transport is of particular interest as this is the flow that is required to rejuvenate the channel bed and achieve channel maintenance objectives (Schmidt and Potyondy 2004). The magnitude of flow required for the onset of Phase 2 sediment transport is a function of channel geometry and bed gradations and is not dependent on flow frequency; therefore, the flow required to initiate Phase 2 transport is the same for the Project and the existing system at full use.

The magnitude of flow required for the onset of Phase 2 sediment transport was calculated for the representative sites for the affected reaches of South Boulder Creek (SBC1 and SBC3) based on the measured D_{16} material size observed at the site (coarse gravel). The recurrence interval, amount of time that flows equal or exceed the Phase 2 flow, and maximum number of years between flow events large enough to cause Phase 2 transport were calculated based on the anticipated hydrology using daily PACSM data. The results, which are presented on Table 18, were compared with the existing system at full use to quantify potential effects of the Project (Corps 2014).

Table 18:
Calculated Phase 2 Sediment Transport of South Boulder Creek under the Project Compared with the Existing System at Full Use

Site	D16 (mm) (Size Class)	$Q_{Phase\ 2}$ (cfs) (Parker/W-C)	Alternative	Recurrence Interval (years) (Parker/W-C)[1]	Frequency Phase 2 Flow is Equaled or Exceeded (Parker/W-C) (% of days)	Maximum Duration between Phase 2 Flows (years) (Parker/W-C)
SBC1	48 (very coarse gravel)	N/A / 973	Full Use	N/A / 4	N/A / 0.26	N/A / 17
			Project	N/A / 3	N/A / 0.38	N/A / 7
SBC3	22 (coarse gravel)	385 / 385	Full Use	1 / 1	14.5 / 14.5	0 / 0
			Project	1 / 1	8.7/ 8.7	1 / 1

1 Using the Parker equation, the flow required to initiate Phase 2 transport is greater than the upper bound flow at SBC1; therefore, the flow was undetermined. This is a result of the relatively large size of the D16 material. Flows, recurrence intervals, and frequencies presented for SBC1 are therefore based solely on results from the Wilcock and Crowe equation.

Results for the Project were compared with results for the existing system at full use to assess how flow alternations would change the frequency of and duration between Phase 2 transport flows.

At SBC1, flows necessary to initiate Phase 2 transport are predicted to occur with a recurrence interval of 4 years under the existing system at full use. Under the Project the recurrence interval is predicted to decrease to 3 years. Calculated flows required to initiate Phase 2 sediment transport were predicted to be greater at the upstream site (SBC1) than at the lower site (SBC3). This is the result of the larger substrate size at SBC1. At SBC1, Phase 2 transport is expected to occur for an average of approximately 1 day per year with the existing system at full use and under the Project. The longest interval between Phase 2 transport events is predicted to be approximately 17 years with the existing system at full use and to decrease to 7 years under the Project.

At SBC3, flows necessary to initiate Phase 2 transport are predicted to occur with a recurrence interval of 1 year under both the existing system at full use and the Project. Flow initiating Phase 2 transport is predicted to be equaled or exceeded approximately 53 days per year (14.5 percent of days) with the existing system at full use, and this frequency is predicted to decrease to approximately 32 days per year (8.7 percent of days) under the Project. This decrease in the frequency of Phase 2 flows is a result of flow reductions during peak flow periods due to planned operations of Gross Reservoir where less flow would be released during traditional peak flow periods. For the existing system at full use, flows necessary for Phase 2 transport are predicted to occur every year, while under the Project, the longest interval between Phase 2 transport events is predicted to be approximately 1 year.

Changes in the predicted frequency and the duration between flows causing Phase 2 sediment transport in South Boulder Creek generally follow anticipated trends related to flow changes, wherein the frequency of Phase 2 sediment transport flows is positively related to flow and the recurrence interval is negatively related to flow.

Five-Year and Ten-Year Flood Events

Based on previous findings, it is believed that maintaining infrequent, peak flood flows such as the 5-year and 10-year flood may be critical to maintaining channel morphology (Ryan 1997). This research, which included streams in the Project area, suggests that channel widths downstream of diversions are maintained if these less-frequent, high-magnitude flows are preserved. Observed changes to channel morphology downstream of diversions are generally limited to unconstrained, wide, pool-riffle stream reaches with cobble bars; changes were typically not observed in other types of stream reaches. The absence of observed changes in channel morphology is attributed to the preservation of high-magnitude, low-frequency flood events such as the 5-year and 10-year events (Ryan 1997).

The magnitudes of the 5-year and 10-year peak flood events for the Project were quantified for the representative sites on South Boulder Creek, and the recurrence intervals of these flows were defined based on hydrology with the existing system at full use to evaluate changes caused by the Project. The calculated peak flows and recurrence intervals are presented in Table 19 (Corps 2014).

Table 19:
Five-Year and Ten-Year Peak Flow Calculations for South Boulder Creek under the Project Compared with the Existing System at Full Use

Site	Alternative	Q_5 (cfs)	Recurrence Interval of Full Use Q_5 (years)	Q_{10} (cfs)	Recurrence Interval of Full Use Q_{10} (years)
SBC1	Full Use	985	1,003	5	10
	Project	993	1,015	4	7
SBC3	Full Use	766	5	834	10
	Project	687	> 45	737	> 45

As indicated in Table 16, very slight increases in the magnitude of the 5- and 10-year event are predicted at SBC1 under the Project when compared to the existing system at full use. For the Project, the recurrence interval would decrease from 10 years to 7 years despite the minimal (approximately 1 percent) change in peak flows. Changes in recurrence intervals are the result of altered peak flows where similar high flow rates are achieved most years.

Decreases of about 10 percent in the magnitude of 5-year and 10-year flood events are predicted at SBC3 under the Project when compared with the existing system at full use. For the Project, both the 5-year and 10-year events would have recurrence intervals in excess of 45 years compared with 5 years and 10 years for these respective events with the existing system at full use. The large peak flow recurrence intervals predicted for the Project are based on planned operations of Gross Reservoir where less flow would be released during traditional peak flow periods.

Effective Discharge

Effective discharge refers to the flow that transports the most sediment over a prolonged period of time. While higher flows transport more sediment, the infrequent occurrence of extreme events results in less sediment transported on average than would be by somewhat more frequent, lower-magnitude flows. Effective discharge is a representative flow that has the ability to transport the most bed material over a period of years. Computation of effective discharge is, thus, a useful tool in assessing the potential for geomorphic change due to alterations in stream flow. However, changes to effective discharge do not necessarily correspond to changes in channel morphology, particularly in sediment-limited systems.

The procedure for determining effective discharge integrates the impacts of physical processes responsible for determining channel dimensions by calculating the total amount of sediment transported by different flows, i.e., by multiplying the frequency of occurrence of each flow by the median sediment load for that flow class. The flow rate that corresponds to the maximum sediment transport capacity is the effective discharge.

Effective discharge was calculated for the representative sites on South Boulder Creek as the average of the effective discharge values calculated using the four different transport equations. The magnitude and recurrence interval of the effective discharge under the Project were compared with the existing system at full use to evaluate changes caused by the Project (Corps 2014). The calculated flow and recurrence interval for the representative sites on South Boulder Creek are presented in Table 20.

At SBC1, the effective discharge with the existing system at full use was calculated to be 730 cfs, with a recurrence interval of 1.5 years. The magnitude of effective discharge under the Project is predicted to increase by approximately 30 percent over the existing system at full use, with a recurrence interval of 2 years.

At SBC3, the effective discharge under the existing system at full use was calculated to be 536 cfs, with a recurrence interval of 1 year. The magnitude of effective discharge under the Project is predicted to decrease by approximately 5 percent from the existing system at full use, with a recurrence interval of 1.4 years.

Table 20:
Effective Discharge for South Boulder Creek under the Project Compared with the Existing System at Full Use

Site	Alternative	$Q_{effective}$ (cfs)	$Q_{effective}$ as % of Full Use (%)	Recurrence Interval of $Q_{effective}$ (years)	Recurrence Interval Change from Full Use (years)
SBC1	Full Use	730	100	1.5	0
	Project	942	129	2	1.5
SBC3	Full Use	536	100	1	0
	Project	512	96	1.4	0.3

Trends in the recurrence interval of effective discharge generally suggest that effective discharge would occur less frequently in areas with decreased flows. The larger recurrence interval for effective discharge downstream from Gross Reservoir predicted for the Project is based on planned operations of Gross Reservoir where less flow would be released during traditional peak flow periods.

Summary of Impacts to Channel Morphology

Predicted impacts to channel morphology were estimated based on a combination of observations of existing conditions, assessment of existing physical data and the numerical assessments presented above. These predicted impacts are compared with the existing system at full use. Numerical analysis of the existing system at full use quantifies various parameters that describe the magnitude and frequency of different events that impact channel morphology and provide a basis for comparing impacts of the Project.

South Boulder Creek above Gross Reservoir (Representative Sampling Site SBC1).

Representative site SBC1 is located on South Boulder Creek upstream of Rollinsville. Under the existing system at full use, flows required to initiate Phase 2 sediment transport are predicted to occur with a recurrence interval of approximately 4 years, with Phase 2 transport occurring approximately 1 day per year. Based on the modeled 45-year daily PACSM results, the longest interval between flows large enough to initiate Phase 2 transport is 17 years. Effective discharge is predicted to occur with a recurrence interval of approximately 1.5 years. Recurrence interval of Phase 2 transport and effective discharge are similar to recurrence intervals for the same parameters at locations where flow depletions have occurred. The frequency of Phase 2 transport is less and the maximum time period between Phase 2 flows is greater than unimpacted sites. Observations that the channel bed at this site is heavily armored likely impact these values.

Increased flows resulting from the Project are predicted to increase the bedload sediment transport capacity at this location by approximately 38 percent and increase sediment supply by 14. Phase 2 sediment transport is predicted to occur with a recurrence interval of 3 years, with flows above the threshold for Phase 2 transport occurring approximately 1 day per year. The maximum duration between flow events large enough to initiate Phase 2 transport is predicted to be 7 years. Flows categorized as the 5-year and 10-year flood events are expected to occur with a recurrence interval of 4 years and 7 years, respectively, at this site. Effective discharge is predicted to occur approximately once every 2 years under the Project. Overall flow increases are predicted to encourage additional transport slightly more than under the existing system at full use. The recurrence interval of Phase 2 transport is predicted to decrease slightly although Phase 2 transport flows are expected to occur with the same low frequency. Peak flood events and effective flows are predicted to occur somewhat more frequently. It is predicted that increased flows under the Project would continue to cause erosive forces that may increase the need for additional localized bank stabilization when compared to the existing system at full use.

South Boulder Creek below Gross Reservoir (Representative Sampling Site SBC3).

Representative site SBC3 is located on South Boulder Creek downstream from Gross Reservoir. Under the existing system at full use, flows required to initiate Phase 2 sediment transport are predicted to occur every year, with Phase 2 transport occurring approximately 53 days per year. Based on the modeled 45-

year daily PACSM results, Phase 2 transport and effective discharge are predicted to occur every year. Recurrence interval of Phase 2 transport, the frequency at which flows reach this threshold, the limited time between Phase 2 events, and the recurrence interval for effective discharge all suggest that high flows encourage transport at this location under the existing system at full use.

Increased flows resulting from the Project are predicted to result in a decrease in the bedload sediment transport capacity at this location by approximately 25 percent, while sediment supply is predicted to increase by 4 percent. Phase 2 sediment transport is predicted to occur every year, with flows above the threshold for Phase 2 transport occurring approximately 32 days per year. The flows categorized as the 5-year flood and the 10-year flood event based on the existing system at full use hydrology are not predicted to occur within the modeled 45-year period under the Project. Effective discharge is predicted to occur approximately once every 1.4 years at this location. Overall sediment transported under the Project is predicted to decrease despite flow increases as a result of the planned timing of releases from Gross Reservoir. Reductions in transport and the frequency of flows initiating Phase 2 transport are expected to decrease erosive potential in the stream and potentially reduce the need for localized bank stabilization when compared to the existing system at full use.

Based on the results of this analysis, the stream system appears to be stable from a channel morphology standpoint. Altered flows resulting from the Project will increase flows throughout this area. Operation of Gross Reservoir under the Project, which are planned to release less water during peak flow periods than under the existing system at full use, are predicted to decrease erosive potential downstream from the reservoir given the Project.

Conclusions supported by the FERC in its review of the Project impacts relating to channel morphology in its review of Project impacts on channel morphology were as follows (FERC Final SEA).

> *The Final EIS for enlargement of the Moffat Collection System reviewed effects to water quality associated with enlargement of Gross Reservoir and changes in channel morphology and modifications to flows in South Boulder Creek.*
>
> *Incorporating the aforementioned monitoring (see mitigation below) and associated consultation for South Boulder Creek's channel stability upstream of Gross Reservoir would help to mitigate the possibility of changes in channel erosion and any potential need for localized bank stabilization in this reach.*
>
> *In review, we [FERC] find that the Final EIS adequately addresses the effects on water quality [including changes to channel morphology] that would occur under Denver Water's amendment proposal.*

8-507.D.7.b.ii.C, Effects to Surface Waters

PROJECT EFFECTS (WATER QUALITY)

Possible changes in water quality of Gross Reservoir and of South Boulder Creek that are specifically related to the Project were analyzed by comparing the Project with the existing system at full use. The Project involves changes in the hydrologic regime, including changes to the quantity and timing of flows and reservoir storage that may affect the water quality of Gross Reservoir and of South Boulder Creek. Most of the impacts to water quality would be indirect through reservoir operation and changes in stream flow.

Methods for Reservoir Water Quality Evaluation

The depth and capacity of Gross Reservoir would increase significantly due to the Project. To assess potential changes in reservoir water quality, results from the Gross Reservoir Temperature Model (Hawley et al. 2013) were considered, along with empirical relationships from Vollenweider (1976).

Methods used to assess the water quality of Gross Reservoir are summarized below.

Methods for Stream Water Quality Evaluation

Potential water quality changes resulting from the Project were evaluated based on one or more of the following categories depending on the ecological conditions and concerns in the basins and on existing and potential diversions and return flows:

- **Impaired Water Bodies**—Potential to cause exceedances or contribute to potential exceedances for CDPHE Regulation 93 303(d) List and Monitoring and Evaluation List constituents or for TMDLs
- **Effects on Wastewater Treatment Plant Operations and Discharges**—Potential to affect the operations of existing Wastewater Treatment Plants (WWTPs) and for wastewater discharges to adversely affect stream water quality due to reductions in dilutive flows
- **Effects on Source Waters for Potable Water Systems**—Potential to affect the quality of source waters used by potable water systems or other potential site-specific effects.
- **Effects on Water Bodies**—Potential to affect the quality of the water entering an existing water body (such as changes in the quality of water imported from a separate river basin affecting the quality of water in the receiving water body).

The methods used to assess these four categories of effects are presented in four subsections below. The following primary information sources were used to support assessment of these four types of effects:

- Water quality data for sampling sites that are near or exceed existing water quality standards listed in CDPHE Regulations
- PACSM results
- Completed and draft TMDLs as published on CDPHE's website (CDPHE 2012b)
- Colorado's 303(d) List and Monitoring and Evaluation List as presented in CDPHE Regulation 93 (CDPHE 2012a)

- NPDES permitted discharges as listed in the EPA's Enforcement and Compliance History Online and Envirofacts databases (EPA 2007a, EPA 2010a)
- Potable drinking water system information as published in EPA's Envirofacts database (EPA 2007b).

Impaired Water Bodies. CDPHE Regulation 93 (CDPHE 2012a) lists impaired stream segments and identify parameter(s) of interest for each segment. CDPHE does not identify sources of pollution, nor does it specify potential methods for reducing parameter concentrations or loadings. For stream segments with TMDLs, the source of pollution is identified, as well as methods for reducing concentrations or removing the pollutants. The source or potential source of identified pollutants is reviewed in terms of 2032 conditions where a potential change in pollutant concentration would occur as a result of the Project.

Gross Reservoir is listed in CDPHE Regulation 93 on the Monitoring and Evaluation List for Aquatic Life Use due to mercury in fish tissue (CDPHE 2012a). It is not listed on the CDPHE 303(d) List as a "water-quality-limited segment requiring TMDLs."

Effects on Wastewater Treatment Plant Operations and Discharges.

The Project could adversely affect the ability of wastewater plant operators to maintain compliance with current and future discharge regulations due to potential flow reductions and reduced dilutive capacity in the receiving streams. Furthermore, changes in stream flow could drive changes in permit conditions. Evaluation of potential impacts to wastewater dischargers was based on potential changes in low flows at the discharge point.

Evaluation of water quality for altered stream flows was conducted by estimating the percentage of stream flows that would be comprised of treated effluent were estimated in accordance with CDPHE procedures.

Effects on Source Waters for Potable Water Systems. Potable water providers could be impacted if changes in contaminant concentrations in regulated drinking water parameters result from potential water transfers. These impacts are discussed for potable water providers that use water sources from affected stream segments in water basins within the Project area. Patterns of water transfer under the Project would be similar to historical patterns, but the quantity of water transferred would change. There is also potential for transfer of organisms, including those pathogenic to humans, from importing surface waters.

Effects on Water Bodies. The quality of water bodies can be altered through changes in the quality of inflows to the water body (or "source" waters). This analysis discusses potential changes in the water quality of Gross Reservoir that would change water quality in South Boulder Creek downstream from the reservoir.

The Moffat Railroad Tunnel Discharge Permit allows for discharge of railroad tunnel seepage water to South Boulder Creek upstream of Gross Reservoir under Discharge Permit number CO-0047554. Potential effects of this seepage on water quality in South Boulder Creek are analyzed in the following sections.

Gross Reservoir

The Project would enlarge Gross Reservoir storage capacity from 41,811 AF to 118,811 AF (with the Environmental Pool for mitigation) by increasing the dam height from 340 to 471 feet.

Short-term changes to Gross Reservoir water quality are anticipated due to inundation of new areas with expansion of the reservoir under the Project. These changes will be minimized through grubbing and land clearing prior to inundation. Potential changes include minor increases in organic carbon concentrations, nutrient concentrations, and chlorophyll a concentrations. Short-term minor to moderate increases in mercury concentrations in fish tissue are also anticipated. The duration of these short-term effects is not known. No long-term adverse effects on Gross Reservoir water quality, including trophic state, are anticipated.

South Boulder Creek

Potential impacts on water quality in South Boulder Creek upstream of Gross Reservoir from implementation of the Project would be related to changes in source water and impacts associated with the Moffat Railroad Tunnel permitted discharge. Each of these potential water quality impacts is discussed below.

Table 14 shows the water quality upstream and downstream from the Moffat Tunnel delivery to South Boulder Creek under current conditions. Water quality measurements for many parameters are below detection limits. Although several constituents differ to a small degree, there are few differences in measured water quality parameters upstream and downstream from the Moffat Tunnel discharge to the stream. South Boulder Creek is within stream standards and drinking water standards.

The Moffat Railroad Tunnel discharges railroad tunnel seepage water into South Boulder Creek just downstream from the Moffat Tunnel. The Moffat Railroad Tunnel Discharge Permit allows for discharge to either the Fraser River or South Boulder Creek under Discharge Permit number CO-0047554. Discharge to South Boulder Creek is limited to 0.5 mgd (about 0.77 cfs). Because this flow is seepage water, the maximum flow is not expected to increase under the Project compared with the existing system at full use. Therefore, there would be no adverse impacts to water quality caused by changes in flow through the Moffat Railroad Tunnel when combined with potential discharges from the Moffat Tunnel between the existing system at full use and the Project. No impacts are anticipated to the Moffat Railroad Tunnel Discharge Permit.

Possible impacts to water quality in South Boulder Creek downstream from Gross Reservoir could result from changes in Gross Reservoir water quality. South Boulder Creek also has the potential to impact drinking water providers through source water quality changes and to affect WWTP dischargers.

Impacts are anticipated with regard to short-term increases in biological productivity downstream from Gross Reservoir in South Boulder Creek. Short-term impacts are also anticipated to affect operations of the Moffat WTP in Lakewood. These impacts would be directly related to expansion of Gross Reservoir under the Project. In addition, impacts to wastewater dischargers downstream from Gross Reservoir are not anticipated.

Outflow temperatures from Gross Reservoir to South Boulder Creek are predicted to decrease under the Project due to expansion of the hypolimnion. Outflow temperature predictions of a hydrodynamic temperature model of Gross Reservoir indicate that peak outflow water temperatures will decrease on the order of 4.0 to 6.6 degrees Celsius (°C) for the range of conditions simulated, resulting in outflow water which is cooler than 9°C throughout the year (Hawley et al. 2013). Potential effects of this temperature reduction on aquatic life are discussed in the next Section.

PROJECT EFFECTS (WATER TEMPERATURE, NUTRIENT LEVELS, AND WASTEWATER PERMITS)

Predicted effects on water temperature, nutrient levels, and wastewater permits are evaluated for Gross Reservoir and for South Boulder Creek. The assessment of potential impacts on stream water quality focuses on flow conditions under the Project. Assessment methods were selected for their applicability to assessing effects on ecological resources and on existing and potential future human uses and activities.

Gross Reservoir

It is anticipated that inundation of new areas at Gross Reservoir could cause minor to moderate changes to water quality during initial reservoir filling operations and, potentially, for several years thereafter. These changes could include increased total organic carbon (TOC) concentrations and increased productivity (algal growth). These short-term changes due to inundation of new areas could also include increases in methylmercury (MeHg). This is relevant because Gross Reservoir is currently on the CDPHE Monitoring and Evaluation List for mercury concentrations in fish tissue (CDPHE 2012a). Analyses supporting these statements regarding water quality are presented in the following discussions of the effects of the Project on 1) the trophic state of Gross Reservoir and 2) MeHg concentrations in Gross Reservoir.

Effects on the Trophic State of Gross Reservoir

Analysis of available data and literature was conducted to evaluate whether the expansion of Gross Reservoir under the Project could result in long-term changes to the trophic state of Gross Reservoir.

To gain an understanding of the potential changes in factors affecting the trophic state of Gross Reservoir that might result from the Project, anticipated changes to the following two key factors were considered:

- Nutrient concentrations
- Epilimnetic temperatures

Nutrient Concentrations. Nutrients can play an important role in determining productivity and corresponding trophic state of a reservoir. Nutrient concentrations were evaluated by review of inflow concentration through use of the Vollenweider relationship (Vollenweider 1976) and in terms of potential changes to internal loading.

Inflow nutrient concentration data were reviewed to assess whether the concentrations in Gross Reservoir would be expected to change in the future due to changes in the relative contributions from upstream South Boulder Creek and the Moffat Tunnel. First, the water quality of Moffat Tunnel deliveries to South Boulder Creek, including Moffat Railroad Tunnel seepage discharge, is not expected to change

under the Project relative to historical conditions. Furthermore, the mixture of native upper South Boulder Creek and Moffat Tunnel inflows to Gross Reservoir is not expected to change greatly. Under Current Conditions, Moffat Tunnel diversions make up approximately 56 percent of the inflow to Gross Reservoir (average over the entire 45-year PACSM simulation), and, under the Project, Moffat Tunnel diversions would make up approximately 61 percent of the inflow to Gross Reservoir, a change of 5 percent. Therefore, inflow water quality concentration changes (including nutrients) are not anticipated.

In an effort to assess the potential change in nutrient concentrations in Gross Reservoir, nutrient (specifically phosphorus) concentrations for the two sources (Moffat Tunnel water and native upper South Boulder Creek water) were compared. In addition, measurements of total phosphorus were taken on South Boulder Creek just above and below the East Portal of the Moffat Tunnel and combined with corresponding flow data to calculate Moffat Tunnel phosphorus concentrations via a mass balance approach. Data collected from the Moffat Tunnel and on South Boulder Creek just above and below the East Portal of the Moffat Tunnel, as well as calculated phosphorus concentrations for the Moffat Tunnel, are shown in Chart 6.

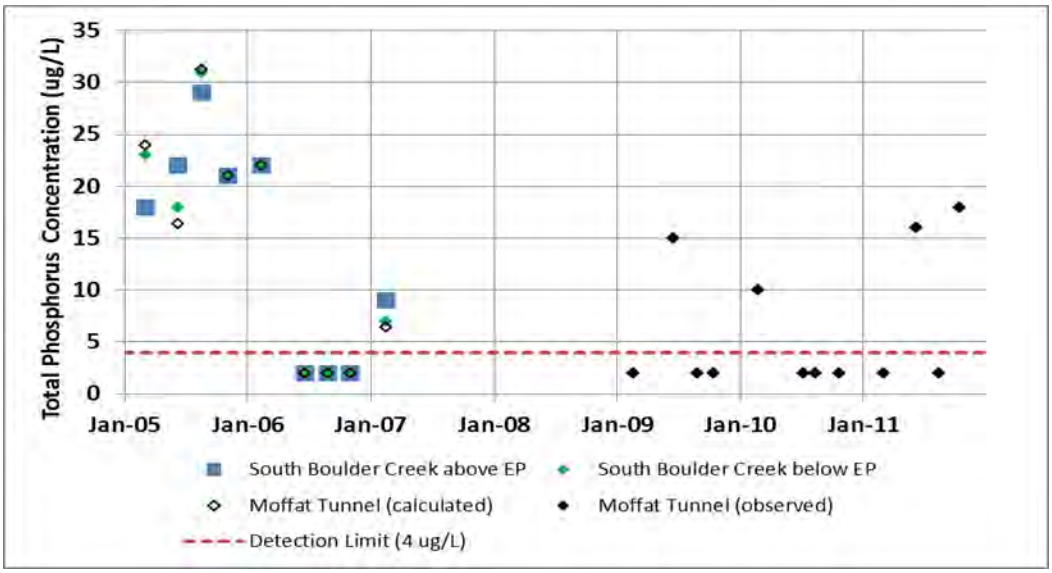

Chart 6: Total Phosphorus Concentrations from the Moffat Tunnel and from South Boulder Creek near the Moffat Tunnel

Notes:
EP = refers to East Portal of the Moffat Tunnel
Calculated = indicates that values were determined by mass balance calculations
µg/L = micrograms per liter

Statistical analysis of these data indicates that there is a very low probability that the Moffat Tunnel concentrations are higher than native upper South Boulder Creek concentrations, i.e., there is no statistical difference in nutrient concentrations in water coming from the Moffat Tunnel and from native upper South Boulder Creek flows. Combined with the relatively small anticipated change in mixing ratios

(a 5 percent increase in the Moffat Tunnel portion of flow into Gross Reservoir), no changes in Gross Reservoir inflow water quality concentrations (including nutrients) are anticipated under the Project relative to historical conditions.

Other calculations (the Vollenweider Relationship) presented in the Corps Final EIS were applied to estimate changes to in-reservoir phosphorus concentrations under the Project due to changes to inflow loading and reservoir size. The assumptions and equations used in the calculations are described in the Corps Final EIS (Corps 2014), and the results of the calculations are given in Table 21.

The results of the analysis indicate that the areal phosphorus load would decrease under the Project when compared with current conditions due to a larger reservoir surface area. This approach predicts a small decrease in average phosphorus concentrations in the reservoir under the Project.

Internal loading of nutrients occurs when nutrients stored in organic matter and sediments at the bottom of a reservoir are released into the water column. Rates of internal loading increase sharply if anoxic conditions develop at the sediment-water interface. Internal loading rates are also positively correlated with temperature at the sediment-water interface. Because increased internal loading of nutrients could affect the trophic state of Gross Reservoir by increasing productivity within the reservoir, the potential for increased internal loading was assessed through consideration of DO concentrations and temperatures at the bottom of the reservoir.

Based on existing DO levels in the hypolimnion and the relatively low productivity of Gross Reservoir, as indicated by low chlorophyll a concentrations, it is assumed that low DO concentrations do not occur at the sediment-water interface. Since inflowing organic matter and nutrient concentrations are not expected to increase, there is no expectation that anoxic conditions will develop in the long term with implementation of the Project.

Table 21:
Vollenweider Calculations Estimating Relative Change in Phosphorus Concentrations in Gross Reservoir

Parameter	Current Conditions	Project
Hydraulic Residence Time (τ, years)	0.25	0.72
Average Depth (z, meters)	27.62	40.28
Surface Overflow Rate (qs, m/yr)	110.8	56.3
Average Surface Area (m2)	1,214,100	2,687,208
Areal Phosphorus Load (Lp, gP/m2/yr)	1.6	0.8
In-reservoir Phosphorus Concentration (µg/L)	10	8

Source: Vollenweider (1975)

Notes:
µg/L = micrograms per liter
$g/m^2/yr$ = grams per square meter per year
m^2 = square meters
m/yr = meter per year

Based on existing DO levels in the hypolimnion and the relatively low productivity of Gross Reservoir, as indicated by low chlorophyll a concentrations, it is assumed that low DO concentrations do not occur at

the sediment-water interface. Since inflowing organic matter and nutrient concentrations are not expected to increase, there is no expectation that anoxic conditions will develop in the long term with implementation of the Project.

Results of the hydrodynamic and temperature model for Gross Reservoir indicate that temperatures at the sediment-water interface are expected to generally decrease in response to changes associated with the Project, especially through the months of summer stratification (Hawley et al. 2013). This decrease in temperature at the bottom of the reservoir would be expected to slow reactions leading to internal loading of nutrients. Based on this analysis, long-term internal loading is expected to remain low or further decrease with implementation of the Project. Furthermore, with the increased volume of the reservoir under the Project, nutrients would be diluted following turnover more than is currently the case, resulting in reduced effects on trophic state for the Project, relative to current conditions.

These analyses suggest that nutrient concentrations and long-term productivity in Gross Reservoir would likely remain the same or decrease under the Project as compared with current conditions.

Epilimnetic Temperature. Changes in epilimnetic temperature could affect the trophic state of Gross Reservoir because algal growth rates can increase with water temperature. Results from the hydrodynamic and temperature model of the reservoir were evaluated to assess potential changes to epilimnetic water temperatures (Hawley et al. 2013). Simulated reservoir temperature profiles for the Project as compared to current conditions show that the key reservoir thermal effect of the expansion of Gross Reservoir would be an increase in the depth (and volume) of the hypolimnion during summer stratification; the depth of the epilimnion would not change. The timing of onset of stratification and turnover changed, with stratification beginning later for the expanded reservoir and fall turnover occurring later. The shift in the summer stratification period was on the order of a month or more for the 2 years simulated. This effect is shown in simulated profiles from the modeling segment adjacent to the dam (Chart 7).

Epilimnetic water temperatures for the Project and current conditions simulations are presented in Chart 7. This figure shows that epilimnetic water temperatures are simulated to be cooler for the expanded reservoir from roughly February through June and part of July (covering the period of currently observed peak algal concentrations). In July and Part of August, epilimnetic waters could be a couple of degrees warmer or slightly cooler for the 2 years simulated. By mid-August through January, epilimnetic waters would be slightly warmer for the Project compared with current conditions. Peak epilimnion temperatures may change slightly from year to year. Based on these findings, there could be a shift in the timing of peak observed algal concentrations because temperatures would be cooler at the top of the reservoir in May and June. However, increased algal growth is not expected because peak temperatures change much less than 1°C), increasing slightly in some years and decreasing slightly in others.

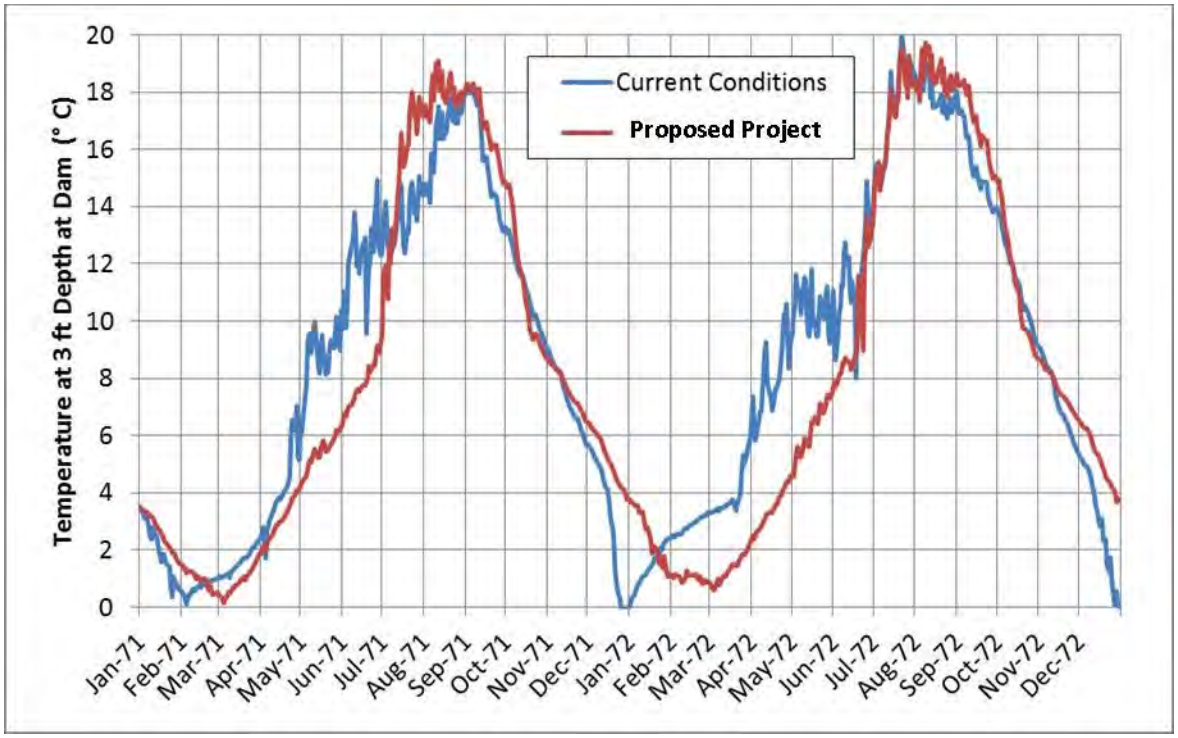

Chart 7: Simulated Gross Reservoir Water Temperature at 3-Foot Depth near Gross Dam, 1971 and 1972, 2012 Meteorology

Effects on Methylmercury Concentrations

Under the Project, the full pool footprint of Gross Reservoir would more than double in size. This expansion would inundate currently vegetated areas. This impact would be minimized by removal of trees and vegetation around the reservoir rim prior to initial filling; however, there would still be some organic material present during reservoir filling operations. This organic material would decay over time following inundation, resulting in consumption of DO and release of organic matter and nutrients to the reservoir. These conditions could influence mercury methylation in Gross Reservoir (Bodaly 1997, see Final EIS for reference materials).

Gross Reservoir is currently on the CDPHE Monitoring and Evaluation List for mercury concentration in fish tissue (CDPHE 2012a, see Final EIS for reference materials). Transient increases in mercury concentrations in fish tissues have been observed to peak and then gradually subside following impoundment of new reservoirs (Bodaly 1997). Most mercury in fish tissue is MeHg, so an understanding of the factors that influence MeHg concentrations is important for analysis of potential changes in concentration of mercury in fish tissue. Food web dynamics can also play a role in the accumulation of MeHg in fish. Rates of mercury methylation and demethylation are highly dependent upon redox potential (Compeau 1984, see Final EIS for reference materials). Higher redox potentials tend to result in increased demethylation, and lower redox potentials tend to result in increased methylation. Lower redox potentials in lakes occur primarily in response to increased decomposition of organic matter, so factors

affecting rates of organic matter decomposition were considered to assess the potential for long-term effects.

Based on the analysis of long-term trophic state effects described above, organic matter concentrations are expected to remain the same or decrease and DO minima at the bottom of the reservoir are expected to remain the same or increase. This suggests less favorable long-term conditions for mercury methylation under the Project compared with current conditions. In the short term, however, there may be some organic matter present at the bottom of the newly inundated areas although efforts would be made to minimize the mass of this material. This material would decay and would likely produce conditions conducive to mercury methylation beyond those of the current configuration. As a result, there may be a temporary increase in MeHg concentrations in fish tissue in response to the expansion. This increase is not expected to be a long-term increase, but instead a temporary, post-inundation phenomenon that would peak in the years following the expansion and subside over subsequent years. The duration of the effect is not known.

Summary of Potential Changes in the Water Quality of Gross Reservoir

Short-term changes in water quality in Gross Reservoir due to land inundation are expected to be minor, with possible increases occurring in TOC and nutrient concentrations. These changes are anticipated to be minimized through grubbing and land clearing prior to inundation. No long-term adverse impacts were identified for water quality within Gross Reservoir.

South Boulder Creek

Potential impacts on water quality in South Boulder Creek upstream of Gross Reservoir from implementation of the Project would be related to changes in source water and impacts associated with Moffat Railroad Tunnel permitted discharge. Each of these potential water quality impacts is discussed below.

Table 14 shows the water quality upstream and downstream from the Moffat Tunnel delivery to South Boulder Creek under current conditions. Water quality measurements for many parameters are below detection limits. Although several constituents differ to a small degree, there are few differences in measured water quality parameters upstream and downstream from the Moffat Tunnel discharge to the stream. South Boulder Creek is within stream standards and drinking water standards.

The maximum increase in flow between current conditions and the Project is 100 percent, i.e., a doubling of contributions from the Moffat Tunnel. Even under these conditions, concentrations of all water quality parameters would be well below stream standards and drinking water standards. Therefore, the change would not be significant.

The Moffat Railroad Tunnel discharges railroad tunnel seepage water into South Boulder Creek just downstream from the Moffat Tunnel. The Moffat Railroad Tunnel Discharge Permit allows for discharge to either the Fraser River or South Boulder Creek under Discharge Permit number CO-0047554. Discharge to South Boulder Creek is limited to 0.5 mgd (about 0.77 cfs). Because this flow is seepage water, the maximum flow is not expected to increase under the Project compared with current conditions. Therefore, there would be no adverse impacts to water quality caused by changes in flow through the Moffat

Railroad Tunnel when combined with potential discharges from the Moffat Tunnel between current conditions and the Project. No impacts are anticipated to the Moffat Railroad Tunnel Discharge Permit.

Only very limited water quality data are available for South Boulder Creek downstream from Gross Reservoir for evaluation of current conditions; however, it is possible to broadly anticipate relative changes in water quality due to implementation of the Project. Possible impacts to the water quality of South Boulder Creek below Gross Reservoir include:

- Changes in Gross Reservoir outflow water quality
- Changes in Gross Reservoir outflow water temperature
- Impacts to water providers due to changes in water quality
- Impacts to WWTP dischargers.

Changes in Gross Reservoir Outflow Water Quality

The short-term changes in water quality in Gross Reservoir are described above. These water quality changes would be reflected in corresponding changes in the water quality of reservoir outflows that may result in short-term, negligible to minor increases in productivity in South Boulder Creek downstream from Gross Reservoir. These changes would not impact impaired or potentially impaired segments farther downstream that are the result of the numerous water withdrawals between Gross Reservoir and the mouth of South Boulder Creek.

Changes in Gross Reservoir Outflow Water Temperature

A two-dimensional, numerical, hydrodynamic and temperature model of Gross Reservoir was developed to simulate outflow temperatures under the Project and under current conditions (Hawley et al. 2013, see Final EIS for reference materials). A 2-year period of the PACSM hydrology (1971 and 1972) was simulated; this time period was selected because it included 1972, the year with the maximum difference between current conditions and the Project in average summertime (July through September) water surface elevation. The simulation period also included a year close to the median difference (1971). Each simulation was run with 2009 meteorological inputs (cooler air temperatures) and 2012 meteorological inputs (warmer air temperatures).

Simulation results demonstrate that the outflow temperature response did not vary much based on meteorological inputs. A larger effect on outflow temperatures was in response to the reservoir expansion. Model results predicting outflow temperatures for 1971 through 1972 for the Project and for current conditions using 2009 meteorology are shown in Chart 8.

The model predicts cooler summer and peak outflow temperatures under the Project. The largest decrease in peak temperature was simulated to be -6.6°C in 1972 (for 2009 meteorological inputs); the largest decrease in peak temperature for 1971 was simulated to be -4.0°C (for 2012 meteorological inputs). These simulated decreases in peak temperatures result in maximum outflow temperatures that do not go above 9°C under the Project, even over a range of meteorological inputs. Table 22 provides summary statistics of the outflow temperature results for the full simulation period of 1971 through 1972.

With respect to South Boulder Creek between the Gross Reservoir outlet and the South Boulder Creek Diversion Canal, the limited set of water temperature observations and the lack of an adequate cross-section of data do not support development of a dynamic temperature model for that reach. However, an empirical review of available data was conducted to assess the potential warming of outflow water that could be expected in summer months between the Gross Reservoir outlet and the South Boulder Creek Diversion Canal.

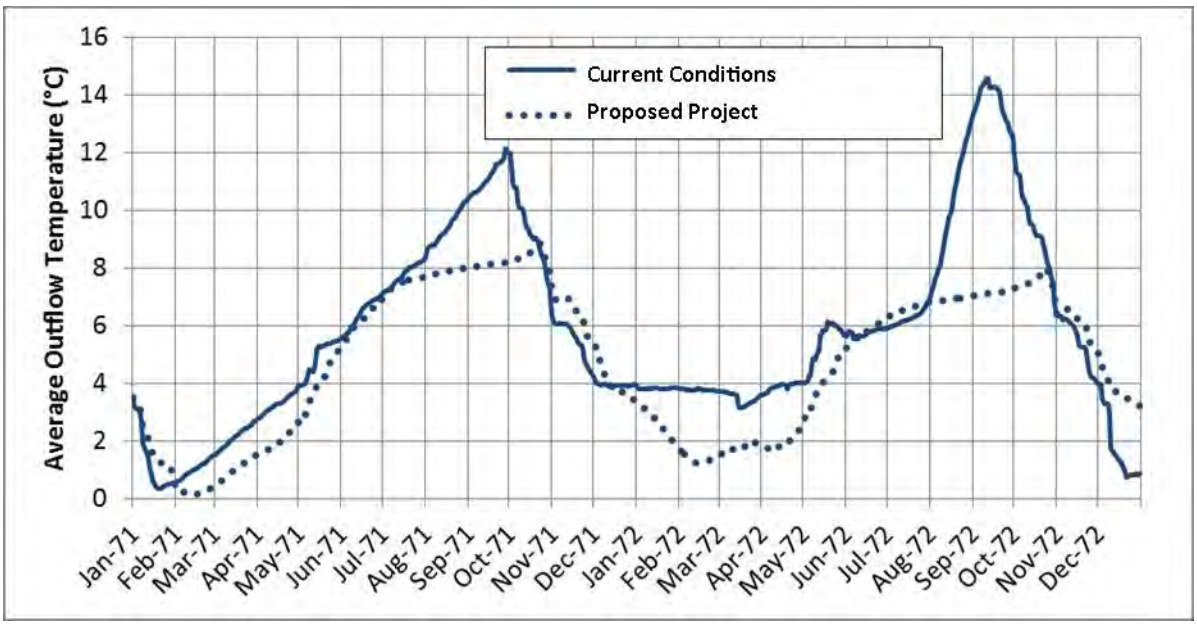

Chart 8: Simulated Gross Reservoir Outflow Temperatures for the Project and Current Conditions Based on 1971 and 1972 Hydrology and 2009 Meteorological Inputs

Table 22:
Summary of 1971 and 1972 Simulated Temperatures for Gross Reservoir Outflows under the Project and Current Conditions

Metric	1971 through 1972 (2009 Meteorological Inputs/2012 Meteorological Inputs)
Difference in Average Annual Outflow Temperature (Project versus Current Conditions)	-1.1°C / -0.9° C
Difference in July-September Average Outflow Temperature (Project versus Current Conditions)	-2.4°C / -2.2°C
Current Conditions Maximum Outflow Temperature	14.6°C / 14.6°C
Project Maximum Outflow Temperature	8.9°C / 8.3°C

Chart 9 presents the difference between 30 available paired observations made from late 2010 through late 2012, with positive values showing warming in South Boulder Creek between the Gross Reservoir outlet and the South Boulder Creek Diversion Canal. Note that temperature observations at the lower site

were only available as whole numbers in degrees Celsius, thereby limiting resolution. Average summertime (July through September) warming over this reach was 2.9°C.

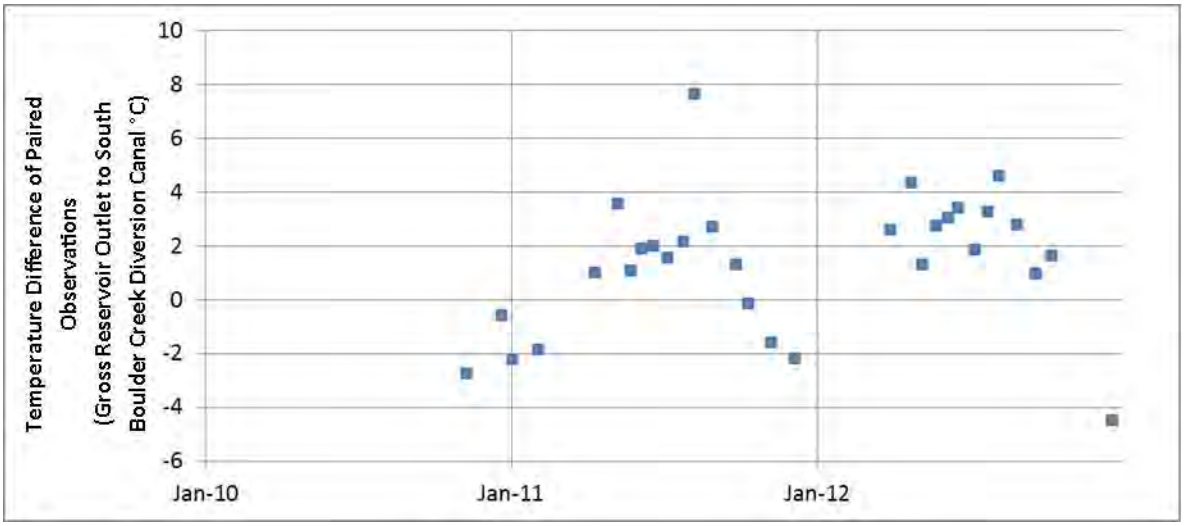

Chart 9: Observed Temperature Difference in South Boulder Creek between the Gross Reservoir Outlet and the South Boulder Creek Diversion Canal

The Corps considered effects on summertime water temperatures in South Boulder Creek between Gross Reservoir and the South Boulder Creek Diversion Canal are predicted them to be moderate to major.

Impacts to Water Providers Due to Changes in Water Quality

Because of the short-term changes noted above, the Moffat WTP in Lakewood would likely experience short-term increases in TOC. TOC is a concern because of the potential formation of disinfection byproducts during treatment and distribution. Optimization of conventional treatment is generally sufficient to provide adequate removal of TOC. Other changes in treatment processes would not be anticipated.

Impacts to WWTP Dischargers

The most likely impact to WWTP dischargers would be attributed to changes in flow, particularly decreases in flow. Two permitted wastewater dischargers exist downstream from Gross Reservoir; the Eldorado Springs WWTP, with a maximum permitted flow of 0.032 mgd (0.050 cfs), and the San Souci Mobile Home Park downstream from Eldorado Springs, with a maximum permitted flow of 0.018 mgd (0.028 cfs). Both dischargers are minor dischargers with flow rate less than the 100:1 dilution test as used by CDPHE for determining anti-degradation.

The PACSM at the South Boulder Creek near the Eldorado Springs gage provided the lowest monthly flow of 6.9 cfs under current conditions and 8.3 cfs under the Project. The lowest monthly flow would increase under the Project, and no potential impact to either WWTP is anticipated.

Summary of Potential Changes in the Water Quality of South Boulder Creek

The following summarizes potential changes in water quality in South Boulder Creek anticipated as a result in changes between current conditions and the Project:

- Short-term, minor changes in water quality in Gross Reservoir, with possible increases in TOC and nutrient concentrations, are anticipated to result in corresponding short-term, negligible to minor increases in productivity in South Boulder Creek downstream from Gross Reservoir.
- Short-term minor increases in nutrients could lead to minor increases in biological productivity in South Boulder Creek downstream from Gross Reservoir.
- Optimization of treatment processes at the Moffat WTP may be needed to address short-term changes in TOC from water quality changes in Gross Reservoir during the initial filling.
- No impacts to WWTP discharge permits are anticipated as both permitted discharges have a dilution rate greater than 100:1.

Conclusions supported by the FERC in its review of Project impacts (FERC Final SEA, page 61) were as follows.

> *Therefore, we [FERC] find that an approval of Denver Water's amendment request should not result in effects on water quality in the project area beyond those determined in the Final EIS, and should in fact reduce effects on water quality in the Project area.*
>
> *The Final EIS for enlargement of the Moffat Collection System reviewed effects to water quality associated with enlargement of Gross Reservoir and changes in channel morphology and modifications to flows in South Boulder Creek.*
>
> *The Final EIS found that the proposed additional 72,000 acre-feet of storage in the reservoir would result in virtually no change in the depth of the epilimnion. It would result in a substantial increase in the depth and volume of the hypolimnion during summer stratification, and a shift on the order of a month later for the summer stratification period. CE-QUAL-W2 modeling (Hydros Consulting, 2013) 15 of the proposed additional 72,000 acre-feet of storage predicted cooler summer outflow temperatures, resulting in a maximum outflow temperature of 9°Celsius (C), in comparison to 14.6°C under existing conditions. The Final EIS also found short-term, minor increases in productivity would occur in the reservoir, and corresponding short term, negligible to minor increases in productivity in South Boulder Creek downstream. No anoxic conditions or increases in methylmercury concentrations were predicted in the reservoir over the long term. The Final EIS found that the enlargement of the Moffat Collection System with the 72,000 acre-foot enlargement of Gross Reservoir could cause erosive forces that could increase the need for localized bank stabilization in South Boulder Creek upstream of Gross Reservoir, but it could decrease erosive forces in South Boulder Creek downstream of Gross Reservoir. The review in the Final EIS did not identify any specific effects to water quality from operation of the proposed Environmental Pool.*
>
> *The Final EIS did not address positive effects to water quality that would result from implementation of several plans Denver Water would finalize under its proposal, or its compliance*

with conditions in the WQC issued by Colorado DPHE or 4(e) conditions stipulated by the Forest Service.

Additional conclusions supported by the FERC in its review of Project impacts (Final SEA, Section 5.1.3.2) were as follows.

Denver Water would minimize water quality impacts in Gross Reservoir and downstream that could be caused by decomposition of organic matter when the reservoir is filled to its new higher elevation by implementing a finalized tree removal plan. Denver Water indicates in its application that the plan would address Forest Service condition 27, and that the plan would be finalized in consultation with the Forest Service, Colorado State Forest, Boulder and Jefferson Counties and then filed with the Commission for approval.

Monitoring water quality in Gross Reservoir (WQC condition 16) at a deep-water site near the dam would provide documentation of water quality conditions in the enlarged Gross Reservoir. Monitoring would start during the first ice-free season and continue for 5 years after the project is fully operational, would identify any effects from construction, inundating of new land, and operating the enlarged reservoir. In addition, monitoring metals and hardness in South Boulder Creek (WQC condition 14)18 would identify any unexpected adverse effects of the project on metals in South Boulder Creek. If project-caused metal impairments are identified in South Boulder Creek, WQC condition 15 provides for an assessment and approach to resolve any project-caused impairments.

Monitoring accumulation of mercury in Gross Reservoir fish (WQC condition 13) is discussed below in Section 5.1.4.2.

Denver Water would monitor DO and temperature under its approved Article 402 Dissolved Oxygen and Temperature Monitoring Plan, which includes monitoring within 500 feet of the tailrace below Gross Reservoir at 1-hour intervals, and notifying Colorado DPHE, Colorado Parks and Wildlife, and FWS if DO does not meet the applicable state criteria of 7.0 mg/L for coldwater fish spawning and 6.0 mg/L for the remainder of the year.

Denver Water would also collect water temperature data at 15-minute intervals under WQC condition 6 at the Gross Reservoir outlet and at three South Boulder Creek sites (at Pinecliffe, a location between the reservoir outlet and diversion point, and at the South Boulder diversion structure). These data would confirm the predicted temperature regime and provide temperature data to confirm conclusions on the longitudinal extent of temperature effects on aquatic communities in the reservoir. In addition, DO and temperature data collected at the established site for the Dissolved Oxygen and Temperature Monitoring Plan would be directly comparable to measurements made between 2010 and 2013 (Denver Water, 2012, 2013, 2014).

Implementation of Denver Water's proposal to revise its approved South Boulder Creek Channel Stability Monitoring Plan, would document channel conditions, focusing on channel instability and erosion in South Boulder Creek upstream of Gross Reservoir. The results of monitoring under this

plan would be used to determine whether Denver Water would need to meet with the Forest Service to discuss the need for restoration and the preparation of any needed restoration plan(s). Incorporating the aforementioned monitoring and associated consultation for South Boulder Creek's channel stability upstream of Gross Reservoir would help to mitigate the possibility of changes in channel erosion and any potential need for localized bank stabilization in this reach.

In review, we [FERC] find that the Final EIS adequately addresses the effects to water quality that would occur under Denver Water's amendment proposal. Finalizing a tree removal plan pursuant to Forest Service condition 27, in consultation with the agencies, followed by Commission [FERC] approval of the plan, would help reduce effects to water quality. Denver Water's Stormwater Management Plan, Erosion Control and Reclamation Plan, Quarry Operation Plan and Quarry Reclamation Plan, with the agency consultation and Commission [FERC] approval, would increase protection of water quality. Together with Denver Water's compliance with Forest Service 4(e) conditions 19 (Erosion Control and Reclamation), 26 (Pit Development and Reclamation Plan), and 28 (Reclamation and Revegetation Seed Mixes and Mulch Materials), any effects to water quality in the project area should be significantly reduced effects to geology and soils in the project area. Further, the water quality monitoring Denver Water would perform pursuant to its approved Dissolved Oxygen and Temperature Monitoring Plan, and bank stability monitoring it would perform, both pursuant to the Forest Service 4(e) conditions and WQC conditions would provide further protection of water quality at the project, during and after construction and enlargement of the reservoir. In addition, as noted in Section 5.1.1 Geology and Soils, Denver Water would need to file an Erosion and Sediment Control Plan with the Commission's San Francisco Regional Office for approval prior to any land-disturbing activity. Erosion and sediment control measures in this plan would also help to reduce possible impacts to water quality through erosion and sedimentation.

Therefore, we [FERC] find that an approval of Denver Water's amendment request should not would result in effects to water quality in the project area beyond those determined in the Final EIS, and should in fact reduce effects to water quality in the project area.

Additional conclusions supported by the FERC in its review of Project impacts (Final SEA, Section 8) were as follows.

We did not identify any elements of Denver Water's proposal which would cause effects to water quality in the Gross Reservoir Project area to exceed the levels identified in the 2014 Final EIS. We [FERC] found that effects to water quality through erosion, turbidity and sedimentation would be reduced through Denver Water's Tree Removal Plan, Stormwater Management Plan, Erosion Control and Reclamation Plan, Quarry Operation Plan, and Quarry Reclamation Plan, if, as we [FERC] recommend, these plans are finalized in consultation with the agencies identified in its application and any entities required through applicable Forest Service conditions, and approved by the Commission before any land-disturbing activity, as described above. Effects would also be reduced by approval of an Erosion and Sediment Control Plan by the Commission's San Francisco Regional Office prior to any land-disturbing activity, as described above. The water quality monitoring Denver Water would perform is consistent with its approved Article 402

Dissolved Oxygen and Temperature Monitoring Plan and would help ensure protection of water quality. The bank stability monitoring it would perform, and its compliance with other relevant Forest Service 4(e) conditions and WQC conditions, would help ensure protection during and after construction and enlargement of the reservoir.

Conclusions supported by CDPHE in its 401 Water Quality Certification letter (Corps ROD, Attachment D) for the Project were as follows.

Certification Statement

Based on the Division's [CDPHE's Water Quality Control Division's] analysis and evaluation, as further explained in the attached Rationale for Conditional 401 Certification for the Moffat Collection System Project [the Project], and based on consideration of the short-term impacts of construction activities and BMPs and conditions imposed by other agencies, as well as conditions on operation of the Project as imposed by the Division, including the development of adaptive management practices in response to monitoring and assessed conditions, the Division concludes that there is reasonable assurance that the Project will be conducted in a manner that complies with all applicable water quality requirements. See 5 CCR 1002-82, § 82.5(A)(3); 40 CFR § 121.2(a)(3). Therefore, this letter shall serve as official notification that the Division is issuing a "Conditional Certification" in accordance with 5 CCR 1002-82, § 82.5(A)(3). Conditions for this certification are included in the attached document, Rationale for Conditional 401 Certification of the Moffat Collection System Project.

MITIGATION (WATER QUALITY)

Denver Water's License Amendment Application to the FERC evaluated mitigation measures for water quality (Exhibit 5) in Table 5.1-1 as provided below.

Per 401 Certification Condition 16 adopting mitigation identified in the 2011 Fish and Wildlife Mitigation Plan (FWMP) developed between Denver Water and CPW, Denver Water will monitor mercury in fish tissue in Gross Reservoir with assistance from CDPHE and CPW. Denver Water will work with CDPHE and CPW to provide public education, including the posting of revised FCA signs at Gross Reservoir (if needed).

Per 401 Certification Condition 13 adopting mitigation identified in the 2011 FWMP developed between Denver Water and CPW, Denver Water will monitor general water quality parameters (nutrients, organic carbon, metals, major ions, temperature, and chlorophyll a) in Gross Reservoir. Monitoring results will be submitted annually to CDPHE.

Per the USFS Section 4(e) Condition 27 (Tree Removal Plan) from the Denver Water/USFS Settlement Agreement adopting mitigation identified in the 2011 FWMP developed between Denver Water and CPW; and the mitigation required by the FERC in the amended License to consult with other parties in addition to the USFS in developing the Tree Removal Plan: Denver Water will minimize water quality impacts from organic matter by removing vegetation in the inundation area according to a Tree Removal Plan.. The Tree Removal Plan will determine preferred removal and disposal methods through consultation with the USFS, the Colorado State Forest Service, Boulder County and the local community. A final plan will be

prepared and filed with the FERC for approval prior to land clearing activities. Pursuant to USFS Section 4(e) Condition 27, Denver Water will compensate the USFS for merchantable timber and will collaborate on best methods to remove timber on NFS lands. During development of the Tree Removal Plan, Denver Water will explore ways by which its tree removal operations or the material can provide benefit to the local community (e.g., firewood). The Tree Removal Plan would also include consideration of avoidance and minimization of associated nuisance factors such as noise, light, and obnoxious odors.

Per 401 Certification Condition 6, Denver Water will monitor continuous stream temperature at four locations in South Boulder Creek (one location upstream of Gross Reservoir and three locations downstream).

Per 401 Certification Condition 14 and Condition 15, Denver Water will monitor concentrations of metals and hardness at three locations in South Boulder Creek (two locations upstream of Gross Reservoir and one location downstream).

Mitigation required by the FERC in the amended License 401 Certification Condition 6 and Condition 12 states that Denver Water will monitor temperature and dissolved oxygen (DO) in the Gross Reservoir outflow consistent with the existing FERC-approved DO Monitoring Plan (which was completed under Article 402) for 3 years after construction of the Project is complete. The purpose of the monitoring is to ensure that stream flows downstream from the Project maintain adequate temperature and DO levels.

The FERC evaluated the effects of all mitigation measures for water quality (Final SEA (page 35) and concluded as follows.

Clean Water Act Section 401

The CWA gives authority to each state to issue a Section 401 WQC [Water Quality Certification] for any project that needs a federal Section 404 permit. Additionally, an applicant is required to obtain a WQC for any activity that may result in a discharge into navigable waters. The WQC is verification by the state that the project would not violate water quality standards.

On September 3, 1997, Colorado DPHE issued a WQC for the licensing of the Gross Reservoir Project.

Denver Water filed an application with Colorado DPHE for a WQC for the proposed enlargement of the Moffat Collection System, including enlargement of Gross Reservoir, on April 29, 2015. Colorado DPHE noticed the application for a 30-day public comment period, which closed on July 31, 2015, and subsequently issued the WQC on June 23, 2016. The June 23, 2016 WQC includes 16 conditions.

The WQC includes conditions that address water quality at locations throughout the Moffat Collection System. Commission staff reviewed the conditions contained in the WQC and determined that conditions 1 through 5 and conditions 7 through 11 do not have a nexus to the FERC-licensed Gross Reservoir Project [the Project] or the proposed amendment of license, and

are not analyzed in this Final Supplemental EA. The WQC conditions that do have a nexus to the Commission's [FERC's] action are summarized below.

- *Condition 6: Monitor continuous stream temperature at four locations in South Boulder Creek, including (1) South Boulder Creek above Gross Reservoir at Pinecliffe; (2) Gross Reservoir Outlet (FERC monitoring location); (3) South Boulder Creek at a location between the reservoir outlet and the diversion point (to match the corresponding site for sampling benthic macroinvertebrates); and (4) South Boulder Creek at the diversion structure. Monitoring at these sites would begin later than 1 year after the date of issuance of the Corps' 404 permit [already issued] or the FERC license, whichever is later, and would continue for not less than 5 years after the project becomes fully operational.*
- *Condition 12: Monitor aquatic communities at three sites in South Boulder Creek below Gross Reservoir, including (1) South Boulder Creek immediately downstream of Gross Reservoir; (2) South Boulder Creek at a location between the reservoir outlet and the diversion point for the municipal water supply; and (3) South Boulder Creek upstream of the diversion point and the lentic zone it creates. Monitoring would include sampling benthic macroinvertebrates using Colorado DPHE methods and calculating multi-metric index (MMI) scores. If monitoring of aquatic life demonstrates that the project is responsible for degradation of aquatic life (as indicated with the MMI), Denver Water would be required to develop a mitigation plan.*
- *Condition 13: Work with Colorado DPHE to support a biennial program to monitor mercury in fish tissue in Gross Reservoir. The sampling effort for Gross Reservoir would begin in the first field season after the enlarged reservoir has filled and continue for 5 more years. If mercury levels fall below the level of concern for the last 3 years of sampling, Denver Water's monitoring obligation would end. If there is bioaccumulation of mercury in fish tissue at the end of the 5-year period, the obligation for monitoring would be extended for an additional 5 years. If fish tissue analyses show that a fish consumption advisory is required, Denver Water would work with the Technical Advisory Team 34 of the Colorado Fish Consumption Advisory Committee to provide public education including the posting of signs with associated consumption advisories.*
- *Condition 14: Monitor concentrations of total recoverable metals, dissolved metals, and hardness at the following sites: (1) South Boulder Creek above Moffat Tunnel outfall; (2) South Boulder Creek at Pinecliffe; and (3) South Boulder Creek at the diversion structure. Collect samples monthly except where winter conditions prevent access. Monitoring at these sites would begin no later than the date of issuance for the Corps' 404 permit [already issued] or the amended FERC license, whichever is later, and continue for 5 years after the project becomes fully operational. Denver Water would submit the data annually to Colorado DPHE, along with a report documenting exceedances of the nutrient standards, by April 1 following each calendar year of sampling.*
- *Condition 15: If monitoring indicates an impairment to water quality, perform investigations to determine what contribution operation of the project has made to the impairment. Denver Water would submit the investigation report to Colorado DPHE within 12 months after the impairment is detected. If the Colorado DPHE concludes that operation of the project is primarily responsible for the impairment, Denver Water would prepare a mitigation plan.*

- *Condition 16: Monitor water quality in Gross Reservoir beginning no later than the ice-free season following issuance of the Corps' 404 permit or the amended FERC license, whichever is later, and continue for 5 years after the project becomes fully operational. Denver Water would submit monitoring data to Colorado DPHE annually by April 1 following each calendar year of sampling. Sampling would occur monthly during the ice-free season and a site in deep water near the dam. Analysis would include general field parameters, nutrients and biological collections, major ions, and metals.*

The Corps addressed water quality mitigation in the Corps ROD (Section 9.1.8 and Attachment E) and concluded the following.

> *The Final EIS contain detailed information about effects to water flows from the Moffat Project. Denver Water has entered into multiple third-party agreements to monitor or enhance Colorado River, Fraser River, South Boulder Creek, North Fork of the South Platte River, and/or South Platte River suspended particulates and turbidity. Condition 16 of the Section 401 Colorado Water Quality Certification No. 4369 requires monthly monitoring at Gross Reservoir for various general field parameters, including turbidity. The South Boulder Creek Restoration Project and Colorado Headwaters Mitigation Project, as described in Sections 1.2 and 1.3, respectively, of the Mitigation Plan, are incorporated as conditions of this authorization and will compensate for impacts to suspended particulates and turbidity.*
>
> *The Fish and Wildlife Mitigation Plan is a Special Condition of the permit and includes included multiple actions that Denver Water will implement within one year of receiving the FERC license amendment that would further mitigate for impacts to fish and wildlife values. The Corps understands that the commitment for riparian habitat plantings is replaced by the conveyance and protection of 253 acres of riparian habitat within the 539-acre Toll Property by Denver Water to the USFS.*
>
> *Additionally, Denver Water has entered into multiple third-party agreements to monitor or enhance South Boulder Creek environmental conditions as described in Section 10.0 of the ROD. Additionally, the Mitigation Plan describes other authorizations and legal requirements. The Corps understands that these enhancements are intended to provide an overall benefit to suspended particulates and turbidity.*

8-507.D.7.b.ii.D, Groundwater

A geologic map has been provided in Figure 3-2 in Exhibit 1. This map provides a general overview of the localized aquifers in the area of the Project. A map of water wells in the area of the project is provided in Figure 16 of Exhibit 1, Location of Water Wells Map.

Note that aquifer conditions are localized in the vicinity of the Project and groundwater flow directions are also associated with local features and conditions. Therefore, a regional groundwater flow description is not relevant for the Project. This section addresses the characteristics of groundwater and included a general discussion of recharge in relation to the Project. Impoundment of groundwater is not applicable to

this Project. Seepage losses are addressed in this section. Calculation of specific seepage losses is not applicable to this Project.

The following groundwater information and analysis was gathered for Denver Water's License Amendment Application to the FERC (Section 3.3.4):

AFFECTED ENVIRONMENT (GROUNDWATER)

Groundwater is a key component of the hydrologic cycle, which is a conceptual model of the circulation and physical interrelationships of water in the Earth's crust, atmosphere, oceans, lakes, and streams. Porous subterranean sediment or rock formations that are saturated with groundwater and have sufficient permeability to yield water to a well or spring in a useable quantity are called aquifers. These hydrogeologic units store groundwater and transmit it from recharge areas to discharge areas. Groundwater aquifers are recharged by infiltration of precipitation or seepage from surface water bodies. Aquifers in the mountains in the Project area are generally in fractured, crystalline rock. Along streams and in the lower parts of the valleys, shallower aquifers composed of alluvial sediments overlie the crystalline bedrock.

Water flowing in a stream can originate from precipitation or from groundwater that seeps from the streambed. The proportion of the stream flow attributable to groundwater is termed base flow, which sustains stream flow during the periods of the year when there is no precipitation or snowmelt runoff. Depletion of groundwater in storage increases the costs of extraction and may induce water quality degradation, land subsidence, and eventual loss of the resource.

Reservoirs serve as temporary storage locations for diverted water. Surface water storage sites may influence the hydrologic environment and alter the natural groundwater quality, i.e., the chemistry of the water.

Groundwater protection occurs at the federal, state, and local government levels through various environmental, agricultural, and natural resources agencies and through laws, regulations, and policies.

The affected environment for groundwater is described for current conditions and includes additional groundwater data collected in the fall of 2010 in response to comments on the Moffat Collection System Project Draft EIS.

Gross Reservoir

Bedrock in the Project area is Precambrian rock (Boulder Creek Granodiorite) that has been uplifted as part of the formation of the Front Range Mountains. Stream sediments consist of Quaternary alluvium. Gross Reservoir discharges to localized aquifers in the surface soils, alluvium, and bedrock. The bedrock does not transmit water except where fractures are present; however, the alluvium along the stream channel has a higher hydraulic conductivity and transmits groundwater more readily (Denver Water 1998b, see Final EIS for reference materials).

Based on review of the SEO well records, there are at least 50 water wells located approximately 0.3 mile north of Gross Reservoir near Retallack Gulch (see Figure 16, Exhibit 1). However, the majority of the

wells near Gross Reservoir are located about 1.5 miles south of the reservoir near the towns of Wondervu and Crescent Village. These latter wells are located upgradient (i.e., at a higher elevation) from Gross Reservoir. Information for household-use wells in the vicinity of Gross Reservoir, including water level information is provided in Table 23. Seasonal water level data were not available for these wells.

Table 23:
Groundwater Wells Located within the Vicinity of Gross Reservoir

Number of Wells	Township	Range	Section	Date Constructed	Total Depth (feet)	Water Level (feet below ground surface)	Flow Rate (gallons per minute)	Reported Well Use	Aquifer
3	IS	71W	16	1973, 198S, 1988	266 to 502	20 to 40	1.5 to 6.5	Household Use Only	NI
42	15	71W	17	1973 to 2007	205 to 700	7 to 280	1 to 15	Household Use Only	NI
8	15	71W	18	1974 to 1987	215 to 560	15 to 100	3.5 to 15	Household Use Only	NI
1	15	71W		1972	200	79	15	Household Use Only	NI
2	IS	71W	29	1972	32 5	80	3	Household Use Only	NI

NI - Not indicated in the database record.
Data taken from Colorado Division of Water Resource website.

South Boulder Creek

South Boulder Creek flows east from its headwaters near the Continental Divide. South Boulder Creek is a tributary of Boulder Creek, which is part of the South Platte River Basin system. Gross Reservoir is located on South Boulder Creek approximately half-way between its headwaters and its confluence with Boulder Creek.

The Boulder Creek valley exposes approximately 10,000 feet of folded and faulted sedimentary rock at the ground surface but contains a thickness of less than 100 feet of alluvial deposits. The stream is dominated by water from snowmelt and summer thunderstorms, with highest natural flows occurring during May to June and lowest flows during January and February.

There are about 30 groundwater users within a 0.5-mile corridor of South Boulder Creek between the outlet of the Moffat Tunnel to the inlet of Gross Reservoir. Additional water rights that rely on surface water or springs are located within this area. Groundwater is mainly used as domestic water supply in this area (Denver Water 1998b, see Final EIS for reference materials). The SEO water well database indicates that there are scattered water wells located proximal to the creek from the outlet of the Moffat Tunnel to Rollinsville. The area around Rollinsville has many water wells located up to 1 mile away from South Boulder Creek. Similar conditions exist around the towns of Pactolus, Lincoln Hills, and Pinecliffe, with some wells located along drainages to South Boulder Creek. The majority of the water wells found along this portion of South Boulder Creek are located around the towns of Wondervu and Crescent Village, south of Gross Reservoir, and other communities near Retallack Gulch (north of Gross Reservoir) and Woods Gulch (east of Gross Reservoir) have many water wells listed in the SEO database.

PROJECT EFFECTS (GROUNDWATER)

This section addresses potential changes to the groundwater system resulting from implementation of the Project. The analysis of impacts that are specifically related to implementing the Project are based on a comparison of data for the existing system at full use because the latter reflects conditions at the time the Project would come on line in 2032.

Direct and indirect impacts to groundwater may be expected to occur as a result of implementing the Project. Potential groundwater issues documented during scoping for the Moffat Collection System Project EIS included effects on habitats supported by groundwater systems on the East Slope.

The reservoir level would not be lowered to accommodate construction activities and water levels would fluctuate as they currently do during normal operations. After construction, the reservoir level would rise above the current level due to the dam raise. This would raise groundwater levels near the reservoir, which would have a beneficial effect on groundwater wells near the reservoir and downstream by raising groundwater levels in those areas. The Project would not adversely impact water wells. The quarrying for construction of the Project is not expected to impact any groundwater wells.

Gross Reservoir

Under the Project, the projected new normal water elevation in the reservoir would be about 124 feet higher than at present. Increases in Gross Reservoir water level elevations as a result of the Project would increase seepage from the reservoir and cause groundwater levels to rise in adjacent areas.

Increases in groundwater levels may also increase groundwater flow rates to springs and streams near reservoirs, and existing nearby wetlands. The assessment of potential groundwater impacts relies on the surface water hydrology analysis as well as other available hydrogeologic information.

In areas immediately upstream of Gross Reservoir, a groundwater mounding effect resulting from higher reservoir water levels would cause the eastward hydraulic gradient to decrease and thus reduce the eastward rate of groundwater flow toward the reservoir.

South Boulder Creek

Changes to surface stream flow rates may affect groundwater because of stream-aquifer interactions within the natural hydrologic system. Surface water and groundwater are linked components of the hydrologic system in every watershed. Snowmelt infiltration recharges the groundwater flow system in each potentially affected watershed. Snowmelt also causes runoff during the spring and early summer months which increases stream flows. Depending on the elevation of water levels in streams compared to the adjacent groundwater levels, water flows between surface water bodies, streams, and aquifers. Thus, changes in surface water levels may also affect groundwater levels.

Recharge to groundwater is a dynamic hydrologic process involving the deep infiltration of water derived from precipitation. In upland areas of a watershed, snowmelt and rainfall infiltrates the shallow surface soils and migrates below the root zone down to the water table. After reaching the water table, groundwater migrates away from higher water table elevations and toward the lower elevation areas of the watershed. In some areas, recharge is also contributed by water seepage beneath lakes and

streambeds in the upland portions of the watersheds. In the lower elevation areas of a watershed, typically along stream courses, groundwater levels may rise above ground surface creating springs or causing seepage into streams or lakes. Thus, groundwater resources may be impacted by projects that change the physical characteristics of the land surface affecting recharge rates or change the levels of surface water bodies or stream flows.

Under the Project, flow changes along South Boulder Creek above Gross Reservoir would be related to the changes in Moffat Tunnel diversions from the West Slope rivers. Flows would increase in the summer months and remain relatively unchanged during winter months of an average year when compared to the existing system at full use. Below Gross Reservoir, the changes in stream flow would be in response to the increased storage and changes in releases from Gross Reservoir. During the winter months, the transfer of water from Gross Reservoir to Ralston Creek Reservoir would increase flows along South Boulder Creek.

The impacts of these flow changes on groundwater are expected to be negligible. Along South Boulder Creek above Gross Reservoir, the stream generally has a steep gradient typical of mountain streams. Thus, increasing stream flow would cause a relatively small increase in the elevation of the stream level. Even if the stream level increases during the summer months, the rise in groundwater levels would be limited to the area immediately adjacent to the stream and would not be more than the slight change in stream level caused by the flow increase.

Downstream from Gross Reservoir, flow changes during the winter months are expected to cause even smaller rises in groundwater levels, which would also be localized in areas immediately next to the stream. Immediately below Gross Reservoir, the greater degree of reservoir seepage into groundwater under the Project would cause groundwater levels to rise slightly and cause groundwater discharge into South Boulder Creek to increase slightly.

Downstream from Gross Reservoir, South Boulder Creek would experience a slight decrease in stream level in the spring, about 2 inches, which would have negligible impacts to groundwater levels. During the low flow season of the year, higher reservoir seepage rates would provide more groundwater discharge to the stream.

Other than those associated with raising Gross Dam, there would be no discernible effects on groundwater resources in the Project area under the Project.

The CDPHE Water Quality Control Commission has established Basic Standards for Ground Water as Regulation No. 41, 5 CCR 1002-41. These standards are based on use classifications including domestic use, agricultural use, and surface water quality protection. Numeric standards have been established for radioactive materials, organic pollutants, biological parameters, and inorganic parameters. Regulation No. 42—Site-Specific Water Quality Classifications and Standards for Ground Water—includes specific classified areas that have site-specific standards. Based on a review of the classified areas, there are no site-specific standards listed for any areas located in Boulder County.

The surface water diverted into the stream is of very high quality, and, thus, it is unlikely that groundwater quality would be affected by the Project.

8-507.D.7.b.ii.E, Wetlands and Riparian Areas

Figure 17 in Exhibit 1, Wetlands and Riparian Areas Map, provides a map of wetlands, riparian areas, and other water features in the Project area.

The following wetland and riparian information and analysis was gathered for Denver Water's License Amendment Application to the FERC Section 3.3.8):

AFFECTED ENVIRONMENT (WETLANDS AND RIPARIAN AREAS)

This section addresses riparian areas, wetlands, and other water features in the Project area. Riparian areas are unique vegetation communities located adjacent to waterways and wetlands that provide important habitat for numerous plant and animal species. They generally occupy transition areas between aquatic and upland habitats and may function as excellent vegetative buffers for aquatic resources. Although riparian habitats are often combined with wetland habitats as a result of their intimate relationship to the hydrologic regime, they differ in that riparian areas are generally linear, are more terrestrial, are often dependent on a natural disturbance regime, and do not include the instream environment (Naiman et al. 2005, see Final EIS for reference materials). Riparian areas are defined as:

> *Those plant communities adjacent to and affected by surface or groundwater of perennial or ephemeral water bodies such as rivers, streams, lakes, ponds, playas, or drainage ways. These areas have distinctly different vegetation than adjacent areas or have species similar to surrounding areas that exhibit a more vigorous or robust growth form (CDOW 2006a).*

Wetlands are areas that are inundated or saturated with water at or near the surface of the soil for a sufficient duration during the growing season to develop characteristic soils and vegetation adapted to anaerobic conditions (Environmental Laboratory 1987, see Final EIS for reference materials). Many wetlands are protected under Section 404 of the CWA as Waters of the U.S. and special aquatic sites. Non-wetland riparian areas include areas that receive extra moisture but do not meet the criteria to be considered wetlands.

"Other water features" include surface water features such as reservoirs, ponds, streams, and ditches, many of which are also under the jurisdiction of the Corps under Section 404 of the CWA. Linear features must have a defined bed and bank and a scoured bed that contains less than 50 percent vegetation cover to be classified as other water features.

Wetland and Riparian Functions

Wetland and riparian areas provide a number of functions and societal values. Functions are natural processes that operate regardless of their perceived value to people. They include hydrological controls such as short- and long-term water storage and flood attenuation; geomorphic functions such as bank stabilization and sediment retention; biogeochemical functions such as nutrient and toxicant removal; and habitat functions such as support of fish and wildlife habitat and food chain support.

The Corps Denver Regulatory Office uses the FACWet (*Functional Assessment of Colorado Wetlands*) Method (Johnson et al. 2011, see Final EIS for reference materials) in its review of Section 404 Individual Permits, including mitigation planning. The methods for assessing potential changes in wetland functions are described in the Moffat Collection System Project Final EIS (Corps 2014). Assessment of impacts to wetlands functions that would be affected by implementation of the Project was performed as part of the required Individual 404 Permit approval process. Following the wetland assessment in the Final EIS (2014), an updated wetland delineation was conducted in 2015 (Exhibit 13).

Wetland and riparian functions of the areas that will affected by the Project are described in Section 4 of Exhibit 13, 2015 Wetland Delineation Report.

Study Methods

Two different methodologies were used to describe the affected environment for riparian and wetlands areas, as follows.

Gross Reservoir. The first methodology was applied to Gross Reservoir and other associated water features in immediate proximity to the reservoir because these areas could be affected by a variety of direct and indirect impacts during construction and operation, including ground-disturbing activities. These facilities were evaluated using field studies within the affected areas to delineate wetlands and other water features and to map riparian woodland and shrubland communities.

Riparian areas within the Project area have been broadly defined as those non-wetland areas dominated by woody vegetation that are adjacent to aquatic habitats. They have been classified into three groups: (1) woodland, (2) shrubland, and (3) woodland/shrubland combination (wood/shrub). These groups are generally defined based on the dominant vegetation type. Most of the riparian woodland areas are very small and are dominated by widely spaced riparian deciduous trees with canopy cover less than 60 percent (Carsey et al. 2003, see Final EIS for reference materials). The riparian shrublands are generally small and are dominated by dense populations of shrub species.

Riparian areas within the Project area have also been described using plant associations available in the CNHP *Field Guide to the Wetland and Riparian Plant Associations of Colorado* (Carsey et al. 2003). For riparian areas that have been classified as wood/shrub combination, both woodland- and shrubland-association components have been identified.

The Carsey plant associations (Carsey et al. 2003, see Final EIS for reference materials) identified in the Project area include:

- Narrowleaf Cottonwood (*Populus angustifolia*)/Thinleaf Alder (*Alnus incana*) Woodland—Thinleaf alders (and sometimes other less dominant shrubs) along other waters, with an open to nearly closed canopy of narrowleaf cottonwood trees. This plant association is considered a mid-seral community (not the youngest or oldest cottonwood stands in the area).
- Narrowleaf Cottonwood/River Birch (*Betula occidentalis*) Woodland—One of the wettest narrowleaf cottonwood communities, which grows thick along stream banks, with river birch as a co-dominant

and other less-dominant shrub species. This plant association is considered an early- to mid-seral community.

- Sandbar Willow *(Salix exigua*)/Barren Ground Shrubland—An almost exclusively thick-shrub canopy of sandbar willow associated with annual flooding that is found along the edge of rivers and streams and can grow into the channel. This plant association is considered an early-seral community.
- Sandbar Willow/Mesic Graminoid Shrubland—Sandbar willow-dominated shrubland with other shrub species possible, including various willow species and thinleaf alder in the shrub layer, and at least 30 percent ground cover of grasses and forbs. This is considered an early-seral community.
- River Birch/Mesic forb Shrubland—A tall-shrub to small-tree community with a limited forb understory due to the thick shrub canopy. River birch dominates the tree/shrub layer with other species possible, including thinleaf alder, red-osier dogwood (*Cornus sericea*), Utah serviceberry (*Amelanchier utahensis*), cliffbush (*Jamesia americana*), chokecherry (*Prunus virginiana*), and mountain willow (*Salix monticola*). This is considered a mid-seral community.

Wetlands are important biological resources that perform many functions, including groundwater recharge, stormwater and flood flow attenuation, erosion control, and water quality improvement. They also provide habitat for many plants and animals, including threatened and endangered species.

Many wetlands and other water features, including reservoirs, ponds, intermittent and perennial streams, and some stormwater and irrigation ditches, are considered Waters of the U.S. by the Corps. These "jurisdictional" areas require a permit from the Corps for any discharge of dredged or fill material into such waters. Furthermore, Executive Order 11990—*Protection of Wetlands* directs all federal agencies to "minimize the destruction, loss or degradation of wetlands."

Wetland areas were delineated for all Project areas, including Gross Reservoir as most recently documented in Exhibit 13. Delineation methods followed the Routine Determination procedures outlined in the *1987 Corps of Engineers Wetlands Delineation Manual* (Environmental Laboratory 1987, see Final EIS for reference materials). This method involves a detailed examination of the plants, soils, and hydrologic indicators. The same procedures were used for wetlands observed in non-accessible areas except that all soils were interpolated from existing data, and all hydrologic and vegetation data collected were limited to those observable from the closest accessible vantage point(s) with the aid of binoculars (if needed).

After determining the approximate extent of the wetlands, the wetland boundaries were mapped on 1-inch equals 200-foot (1:200) color aerial photographs, and then the accessible area was determined using a Global Positioning System device with sub-meter accuracy. The surveyed and/or mapped wetland locations and boundaries were then transferred to ArcGIS computer software for calculation of areas and generation of maps.

Wetlands were classified using *Classification of Wetlands and Deep Water Habitats of the U.S.* (Cowardin et al. 1979). The wetlands in the Project area were classified as Palustrine Emergent (PEM), Palustrine Scrub/Shrub (PSS), or a combination of Palustrine Emergent and Palustrine Scrub/Shrub (PEM/PSS). PEM Wetlands are defined by Cowardin et al. (1979) as those wetlands that are dominated by erect, rooted, herbaceous plants. PSS Wetlands are those wetlands that are dominated by woody vegetation

less than 20 feet tall. PEM/PSS Wetlands are those wetlands that are composed of distinct communities of both PEM and PSS vegetation. Wetlands observed in the Project area are shown in Figure 17, Wetland and Riparian Areas and Other Water Features, in Exhibit 1.

Other Water Features identified within the Project area include Gross Reservoir and a number of intermittent and perennial streams associated with the reservoir. Other water features observed in the Project area are shown in Figure 17, Wetland and Riparian Areas and Other Water Features, in Exhibit 1.

South Boulder Creek. South Boulder Creek was evaluated using a different study methodology than was used in the Project area because the stream would be affected only by changes in stream flows, i.e., there would be no ground-disturbing activities related to the Project. This method consisted of using existing CPW riparian mapping data, selecting representative sampling sites, and conducting detailed field studies at the sampling sites.

Riparian vegetation along South Boulder Creek was mapped according to the following CPW groups/plant associations: Riparian Evergreen (RE), Riparian Deciduous Tree (RT), Riparian Shrub (RS), and Riparian Herbaceous (RH). The CPW mapping data do not specifically identify wetland conditions, and the riparian map units include both wetland and non-wetland- areas. Therefore, the discussions of South Boulder Creek address riparian resources in the broad sense, including all wetland and non-wetland areas along the stream that could be affected by stream flow. Because changes in stream flow would not trigger the requirement for Section 404 permitting, wetlands and other water features were not delineated.

Representative sampling sites were selected to characterize the types of riparian communities documented through the CPW mapping. Representative sampling sites SBC1 and SBC3 were selected as being generally representative of the types of riparian communities along South Boulder Creek from the Moffat Tunnel discharge to Gross Reservoir and from Gross Reservoir to Denver Water's South Boulder Creek Diversion Canal, respectively. Sampling site selection was based, in part, on a preliminary stratification of river segments into Rosgen (1994) stream types, followed by field reconnaissance to evaluate other site characteristics and to become familiar with the range of site conditions. The Rosgen system is based on the channel width-to-depth ratio, available floodplain width, and channel gradient. Different riparian communities are often associated with stream characteristics of slope, sinuosity, and bed material: some reaches of South Boulder Creek have relatively lengthy areas of steeper, low sinuosity reaches typical of streams at higher elevations in Colorado (classified as Rosgen Type A streams), and other reaches have portions in less steep, moderate sinuosity reaches (classified as Rosgen Type B streams) (Ecological Resource Consultants 2006, see Final EIS for reference materials). Other factors considered in sampling site selection included a site's suitability for hydraulic modeling, the quality and type of riparian and wetland vegetation, land use or disturbance history, and accessibility of the site.

Representative sampling sites SBC1 and SBC3 were also used for hydraulic analysis and for channel dynamics studies (Ecological Resource Consultants 2006, see Final EIS for reference materials). A multidisciplinary approach was followed at the sampling sites so that riparian vegetation sampling was coordinated with hydraulic analysis and the channel dynamics studies.

Field studies were conducted during August and September 2005 to characterize riparian vegetation at the SBC1 and SBC3 sampling sites. Additional field observations were conducted in September 2010 to evaluate the presence of wetlands and sources of hydrology. Riparian and wetland data collected at the representative sampling sites included:

- Dominant and most frequently occurring plant species
- Horizontal and vertical measures of vegetation breaks along transects
- Detailed mapping of vegetation types based on the CNHP *Field Guide to Wetland and Riparian Plant Associations of Colorado* (Carsey et al. 2003; see Final EIS for reference materials) to classify riparian and wetland plant associations and to identify each association's position relative to the stream channel, hydrologic affinity, and other relevant characteristics
- Quantitative and qualitative data on active channel and floodplain features, such as beaver ponds, overflow and side channels, seepage areas, and gravel bars.

As mentioned above, wetland delineation was not conducted at the stream sampling sites.

Gross Reservoir

The Project area was observed by pedestrian, automobile, and boat surveys in July 2005 and revisited in June 2006 to identify riparian areas, wetlands, and other water features. The Project area includes the enlarged extent of Gross Reservoir and all areas of construction disturbance, including dam modifications and access roads. Riparian areas and/or wetlands were observed along the Gross Reservoir shoreline and along drainages associated with the reservoir, including South Boulder Creek upstream and downstream of the reservoir, Winiger Gulch and its tributaries, Forsythe Canyon, and several unnamed tributaries to the reservoir. More recent wetland delineation was conducted in 2015 and the report is included in Exhibit 13.

Riparian Areas

A total of 4.24 acres of riparian areas were observed within the Project area (Table 24).

Riparian deciduous woodlands occupying 0.73 acre were observed in the Project area: 0.43 acre is associated with the reservoir shoreline, and 0.30 acre is associated with drainages within the reservoir.

The reservoir shoreline riparian woodlands are categorized in the Narrowleaf Cottonwood/Thinleaf Alder Association, with the additional dominant of plains cottonwood in the community. These woodlands are characterized by very widely-spaced narrowleaf cottonwood and plains cottonwood, with pockets of very tall thinleaf alder. The riparian woodlands associated with drainages are categorized in the Narrowleaf Cottonwood/River Birch Association, with the additional dominant of plains cottonwood in the community. They are characterized by an overstory of narrowleaf cottonwood and plains cottonwood, with pockets of very tall thinleaf alder and river birch. These areas are generally lined with various evergreen species, including Douglas fir (*Pseudotsuga menziesii*), lodgepole pine (*Pinus contorta*), blue spruce (*Picea pungens*), and Engelmann spruce (*Picea engelmannii*).

Riparian shrublands encompassing 2.37 acres were observed in the Project area: 0.71 acre is associated with the reservoir shoreline, and 1.66 acres are associated with drainages within the reservoir.

The reservoir shoreline riparian shrublands generally occur in very small pockets and are dominated by sandbar willow. These areas are categorized in the Sandbar Willow/Barren Ground or Sandbar Willow/Mesic Graminoid Association, with those on barren ground closer to the shoreline where more frequent flooding occurs. The riparian shrublands associated with drainages (especially South Boulder Creek above the reservoir) are much more diverse and are categorized in the River Birch/Mesic Forb Shrubland Association. Other species commonly observed in the areas include various willows (*Salix* spp.), serviceberry (*Amelanchier alnifolia*), river birch, red-osier dogwood, cliffbush, ninebark (*Physocarpus monogynus*), chokecherry, various gooseberries (*Ribes* spp.), Wood's rose (*Rosa woodsii*), and snowberry (*Symphoricarpos* sp.), along with pockets of dense herbaceous vegetation.

Woodland/shrubland riparian areas encompassing 1.14 acres were observed in the Project area, including a 0.63-acre area associated with the reservoir shoreline and a 0.51-acre area associated with drainages within the reservoir. These areas generally contain a mixture of the Riparian Woodland and Riparian Shrubland associations and the same species listed above for these communities.

Table 24:
Summary of Riparian Areas and Wetlands in the Project Area

Location	Riparian Type (acres)				Wetland Type[1] (acres)			
	Woodland	Shrubland	Wood/ Shrub	Total	PEM	PSS	PEM/ PSS	Total
Gross Reservoir Shoreline	0.43	0.71	0.63	1.77	0.42	0.16	0.05	0.64
South Boulder Creek Upstream	0.08	0.14	0.09	0.31	0.00	0.02	0.22	0.24
South Boulder Creek Downstream	0.04	0.00	0.00	0.04	0.00	0.00	0.16	0.16
Winiger Gulch	0.06	0.55	0.00	0.61	0.00	0.39	0.00	0.39
Winiger Gulch Tributaries	0.00	0.14	0.00	0.14	0.00	0.18	0.29	0.47
Winiger Ridge Tributary	0.00	0.00	0.00	0.00	0.07	0.00	0.00	0.07
Forsythe Canyon	0.04	0.73	0.00	0.77	0.00	0.19	0.00	0.19
Forsythe Gulch Tributary	—	—	—	—	0.00	0.06	0.00	0.06
Unnamed Southern Tributaries	0.00	0.10	0.42	0.52	0.04	0.31	0.00	0.35
Chamberlain Gulch	0.08	0.00	0.00	0.08	0.00	0.00	0.00	0.00
Advent Gulch	—	—	—	—	0.00	0.00	0.07	0.07
Advent Gulch Tributary	—	—	—	—	0.00	0.02	0.00	0.02
Total (acres)	0.73	2.37	1.14	4.24	0.53	1.33	0.79	2.66

Notes:
1 Wetland type is based on Cowardin et al. 1979
PEM = Palustrine Emergent Wetland
PSS = Palustrine Scrub/Shrub Wetland

Wetlands

A total of 2.66 acres of wetlands were delineated in the Project area (Table 24) based on the 2015 wetland delineation included in Exhibit 13.

- PEM Wetlands encompassing 0.53 acre were observed in the Project area, including 0.42 acre along the reservoir shoreline and 0.11 acre along drainages associated with the reservoir. The reservoir shoreline PEM Wetlands are commonly dominated by creeping bentgrass (*Agrostis stolonifera*), woolly sedge (*Carex pellita*), fowl mannagrass (*Glyceria striata*), reed canarygrass (*Phalaris arundinacea*), and panicled bulrush (*Scirpus microcarpus*). The PEM Wetlands associated with the drainages are commonly dominated by giant angelica (*Angelica ampla*), common spikerush (*Eleocharis palustris*), field horsetail (*Equisetum arvense*), fowl mannagrass, and American speedwell (*Veronica americana*).
- PSS wetlands encompassing 1.33 acres were observed in the Project area, including 0.16 acre along the reservoir shoreline and 1.17 acre along drainages associated with the reservoir. The reservoir shoreline wetlands are commonly dominated by sandbar willow. The wetlands associated with drainages are commonly dominated by thinleaf alder, river birch, Missouri River willow (*Salix eriocephala*), sandbar willow, and park willow (*Salix monticola*).
- PEM/PSS Wetlands encompassing 0.79 acre were observed in the Project area, including 0.65 along the reservoir shoreline and 0.14 along drainages associated with the reservoir. The dominant vegetation in these wetlands reflects a combination of vegetation found in the PEM and PSS Wetlands of the area.

The water source for wetlands associated with the reservoir shoreline is primarily the reservoir itself. The water source for wetlands associated with the drainages is primarily provided by groundwater discharges (seeps), capillary action, and overbank flooding.

Functions provided by the wetlands at Gross Reservoir vary with location, dominant vegetation, and size. All of the wetlands provide good general wildlife habitat, and many also provide good fish/aquatic habitat. Many of the wetlands in the Project area provide good shoreline stabilization and production export/food chain support due to the vegetation density, type, and structure in the wetlands.

Wetlands along the edges of the perennial drainages (which include all but the unnamed southern tributary and Chamberlain Gulch) may provide potential habitat for Colorado state species of concern, including the northern leopard frog (*Lithobates pipiens*).

Other Water Features

Seven other water features were identified in the Project area, including the reservoir itself and six linear features.

Gross Reservoir covers a total of 418 acres at normal water elevation (7,282 feet) capacity. The linear features encompass a total of 4.06 acres (13,790 linear feet), including South Boulder Creek (3.27 acres, 2,550 linear feet), Winiger Gulch (0.21 acre, 2,290 linear feet) and its tributary (0.05 acre, 700 linear feet), Forsythe Canyon (0.36 acre, 6,350 linear feet), Chamberlain Gulch (0.03 acre, 400 linear feet), and an unnamed southern tributary (0.14 acre, 1,500 linear feet).

All of these linear features are natural tributaries associated with Gross Reservoir, except for Chamberlain Gulch, and all are perennial, except for the intermittent unnamed southern tributary and Chamberlain Gulch. Chamberlain Gulch is classified as a perennial feature on topographic maps, but only occasional shallow pools were observed in the channel during field visits. Details of the linear features are described below.

- South Boulder Creek enters Gross Reservoir at its southwest end and exits at the dam outlet. It has a cobble bed with 1- to 2-foot-high banks. The channel width is 30 to 80 feet, with an observed water depth of 6 to 30 inches.
- Winiger Gulch enters the reservoir from the northwest just north of where South Boulder Creek enters. The tributary to Winiger Gulch enters Winiger Gulch approximately 1,300 feet upstream (northwest) of the reservoir. Both are approximately 3 feet wide with 1 to 3 inches of water and a sandy bed.
- Forsythe Canyon enters Gross Reservoir at its northwest arm. It is approximately 5 feet wide, with an observed water depth of 0 to 6 inches and a cobble bed with intermittent boulders.
- There are two unnamed southern tributaries associated with Gross Reservoir, but only the eastern one has a scoured bed and defined banks with less than 50 percent vegetation cover and is, therefore, classified as an “other water feature.” This tributary is approximately 2 feet wide, with an observed water depth of less than 1 inch and a cobble bed.
- Chamberlain Gulch is the only linear water feature in the Project area that is not a tributary to Gross Reservoir. It parallels the east side of Gross Dam Road at the southeastern edge of the Project area. The channel has a width of approximately 2 to 3 feet with a sand and cobble bed. Though topographic maps show it as a perennial stream, no water was observed in the channel during field visits except for occasional pools no more than 2 inches deep.

South Boulder Creek

The headwaters of South Boulder Creek are located in the vicinity of Haystack Mountain on the Continental Divide. Within about 2 miles, water diverted from West Slope rivers as part of Denver Water’s Moffat Collection System discharges into the stream from the East Portal of the Moffat Tunnel. From there, South Boulder Creek flows to Gross Reservoir, where it is impounded. From Gross Reservoir, South Boulder Creek flows to Eldorado Springs and eventually drains into Boulder Creek just east of Boulder. Approximately 4.5 miles downstream from Gross Reservoir, water is diverted to Denver Water’s South Boulder Diversion Canal to supply water for Denver Water’s municipal water consumers.

The characterization of existing riparian and wetland acres focused on the South Boulder Creek stream reach from the outlet of Moffat Tunnel to Eldorado Springs near Denver Water’s South Boulder Diversion Canal, which is 22 miles long and ranges in elevation from approximately 6,000 to 9,200 feet. A summary description of riparian communities based on CPW mapping is provided in Table 25.

Table 25:
Areal Extent of CPW Riparian Vegetation Types at South Boulder Creek Representative Sampling Site SBC1

Length (miles)	Riparian Evergreen (RE)		Riparian Deciduous Tree (RT)		Riparian Shrub (RS)		Riparian Herbaceous (RH)		Total Area (acres)
	Acres	Percent	Acres	Percent	Acres	Percent	Acres	Percent	
22.0	56	18.8	37	12.4	93	31.2	112	37.6	298

Source: CDOW (2006a)

South Boulder Creek above Gross Reservoir (Representative Sampling Site SBC1)

As described above, a single representative sampling site (SBC1) was selected to characterize the riparian and wetland features of South Boulder Creek from the Moffat Tunnel outlet to Gross Reservoir. The SBC1 sampling site is located above Gross Reservoir approximately 2 miles upstream of Rollinsville at the Jumbo Mountain Picnic area.

South Boulder Creek above Gross Reservoir consists of Rosgen Types A, B, and C streams. Much of this stream reach has been highly modified and disturbed by past and/or ongoing land uses. The SBC1 sampling site is a Rosgen Type B stream within a confined valley. The bed consists of cobble and boulder, with small quantities of stored sand in the bed and bank. No alluvial deposits suitable for plant colonization were observed within the active channel during field sampling. Riparian vegetation along the main channel is limited to a narrow, inconsistent fringe of mesic herbs and willow shrubs.

The SBC1 study reach is 599 feet long and occupies 0.27 acre. The active channel alluvial habitat that supports colonization by riparian plant species was mapped at 0.06 acre. These habitats were observed only along the uppermost edge of the active channel along the left bank, where colluvium has helped to create a sliver of habitat suitable for colonization. The elevations associated with these habitats ranged from 0.62 to 0.13 foot below the water surface. The areal extent of CNHP groups/plant associations mapped at representative sampling site SBC1 is provided in Table 26.

No CNHP plant associations in the Evergreen Riparian Forest group were mapped at SBC1. However, one stand of upland conifer dominated by lodgepole pine was mapped on 0.44 acre adjacent to the sampling site. The understory species include a few hydrophytic species and several aspen trees. This stand is positioned as high as 11.7 feet above the river on top of the right bank levy but extends to lower elevations on the steep cutbank hillslope downstream.

Two shrub-dominated riparian plant associations were mapped at SBC1, one association each in the Tall Willow Shrubland group and the Non-willow Shrubland group. These two associations collectively occupy 0.59 acre (100 percent) of the sampling site. These shrub-dominated stands support Drummond's willow, thinleaf alder, and river birch to varying degrees and are located primarily along the overflow channel along river right but also occur in scattered locations along the main channel and the high left bank slope. The Tall Willow Shrubland Association mapped along the main channel is poorly defined, with clumps of willow scattered along the steep boulder-cobble shoreline. At higher elevations on the steep left bank, groundwater provides essential moisture to support patches of willows and mesic forbs. The elevations of these stands were generally from 1.6 to 3.0 feet, with a maximum elevation of 14.3 feet above the water surface on the left bank. On the high banks, the hydrophytic understory species are limited to seepage

areas and often grow next to species with stronger upland affinities. Associated understory species include Woods' rose, fireweed (*Epilobium angustifolium*), field horsetail, fringed brome, American red raspberry, stinging nettle (*Urtica dioica*), whitestem gooseberry, and wax currant (*Ribes cereum*). The association in the overflow channel is primarily dominated by Drummond's willow and thinleaf alder but also includes some river birch, narrowleaf cottonwood, and aspen. This community also supports a lush understory that includes fowl bluegrass, twinflower honeysuckle, tall fringed bluebells, and bluejoint reedgrass. The elevations measured within the overflow channel ranged from 7.9 to 11.7 feet above the water surface, which may, to some degree, indicate how much the main channel has degraded due to channelization.

Table 26:
Areal Extent of CNHP Groups/Plant Associations at South Boulder Creek Representative Sampling Site SBC1

CNHP Group/Association	Acres	Percent
Tall Willow Shrubland (RS-CPW)		
Drummond's willow/mesic forb	0.17	29
Non-willow Shrubland (RS-CPW)		
Thinleaf alder-Drummond's willow	0.42	71
Shrub-dominated Riparian Total	0.59	100
Total Acres Mapped	0.59	100

Notes:
1 CPW vegetation type equivalent to the CNHP Group/Association is provided in parentheses, e.g., RS-CPW.
2 Total does not include active channel or upland vegetation community acreages.
3. Totals may not equal 100 percent due to rounding.
CNHP = Colorado Natural Heritage Program
CPW = Colorado Parks and Wildlife
RS = Riparian shrub

The shrub-dominated Riparian group mapped at SBC1 best represents the more-channelized portions of the river segment generally found upstream of Rollinsville.

No CNHP association in the Herbaceous Vegetation group was mapped at SBC1. However, an upland grass vegetation type was mapped nearby. This upland grass type has a relatively low herb cover on a steep gravelly bank. It was not strictly dominated by grass species but included low-growing prairie sagewort (*Artemisia frigida*), fringed brome, fireweed, timothy, Canada thistle, sulphur-flower buckwheat (*Eriogonum umbellatum*), and ox-eye daisy (*Chrysanthemum leucanthemum*). Hydrophytic herbaceous species were common in areas influenced by groundwater seepage. The upland grass community occurred as high as 12 feet above the river although elevations generally ranged from 3.0 to 4.4 feet above the water surface. This type of high, steep bank is common along the channelized portions of the river segment and likely would be interpreted as riparian herbaceous using CPW mapping techniques. An example of riparian herbaceous-dominated vegetation that included a substantial proportion of hydrophytic species at SBC1 occurred only as part of the understory associated with Shrub-dominated Riparian group.

The upland grass vegetation documented at SBC1 best represents the more channelized portions of the river segment generally upstream of Rollinsville. The Herbaceous Vegetation group mapped at SBC1 is

more typical of the less-disturbed Rosgen Type A and Type B streams downstream of the channelized portions of this stream reach.

Redtop is a facultative wetland species that grows in mesic to semi-hydric conditions and is tolerant of some flooding. The association is typically found in or near irrigated hay meadows or along streams and ditches. Typically cultivated as a hay crop, this species readily escapes cultivation and can be found in many wet meadows in the western U.S., including those that are no longer cultivated or have never been cultivated (Carsey et al. 2003, see Final EIS for reference materials).

South Boulder Creek below Gross Reservoir (Representative Sampling Site SBC3)

Representative sampling site (SBC3) was selected to characterize the riparian and wetland features of the stream reach below Gross Reservoir downstream to Eldorado Springs. The SBC3 sampling site is located approximately 1 mile downstream from Gross Reservoir.

South Boulder Creek below Gross Reservoir is generally classified as a Rosgen Type A stream. Although its Rosgen Type B classification differs from the generally Type A stream classification for South Boulder Creek below Gross Reservoir, the SBC3 site was considered an excellent choice for sampling.

This reach of South Boulder Creek has a predominantly cobble and boulder bed, with various bedrock outcrops and stored sand and gravel. A significant amount of exposed in-channel alluvium was present during field sampling, most of which supported colonizing riparian herbs and willow seedlings. Most of the riparian vegetation is restricted to a relatively narrow margin along the main channel because the stream banks are generally steep or V-shaped and riparian habitat transitions to upland habitat over a relatively short distance.

The SBC3 study reach is 446 feet long and occupies 0.59 acre. The SBC3 sampling site contains approximately 0.16 acre of alluvial habitat within the active channel. Colonizing species, including seedlings of sandbar willow and another unidentified willow, as well as scouring rush horsetail (*Equisetum hyemale*), were observed in this habitat. Elevations ranged from -0.29 foot to 2.0 feet above the mean water surface elevation on the day of field sampling. The uncolonized portions of the gravel bar were not distinguished from colonized portions due to their small size and the difficulty in mapping them. The areal extent of CNHP groups/plant associations mapped at representative sampling site SBC3 is provided in Table 27.

The SBC3 sampling site includes one Riparian Evergreen group/plant association mapped on 0.03 acre (11 percent) of the mapped portion of SBC3. This stand occupies a narrow bench along the right bank (looking downstream) where it commingles with the more abundant upland conifer forest. The upland conifer forest stand may also be Riparian Evergreen, but the site has been highly disturbed by recreation access, which may have destroyed the hydrophytic understory. The two stands have similar elevations, with Riparian Evergreen group/association ranging from -0.32 to 6.04 feet above the water surface, and the upland conifer forest ranging from 3.2 to 4.0 feet above the water surface. Combined, the two stands occupy 0.33 acre.

Table 27:
Areal Extent of CNHP Groups/Plant Associations at South Boulder Creek Representative Sampling Site SBC3

CNHP Group/Association	Acres	Percent
Riparian Evergreen (RE-CPW)		
Blue spruce/field horsetail	0.03	11
Riparian Evergreen Total	0.03	11
Riparian Shrub (RS-CPW)		
River birch/mesic forb	0.04	15
River birch/mesic graminoid	0.02	7
Riparian Shrub Total	0.06	22
Riparian Herbaceous (RH-CPW)		
Blue joint reedgrass	0	0
Beaked sedge	0.01	4
Redtop	0.17	63
Riparian Herbaceous Total	0.18	67
SBC3 Total Acres Mapped	0.27	100

Notes:
CPW vegetation type equivalent to the CNHP Group/Association is provided in parentheses, e.g., RE-CPW.
Totals do not include active channel or upland vegetation community acreages.
Totals may not equal 100 percent due to rounding.
CNHP = Colorado Natural Heritage Program
CPW = Colorado Parks and Wildlife
RE = Riparian evergreen
RH = Riparian herbaceous
RS = riparian shrub

The dominant tree species in these stands is blue spruce, but several ponderosa pines (*Pinus ponderosa*) were also observed. The more mesic understory species included field horsetail, common cowparsnip (*Heracleum maximum*), Canada goldenrod (*Solidago canadensis*), Woods' rose, and snowberry.

Mapping of the Riparian Shrub group/association at the SBC3 sampling site included two associations in the Non-willow Shrubland group. These two associations were mapped on 0.06 acre (22 percent) of the mapped portion of SBC3. The stands are dominated by river birch but also include significant amounts of thinleaf alder, Bebb's willow (*Salix bebbiana*), sandbar willow, and two other unidentified willow species, which made classification of these stands very difficult. One relatively large stand of river birch and alder was associated with a large meadow and had a mesic graminoid understory of redtop (*Agrostis gigantea*), bluejoint reedgrass (*Calamagrostis canadensis*), fowl mannagrass, common cowparsnip, Canada thistle (*Cirsium arvense*), and field horsetail. The other stand had a sparse mesic forb understory and occurred along the edge of the stream; associated species included starry false lily of the valley (*Smilacina stellata*), field mint (*Mentha arvensis*), common cowparsnip, Porter's aster (*Aster porteri*), darkthroat shootingstar (*Dodecatheon pulchellum*), and bluejoint reedgrass. The elevations associated with the two plant associations were similar and ranged from approximately 1.4 to 3.0 feet above the mean water surface elevation on the day of field sampling.

The Riparian Herbaceous group/association at sampling site SBC3 included three plant associations mapped on 0.18 acre (67 percent) of the of the mapped portion of SBC3. The majority of this group was mapped in one meadow dominated by redtop, with a number of other abundant herbaceous species also present, including mountain rush (*Juncus balticus* var. *montanus*), beaked sedge (*Carex utriculata*), saltspring checkerbloom (*Sidalcea neomexicana*), western aster (*Aster ascendens*), panicled bulrush (*Scirpus microcarpus*), Canada thistle, fowl bluegrass, and Kentucky bluegrass (*Poa pratensis*). This meadow ranged in elevation from 1.8 to 2.4 feet above the water surface. The two other Riparian Herbaceous associations were located along the edge of the active channel and were dominated either by beaked sedge or by bluejoint reedgrass; these associations ranged from 0.7 to 1.7 feet above the water surface.

PROJECT EFFECTS (WETLANDS AND RIPRARIAN AREAS)

This section describes the direct and indirect impacts to riparian and wetland resources that may occur as a result of implementing the Project. Scoping for the Moffat Collection System Project EIS identified the following potential riparian and wetland issues in the Project area:

- Impact of planned water level changes in Gross Reservoir on existing wetlands
- Impact of South Boulder Creek depletions on riparian and aquatic habitat
- Impact of changes in stream flows causing a trend from aquatic vegetation species to upland species.

These scoping issues and potential impacts to riparian and wetland resources as a result of construction and inundation are evaluated. Potential changes to riparian and wetland resources that are specifically related to implementation of the Project are analyzed by comparing the Project to the existing system at full use because the latter reflects conditions at the time the Project would come online in 2032.

Construction and Inundation

Construction and inundation effects at Gross Reservoir include direct permanent impacts, indirect permanent impacts, and temporary impacts.

Direct permanent impacts can result from clearing, excavating, grading, inundation, and filling that would modify the existing functions of Gross Reservoir. The inundation impact area includes the Environmental Pool (elevation 7,406 feet) and vegetation up to elevation 7,410 feet. Project impacts were assessed by overlaying the footprint of the facilities and construction areas on maps of wetlands and other water features.

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, and potential invasions of noxious weeds. Indirect impacts were assessed qualitatively.

Temporary impacts are primarily associated with construction access and staging areas and generally do not have long-term impacts on wetland hydrology and/or function. Construction impacts would occur in temporary use areas and construction access roads and would be relatively minor and localized. Construction impacts may include cutting vegetation to facilitate construction adjacent to wetlands or

temporarily placing fill into a wetland area. The topography and hydrology of temporarily affected area would be reestablished after construction, which would, in turn, promote the reestablishment of wetland and riparian vegetation. Herbaceous wetlands would reestablish relatively quickly, while impacts to riparian woodland would take much longer to restore.

Impacts to Waters of the U.S., including wetlands, are subject to review by the Corps under Section 404 of the CWA. Any project that includes the placement of dredged or fill material into waters deemed jurisdictional by the Corps must obtain a Section 404 Permit prior to the activity. Depending on the specific Section 404 authorization, the Corps may also be required to determine that potential impacts have been avoided or minimized to the maximum extent practicable and that remaining unavoidable impacts have been mitigated to maintain no overall net loss of wetlands. The Corps Final EIS provides the basis for regulatory review of the Section 404 Permit application; Appendix K of that document contains the Corps' Section 404(b)(1) analysis (Corps 2014). The Section 404 Permit was issued from the Corps in September 2017.

Stream Flow Changes

The Project would involve changes in Denver Water's management of its existing system that would result in flow changes in stream flows in the associated rivers and streams, including South Boulder Creek. Since the Project is designed to capture surface water flows only during periods of higher runoff in wet or average years, increased diversions are not anticipated for dry years or during periods of low flows. In addition, flow modifications resulting from the Project are within the range of normal variability (i.e., flows already vary substantially from dry years to wet years and over the course of a season).

Maintenance of the hydrology to support riparian vegetation is the result of complex interactions between surface flows, groundwater, precipitation, and the physical characteristics of a stream channel and the floodplain it occupies. Because of this, it is difficult to establish simple cause-and-effect relationships between stream flow and riparian vegetation. The analysis examined two primary mechanisms that may affect riparian vegetation:

- Changes in the width of bank area regularly inundated by stream flows, which may result in drier or moister conditions near the active stream channel
- Lowering of groundwater tables to a degree that causes plant mortality, e.g., plants are no longer able to extend roots deep enough to reach the water source upon which they depend.

The dynamics of surface water and groundwater exchange and the interaction of groundwater, streams, and wetlands are described in detail in the Corps Final EIS (Corps 2014). The discussion there concludes that the streams in the Project area are likely "gaining streams" (streams that gain water through groundwater discharge rather than losing water to groundwater through the streambed) and are, therefore, less sensitive to changes in surface flows.

The groundwater analysis indicates that regional groundwater sources would not be affected by the Project. Localized impacts would be restricted to the immediate vicinity of the streams and would not be any larger than stream elevation changes. These changes would be related only to groundwater storage from high flows; groundwater levels and discharge from regional and local aquifers would remain the

same except for a slight increase in discharge to streams in gaining reaches. Therefore, most of the analysis of riparian and wetland areas focused on how the inundation area along river segments would be modified by reduced flows.

Stream flow has a major influence on riparian vegetation by providing moisture, as well as being the predominant agent of landscape change and natural disturbance. Much of the variability and complexity of riparian landscape is driven by fluvial processes, resulting in a complex mosaic of variations in inundation and soil moisture, topography and geomorphology, substrate characteristics, disturbance, and nutrients (Ward et al. 2002, Naiman et al. 2005, Merritt et al. 2009, see Final EIS for reference materials). Other influences on riparian systems and the relationships between flow modifications and riparian vegetation are discussed in the Corps Final EIS (Corps 2014).

A primary mechanism for impacting riparian vegetation is modification of stream stage and a reduction of the bank area that is regularly inundated in the vicinity of the stream channel. Riparian systems typically exhibit lateral zonation of plants species that are related to depositional features such as active channel bars and terraces that represent increasingly higher levels above the wetted surface and that have corresponding decreases in flooding duration and frequency (Naiman et al. 2005, see Final EIS for reference materials). There appears to be a clear relationship between inundation duration and the type of vegetation present, which suggests that changes in inundation duration can be used to predict vegetation change (Auble et al. 1994, see Final EIS for reference materials). This subject is discussed further in the Corps Final EIS (Corps 2014).

Changes in flood extent under the Project compared with the existing system at full use were modeled using the Corps HEC-RAS computer software (version 4.0) for analysis of stream hydraulics. A HEC-RAS model was developed for the SBC3 representative sampling site using data collected in the field, including stream discharge, velocity, slope, and channel geometry data. The HEC-RAS hydraulic models were used to generate water surface profiles and other hydraulic output as a function of discharge, and 2-year, 5-year, and 10-year flood events were simulated for the South Boulder Creek stream reaches. Probability plotting was relied upon to estimate the flood flow rates for the 2-year, 5-year, and 10-year recurrence intervals evaluated.

Detailed vegetation data were also collected at representative sampling site SBC3 downstream from Gross Reservoir. The SBC3 sampling site represents a small portion of the affected stream segment, which may vary by channel geometry and other factors, but is considered to be generally representative of the South Boulder Creek segment between Gross Reservoir and the South Boulder Creek Diversion Canal. Elevation and width changes represent an average of the results from several transects within the representative reach.

The evaluation focuses on 2-year runoff events, which generally correlate with bankfull conditions. It is recognized that 2-year flows play an important role in establishing and maintaining riparian wetlands by providing inflow to depressions and low areas with enough frequency to potentially establish wetland hydrology (Johnson et al. 1999, see Final EIS for reference materials). The 2-year floodplain can be assumed to be the outer limit of the wetland area potentially affected by changes in stream flow changes (Johnson et al. 1999, see Final EIS for reference materials): reductions in the 2-year flow could result in a

gradual narrowing of the stream channel as vegetation establishes on channel bars. Although the new vegetation would have wetland hydrology, it was conservatively assumed that narrowing of the channel would result in a loss of wetlands at the periphery of the channel. This subject is discussed further in the Corps Final EIS (Corps 2014).

Results for the 5- and 10-year return flows are also presented as an estimator of impacts to riparian vegetation located above the bankfull flow (out-of-bank floods). Such longer-interval floods can have major effects through catastrophic destruction of riparian plant communities, creation of new floodplain surfaces, and channel movement.

Gross Reservoir

Direct permanent impacts to wetlands and riparian habitats at Gross Reservoir and to other water features associated with Gross Reservoir are provided in Table 28.

Wetlands

At the Corps' request, Denver Water submitted an updated wetland delineation report to the Corps (Alpine Eco 2015, herein Exhibit 13), which also included the results of a wetland functional assessment (FACWet Method; Johnson et al. 2013). Delineation methods followed the Regional Supplement to the Corps of Engineers Delineation Manual: Western Mountain, Valleys, and Coast Region (Corps 2012, see Final EIS for reference materials). Wetlands were classified using Cowardin et al. 1979. The boundaries were flagged in the field and recorded using GPS. The 2015 delineation found slight increases in wetland habitat since the previous Final EIS 2005-2006 delineation along South Boulder Creek upstream of the reservoir, Forsythe Gulch, and along the Gross Reservoir shoreline. The Corps accepted the delineation and issued a Preliminary Jurisdictional Determination (JD) on February 8, 2016, which Denver Water accepted.

A total of 2.24 acres of wetlands and 9,492 feet (3.54 acres) of other waters of the U.S. would be permanently impacted by the Project based on the updated delineation and Preliminary JD.

As shown in Table 28, the Project would result in direct and permanent impact to 2.24 acres of wetlands in the Project area based on the updated delineation and Preliminary JD. All permanent impacts would be to wetlands associated with natural hydrology. The majority of the impacts would be associated with the 77,000-AF reservoir expansion, including tree removal (to elevation 7,406 feet) and inundation shoreline wetlands (0.47 acre) and stream inlets (0.13 acre of impact to South Boulder Creek upstream of the reservoir, 0.49 acre to the tributary to Winiger Gulch, 0.40 acre to Winiger Gulch, 0.32 acre to the unnamed southern tributary, and 0.02 acre to Forsythe Canyon), for a total impact to wetlands from reservoir expansion of 1.83 acres. An equivalent area of shoreline wetlands (approximately 0.5 acre) is likely to reestablish along the new shoreline; larger acreages of shoreline wetlands are unlikely due to extreme seasonal water level fluctuations.

A Section 404 Permit application was submitted to the Denver Regulatory Office on October 19, 2009 (Application #200280762) and the final Section 404 Permit was issued by the Corps in September 2017. The Project involves the discharge of dredged or fill material into 5.78 acres of Waters of the U.S. (2.24 acres of permanent impacts to wetlands and 0.21 acre of temporary impacts to wetlands; 3.54 acres

[9,447 linear feet] of permanent impacts to Waters of the U.S. and 0.50 acre [1,314 linear feet] of temporary impacts to Waters of the U.S. under Section 404 of the Clean Water Act.

Smaller areas of wetlands would be permanently affected by construction of the main dam and the saddle dam. The dam footprint would impact 0.08 acre of wetlands along South Boulder Creek immediately downstream from the reservoir, and the saddle dam would impact 0.03 acre of wetlands along Chamberlain Gulch.

Temporary impacts to wetlands in the Project area from construction disturbance consists of 0.17 acre of impact to Palustrine Emergent/Palustrine Scrub-Shrub (PEM/PSS) Wetlands, including 0.08 acre along South Boulder Creek immediately downstream from the reservoir from dam construction and 0.04 acre along Chamberlain Gulch from spillway construction.

Table 28:
Summary of Direct Impacts to Wetlands and Riparian Habitats at Gross Reservoir and to Other Water Features Associated with Gross Reservoir

Gross Reservoir Wetlands		Impact to Wetlands (acres)	
		Permanent	Temporary
Wetland Type	PEM	0.53	—
	PSS	1.12	0.04
	PEM/PSS	0.59	0.17
	Total	2.24	0.21
Gross Reservoir Riparian Habitats		Impacts to Riparian Habitats (acres)	
		Permanent	Temporary
Habitat Type	Woodland	0.69	0.04
	Wood/Shrubland	1.09	—
	Shrubland	2.30	—
	Total	4.08	0.04
Other Water Features at Gross Reservoir		Impacts to Other Water Features (acres)	
		Permanent	Temporary
South Boulder Creek Upstream of Gross Reservoir		2.75	0.48
Forsythe Canyon		0.36	—
Winiger Gulch Tributary		0.05	—
Winiger Gulch		0.20	—
Unnamed Southern Tributary		0.17	—
Chamberlain Gulch		0.01	0.02
Total		3.54	0.50

Notes:
The calculation of the noted acres for the Project assumes disturbance between the current reservoir pool elevation (7,282 feet) and elevation 7,410 feet. This includes disturbance associated with the expanded reservoir of the Environmental Pool for mitigation (elevation 7,406 feet).
PEM = Palustrine Emergent Wetland
PSS = Palustrine Scrub/Shrub Wetland

Other Water Features

A shown in Table 28, permanent impacts to other water features associated with Gross Reservoir include 3.54 acres (8,180 feet) of perennial Waters of the U.S., which the Corps considered a major impact. The majority of impacts to these other water features would result from reservoir filling.

Both temporary and permanent impacts would occur at South Boulder Creek immediately upstream of Gross Reservoir as a result of construction of the dam. Temporary impacts in this area would be 0.48 acre, and permanent impacts would be 2.75 acres.

Both temporary and permanent impacts would also occur at Chamberlain Gulch as a result of disturbance associated with construction of the saddle dam. Temporary and permanent impacts would be 0.02 and 0.01 acres, respectively, which are considered minor impacts.

Riparian Habitat

As shown in Table 28, the Project would result in 4.08 acres of permanent impact to riparian habitats and 0.04 acre of temporary impact. The Corps considered permanent loss of riparian habitat to be a major impact.

Most of the permanent impacts would result from inundation by the expanded reservoir. Permanent woodland impacts from reservoir filling would be greatest along the shoreline (0.48 acre), with additional impacts along Forsythe Canyon (0.03 acre), Winiger Gulch (0.06 acre), and South Boulder Creek upstream of the reservoir (0.04 acre). Shrubland/woodland would be permanently impacted primarily along the reservoir shoreline (0.63 acre), with additional habitat impacted along the unnamed southern tributaries (0.38 acre) and South Boulder Creek upstream of the reservoir (0.09 acre). The majority of shrubland that would be permanently impacted by reservoir expansion occurs around the shoreline (0.74 acre) and along Forsythe Canyon (0.68 acre).

Dam construction would also permanently impact 0.04 acre of riparian woodland along South Boulder Creek immediately below Gross Reservoir, and saddle dam construction would impact 0.03 acre of riparian woodland associated with Chamberlain Gulch.

The Project would result in 0.04 acre of temporary impact to riparian woodland habitat along Chamberlain Gulch from saddle dam construction.

Similar areas of woodland and shrubland vegetation would likely establish themselves naturally along the new reservoir shoreline. The total area of riparian habitat along the existing shoreline is 1.85 acres, including 0.48 acre of woodland, 0.63 acre of shrubland/woodland, and 0.74 acre of shrubland.

South Boulder Creek

The analysis in this section focuses on the interaction between flow changes and inundated area. Modeled changes in flood elevations and widths that would result from the Project are compared with the existing system at full use in Table 29.

The evaluation focuses on 2-year runoff events, which generally correlate with bankfull conditions, and also presents results for the 5-year and 10-year return flows, which estimate impacts from changes in out-of-bank floods.

Table 29:
Two-Year, Five-Year, and Ten-Year Flow Changes at South Boulder Creek Representative Sampling Sites under the Project Compared with the Existing System at Full Use

Sampling Site	Study Segment Length (feet)	Average Channel Width of 2-Year Flow at Full Use (feet)	Environmental Effects of the Project Compared with the Existing System at Full Use for the 2-Year Flow Event			
			2-Year Flow Elevation Change (inches)	2-Year Flow Width Change (feet)*	2-Year Flow Area of Change within Study Segment (acres)	2-Year Flow Area of Change (acres/miles)
SBC1	599	46.10	+1.59	+0.62	+0.008	+0.08
SBC3	446	70.26	-1.99	-4.70	-0.048	-0.57
Sampling Site	Study Segment Length (feet)	Average Channel Width of 5-Year Flow at Full Use (feet)	Environmental Effects of Project Compared to the Existing System at Full Use for the 5-Year Flow Event			
			5-Year Flow Elevation Change (inches)	5-Year Flow Width Change (feet)*	5-Year Area of Change within Study Segment (acres)	5-Year Area of Change per Mile (acres per mile)
SBC1	599	47.09	+0.21	+0.06	+0.001	+0.01
SBC3	446	73.38	-2.04	-2.01	0.02	-0.24
Sampling Site	Study Segment Length (feet)	Average Channel Width of 10-Year Flow at Full Use (feet)	Environmental Effects of Project Compared to the Existing Reservoir for the 10-Year Flow Event			
			10-Year Flow Elevation Change (inches)	10-Year Flow Width Change (feet)*	10-Year Flow Area of Change within Study Segment (acres)	10-Year Flow Area of Change (acres/mile)
SBC1	599	47.23	+0.27	+0.09	+0.001	+0.01
SBC3	446	74.07	-2.39	-2.36	-0.02	-0.29

Note:
*Change of width includes both sides of the stream.

South Boulder Creek above Gross Reservoir (Representative Sampling Site SBC1)

South Boulder Creek above Gross Reservoir would be affected by flow increases as well as flow decreases. At representative sampling site SBC1, daily average flows in June would increase from 620 cfs to 726 cfs under the Project (17 percent), with smaller increases in several other months, based on the PACSM output for South Boulder Creek at Pinecliffe gage. These flows are within the normal range of variability at that location. This increase in daily flow would not be due to an increase in peak flow. For example, the average monthly flow in June is forecast to be 726 cfs with implementation of the Project, but flows in excess of 1,100 cfs already occur during wet years at the gage. Probability plotting indicates that the 2-year flow at SBC1 would increase from 882 cfs to 944 cfs under the Project. There would be changes in durations of flows above about 150 cfs at SBC1 compared to the existing system at full use.

The flow elevation would increase by approximately 1.6 inches as a result of the change in the 2-year flow event under the Project, and the width of the channel would increase by about 0.6 foot, less than 1 percent of the channel width under the existing system at full use. The area affected over the 559-foot reach would be about 0.01 acre, or about 0.1 acre when extrapolated over a 1-mile distance. Within the narrow zone influenced by this increase in stage, there may be a gradual increase in species better adapted to wetter conditions, such as beaked sedge, but the overall impact on riparian vegetation would be negligible. It is also possible that there would be a small increase in the area occupied by riparian vegetation or in the density of riparian vegetation due to the increase in inundated area associated with a 2-year event. The increased 2-year flow would primarily affect the Drummond's willow/mesic forb shrubland.

Probability plotting indicates that the 5-year flow at SBC1 would increase from 985 cfs under the existing system at full use to 993 cfs under the Project, and the 10-year flow would increase slightly from 1,003 cfs under the existing system at full use to 1,015 cfs under the Project. Increases in the 5-year flow would result in an increase of about 0.2 inch in flow elevation and about 0.06 feet in width, about 0.1 percent of the channel width under the existing system at full use. Changes in the 10-year flow would result in an increase of about 0.3 inch in flow elevation and about 0.09 feet in channel width, about 0.1 percent of channel width under the existing system at full use.

The area of overbank flooding from the 5-year and 10-year flows would be very small (less than 1 foot) under the existing system at full use and the Project. The increased amount of overbank flow would primarily occur in the Drummond's willow/mesic forb shrubland. These increases would have a negligible effect on riparian vegetation.

Implementation of the Project would have negligible effects to wetland and riparian functions in South Boulder Creek above Gross Reservoir.

South Boulder Creek below Gross Reservoir (Representative Sampling Site SBC3)

In the South Boulder Creek segment below Gross Reservoir and above the South Boulder Diversion Canal, flows would decrease primarily during the months of May, June, and July and would greatly increase from November to February, based on PACSM output for Gross Reservoir outflow. The reduction in outflow in June would be 13 percent, from 459 cfs under the existing reservoir to 398 cfs under the Project. Probability plotting indicates that the 2-year flow at SBC3 would be reduced from 645 cfs under the existing system at full use to 574 cfs under the Project. There would be changes in durations of most flows at SBC3 compared with the existing system at full use.

The flow elevation would decrease by about 2 inches as a result of the change in the 2-year flow event, and the width of the channel would be reduced by 4.7 feet, about 7 percent of the channel width at the existing system at full use (Table 29). The area affected over the 446-foot reach would be about 0.05 acre, or about 0.6 acre when extrapolated over a 1-mile distance. The width of the area of reduced inundation would be approximately 2.35 feet on each side of the channel. The stream banks in this sampling area are dominated by river birch/mesic forb shrubland, which is not likely to be affected by a small change in stage. The herbaceous understory of this community generally consists of species such as bluejoint reedgrass that are capable of adapting to somewhat drier conditions. This community is likely

to gradually colonize the gravel bars on the edge of the reduced channel. Most of the redtop herbaceous vegetation would not be affected; the beaked sedge and bluejoint reedgrass herbaceous vegetation communities along the banks would likely move to maintain their position along the narrower stream bank. The impact on riparian vegetation would be minor.

Probability plotting indicates that the 5-year flow at SBC3 would be reduced from 766 cfs under the existing system at full use to 687 cfs under the Project, and the 10-year flow would be reduced from about 834 cfs under the existing system at full use to 737 cfs under the Project. Reductions in the 5-year flow would result in a decrease of about 2 inches in flow elevation and a decrease of about 2 feet in channel width, about 3 percent of the channel width under the existing system at full use. Reductions in the 10-year flow would result in a decrease of about 2.4 inches in flow elevation and a decrease of about 2.4 feet in channel width, also about 3 percent of the channel width at the existing system at full use.

The 5-year flow would be about 3 inches higher than the 2-year flow, and the 10-year flow would be about 4 inches higher than the 2-year flow. The width of overbank flooding under the Project would be fairly small, a total of about 6 feet in width for the 5-year flow and 7 feet for the 10-year flow. Reductions in the 5-year and 10-year flows would likely affect vegetation mapped as blue spruce/field horsetail woodland, river birch/mesic graminoid, and redtop herbaceous vegetation. These three communities extend above the area affected by 10-year flows and are probably supported by groundwater discharge. The amount of shading of the stream is not likely to change.

Implementation of the Project would have negligible effects to wetland and riparian functions in South Boulder Creek below Gross Reservoir.

Conclusions were supported by the FERC in its review of the Project impacts for wetland and riparian areas (Final SEA, Sections 4.4.3 and 5.1.5.2) as follows.

> *Effects on riparian and wetland habitats, as described in the Final EIS, would occur primarily through tree clearing and inundation associated with dam enlargement, annual lowering of reservoir levels, and changes in streamflow. The Final EIS found that 4.08 acres of riparian habitat and 1.95 acres of wetland habitat would be permanently affected, and 0.04 acre of riparian habitat and 0.12 acre of wetland habitat would be temporarily affected, by the proposed work at Gross Dam, the reservoir, and related facilities. Effects identified in the Final EIS to wetland hydrology and/or function associated with construction access and staging areas would be short-term. Disturbance, which would occur in temporary use areas and construction access roads, would be relatively minor and localized. Denver Water would address effects on riparian and wetland habitats through proposed BMPs such as implementation of revegetation, erosion control, forest management and weed control, and development of woody riparian plant communities around Gross Reservoir. Following construction, reconstruction and restoration measures included in Denver Water's proposal and required by certain Forest Service conditions would help reestablish affected hydrology and restore affected wetland and riparian vegetation. Herbaceous wetlands would re-establish relatively quickly, while impacts on riparian woodland would take much longer to restore.*

During project operations when the reservoir is refilled to its new higher elevations, some aquatic and terrestrial vegetation types would reestablish in the new inundation zone during seasonal reservoir fluctuations. Wetlands that currently exist along the edge of the reservoir would be inundated when the reservoir is filled to higher levels. However, new wetlands are likely to form in upstream fingers of the expanded reservoir, which would be sustained by shallow groundwater, similar to current conditions.

Clean Water Act Section 404

Under Section 404 of the federal CWA, the Corps reviews permits for projects proposing to deposit or discharge dredge or fill material into waters of the United States, including wetlands, and projects must receive authorization for any such activities. Applicable discharges include return water from dredged material disposed on upland property, and generally any fill material, such as rock, sand, or dirt.

Denver Water applied to the Corps for a CWA Section 404 permit to discharge fill material into South Boulder Creek during work to increase the height of the Gross Reservoir Project's Gross Dam that would be necessary in order to enlarge the Moffat Collection System. South Boulder Creek is a "water of the United States," as defined under the CWA. The Corps determined that an analysis of the potential effects of the enlargement of the Moffat Collection System and its reasonable alternatives was necessary to provide full public disclosure and to aid in decision making. As noted above, the Corps prepared an EIS to evaluate project effects and issued a Final EIS on April 25, 2014. The Corps issued its ROD on July 6, 2017, and its Section 404 permit on September 8, 2017.

MITIGATION (WETLANDS AND RIPRARIAN AREAS)

Denver Water's License Amendment Application to the FERC evaluated all mitigation measures for riparian areas and wetlands (Exhibit 5) in Table 5.1-1 as provided below.

Per the Corps 404 Permit, the Project involves the discharge of dredged or fill material into 5.78 acres of Waters of the U.S. (2.24 acres of permanent impacts to wetlands and 0.21 acre of temporary impacts to wetlands; 3.54 acres [9,447 linear feet] permanent impacts to Waters of the U.S. and 0.50 acre [1,314 linear feet] of temporary impacts to Waters of the U.S.) under Section 404 of the Clean Water Act. Indirect effects would occur in the Fraser and Williams Fork River basins due to reduced stream flows associated with the increased diversions from the Moffat Project. Mitigation to compensate for impacts resulting from the Project will be accomplished by using a combination of purchasing mitigation bank credits.

Per the Denver Water/USFS Settlement Agreement, Denver Water will also mitigate the permanent loss of wetlands through preservation (through USFS protection and administration of NFS lands) of approximately 43 acres of high quality wetlands and fens within the 539-acre Toll Property through its conveyance to the USFS.

Per the Corps 404 Permit condition adopting mitigation identified in the 2011 FWMP developed between Denver Water and CPW, the 2010 Intergovernmental Agreement (IGA) between Denver Water and the cities of Boulder and Lafayette, and the Environmental Pool mandated by FERC: Denver Water will

establish a 5,000-AF Environmental Pool in Gross Reservoir to augment flows during low flow periods, thereby benefiting 17 miles of aquatic habitat in South Boulder Creek from Gross Dam to its confluence with Boulder Creek. The Environmental Pool will enhance flows in South Boulder Creek below Gross Reservoir and provide flows in the lower section of South Boulder Creek, which currently goes dry at times due to diversions by other water users.

Per the Denver Water/USFS Settlement Agreement, permanent impact to 4.08 acres of riparian habitat due to reservoir inundation and 0.04 acres of temporary impact: Denver Water will mitigate the permanent impact to riparian habitat through the preservation (through USFS protection and administration of NFS lands) of approximately 253 acres of riparian woodland at Mammoth Gulch and Middle and Upper South Boulder Creek within the 539-acre Toll Property (which are designated as Colorado Natural Heritage Program [CNHP] PCAs) through its conveyance to the USFS.

Per the Denver Water/USFS Settlement Agreement, Denver Water will convey the 539-acre Toll Property to the USFS to be administered and protected as part of the Roosevelt National Forest as mitigation for resource values that will be lost on Denver Water and NFS lands due to inundation and construction-related ground disturbance. The 539 acres of private, forested lands will be protected and accessible to the public through its addition to the National Forest. The Toll Property parcels are surrounded by the Roosevelt National Forest and contain diverse vegetation types (forest, grassland, fens, wet meadows, pond, stream, and riparian habitat). The property will protect two PCAs: Mammoth Gulch PCA with Very High Biodiversity Significance due to the occurrence of a unique iron fen plus imperiled woodland species and the Middle and South Boulder Creek PCA with High Biodiversity Significance due to the occurrence of a globally vulnerable forested fen and shrubland community. The Toll Property also preserves valuable wildlife habitat including elk and mule deer summer range and migration corridors, potential habitat for lynx (federally threatened and state endangered species), habitat for boreal toad (state endangered and USFS sensitive species), and a wide range of habitats for small mammals and birds.

Per the USFS Section 4(e) Condition 19 (Erosion Control and Reclamation) from the Denver Water/USFS Settlement Agreement, the USFS Section 4(e) Condition 10 (Use of Roads on National Forest System Lands) from the Denver Water/USFS Settlement Agreement, and the USFS Section 4(e) Condition 28 (Reclamation and Revegetation Seed Mixes and Mulch Materials) from the Denver Water/USFS Settlement Agreement: Denver Water will minimize impacts to vegetation on NFS lands through implementation of a new Erosion Control and Reclamation Plan and a new Road Management Plan. Denver Water will revegetate and reclaim NFS lands with seed mixtures and mulch materials approved by the USFS according to a new Reclamation and Revegetation Seed Mixes and Mulch Materials plan.

Per the USFS Section 4(e) Condition 17 (Invasive Species Management) from the Denver Water/USFS Settlement Agreement and the USFS Section 4(e) Condition 30 (Cost Collection and Participating Agreement regarding weed control) from the Denver Water/USFS Settlement Agreement: Denver Water will develop an Invasive Plant and Noxious Weed Species Management Plan for NFS lands in consultation with the USFS.

Denver Water submitted a letter to the Corps Denver Regulatory Office on March 7, 2016 that includes the Compensatory Mitigation Proposal for Direct Impacts to Wetlands and Riparian Areas Analyzed in the

U.S. Army Corps of Engineers' Final Environmental Impact Statement for the Moffat Collection System Project. The letter is included in Exhibit 13. The letter provides information regarding mitigation for effects to wetland, riparian, and surface water functions and areas. Denver Water proposes to preserve approximately 43 acres of wetlands and 253 acres of riparian woodland at Mammoth Gulch and Middle and Upper South Boulder Creek, each designated as Colorado Natural Heritage Program (CNHP) Potential Conservation Areas (PCAs) located in Gilpin County, Colorado (the Toll Property). Importantly, the 43-acre "Wetland Preservation Area" within the Toll Property significantly exceeds the Corps' in-kind mitigation requirements (1:1 ratio, or greater) for the 1.95 acres of permanent wetland impacts anticipated in the Corps Final EIS and also assures the protection of a globally imperiled, rare aquatic resource recognized as the first iron fen site documented in Gilpin County. Additionally, the 253-acre "Riparian Preservation Area" within the Toll Property not only replaces in-kind impacts, but also greatly exceeds the 4.08 acres of permanent riparian impacts identified in the Corps Final EIS. Collectively, the Wetland and Riparian Preservation Areas constitute Denver Water's compensatory mitigation. While not accepted as mitigation by the Corps, FERC acknowledged the benefits of this commitment made by Denver Water.

Conclusions supported by the FERC in its analysis of Project impacts (Final SEA, page 63) were as follows.

> *As noted in the Final EIS, Denver Water would address and mitigate effects on riparian and wetland habitats through proposed BMPs, credits from an approved wetland mitigation bank, and operation of the proposed Environmental Pool which would enhance low flows in South Boulder Creek downstream of Gross Dam, providing a minor benefit to riparian vegetation. As discussed above, Denver water would also, through its off-license agreement with the Forest Service, convey the 539-acre Toll Property to the Forest Service, to be administered and protected as part of the Roosevelt National Forest. This would provide permanent offsite mitigation by preserving about 43 acres of high-quality wetlands and fens. Effects on wetlands in the Gross Reservoir area would be consistent with the findings in the Final EIS.*

8-507.D.7.b.iii, Terrestrial and Aquatic Animals and Habitat

Biological resources are shown in the following maps included in Exhibit 1:

- Figure 4, Threatened and Endangered Species Map—Preble's Meadow Jumping Mouse
- Figure 5, Critical Wildlife Habitat and Migration Corridors
- Figure 10, Terrestrial and Aquatic Animals and Habitat Map—American Elk Habitat
- Figure 12, Terrestrial and Aquatic Animals and Habitat Map—Bald Eagle Habitat
- Figure 18, Terrestrial and Aquatic Animals and Habitat Map—High Biodiversity Areas
- Figure 19, Terrestrial and Aquatic Animals and Habitat Map—Rare Plant Areas & Significant Natural Communities

The Corps, FERC, USFWS, and CPW relied on the field surveys described in the Corps' Final EIS for their reviews and approvals of the Project. These surveys are listed below:

- Information on wildlife species distribution was obtained from habitat assessments using aerial photography during 2005-2006 field visits, the Natural Diversity Information Source (NDIS), previous studies conducted in the Project area and reports, and literature searches.
- Special status species information was obtained from field visits, CNHP element occurrence data, the Natural Diversity Information Source (NDIS) website of species' ranges, USFS data, previous studies and reports, and literature searches. Habitats that support special status species were further identified using Geographic Information System (GIS) to overlay aerial photographs on study area boundaries.
- Aquatic biological resources data were available as far back as 1970 for some portions of the Project area and as recent as 2010 for others. None of the sections of stream or reservoirs have continuous data over this entire period. For most stream sections, the available data are the result of one or more short-term studies. In most cases, the available data are presented from the 1980s through 2010.

Denver Water's mitigation measures for wildlife and habitat are summarized in the Project Description above.

Denver Water evaluated Boulder County's wildlife species of concern list and assessed the probability of occurrence for each in Exhibit 17.

The following wildlife information and analysis was gathered for Denver Water's License Amendment Application to the FERC (Section 3.3.9):

AFFECTED ENVIRONMENT (TERRESTRIAL AND AQUATIC ANIMALS AND HABITAT)

Information on species distributions was obtained from habitat assessments using aerial photography during 2005-2006 field visits, the Natural Diversity Information Source (NDIS), previous studies conducted in the Project area, reports, and literature searches. Identification of species likely to occur was based primarily on habitats present and reported ranges.

Gross Reservoir

The Project area comprises several wildlife habitat types, including ponderosa pine (*Pinus ponderosa*) woodland, mixed conifer forest consisting of Douglas fir (*Pseudotsuga menziesii*) and ponderosa pine, mountain grassland, wetlands and riparian areas, and disturbed or bare ground. The wetland and riparian habitats in the Project area are primarily located in Winiger Gulch, South Boulder Creek, and Forsythe Canyon.

Montane forest provides wildlife with food and shelter. The understory in the forested habitats is composed of grasses, forbs, and patches of bare ground. Insect infestations (mountain pine beetle [*Dendroctonus ponderosea*] and western spruce budworm [*Choristoneura occidentalis*]) have killed large patches of ponderosa pine and Douglas fir on the west side of Gross Reservoir. These dead trees provide good habitat for cavity-nesting birds.

Big Game

Mule deer (*Odocoileus hemionus*) are common, non-migratory, year-round residents of the Project area (NDIS 2011). CPW divides the state into data analysis units (DAU), which are again divided into game

management units (GMU). DAUs encompass a herd's entire range throughout the year; GMUs are smaller areas designed to manage big game hunting by geographic area. The herd inhabiting the area around Gross Reservoir is part of DAU 27 and GMUs 29 and 38, which encompass an area bounded on the north by Left Hand Canyon and on the south by Interstate 70 (I-70) (NDIS 2011, see Final EIS for reference materials). In 1994, the DAU 27 mule deer population was estimated at 6,646 animals; the herd size increased until 2001, after which the population declined. In 2004, the herd size was estimated at 7,000 individuals with a buck-to-doe ratio of 46:100 (Denver Water 1998b, Huwer 2005, see Final EIS for reference materials), and the 2009 post-hunt population was estimated at 7,260 (CDOW 2011a, see Final EIS for reference materials). No migration corridors, winter concentration, or severe winter range for mule deer are located in the vicinity of Gross Reservoir (NDIS 2011, see Final EIS for reference materials).

American elk (*Cervus elaphus*) generally inhabit semi-open forests or forest edges adjacent to meadows (Fitzgerald et al. 1994, see Final EIS for reference materials). The elk inhabiting the Project area are part of the Clear Creek elk herd located in GMUs 29 and 38 (Huwer 2005, see Final EIS for reference materials). As of 2004, herd size was estimated to be 1,150 individuals, which is CPW's goal for this herd (Huwer 2005). The 2009 post-hunt population was estimated to be 1,170 (CDOW 2011a, see Final EIS for reference materials). The herd size increased between 1994 and 1998 but decreased after CPW implemented a management strategy of increasing hunting licenses (Huwer 2005, see Final EIS for reference materials).

Severe winter range for elk is present all around the reservoir, and a winter concentration area extends around the northern two-thirds of the reservoir (Figure 10 in Exhibit 1) (NDIS 2011, see Final EIS for reference materials). *Severe winter range* is the part of the overall range where 90 percent of the individuals are located when the annual snowpack is at its maximum and/or temperatures are at a minimum in the two worst winters out of ten (NDIS 2011, see Final EIS for reference materials). A *winter concentration area* is defined as the part of the winter range where densities are at least 200 percent greater than the surrounding winter range density during the same period used to define winter range in the average of five winters out of ten (NDIS 2011, see Final EIS for reference materials). An elk migration corridor extends about 9 miles from south of Nederland to Gross Reservoir and includes the entire Gross Reservoir shoreline.

Mountain lions (*Felis concolor*) are another big game species known to inhabit the Project area. Mountain lions are present at Gross Reservoir year-round and inhabit montane forest and shrubland in rough, broken foothill and canyon areas. Mountain lions primarily prey on deer. Home range size varies by sex, reproductive condition, and age of the individual but is generally 15 to 27 square miles for females and 40 to 320 square miles for males (Fitzgerald et al. 1994, see Final EIS for reference materials).

Black bear (*Ursus americanus*), the largest carnivore in Colorado, inhabits the Project area, especially in montane forest and shrubland and areas with berry-producing shrubs. The diet of black bears primarily consists of seasonally available vegetation such as grasses and forbs in the spring and berries and acorns in the fall. Black bears also opportunistically eat insects, rodents, rabbits, ungulates, and carrion (Fitzgerald et al. 1994, see Final EIS for reference materials). Winter denning begins in early October through late December. Home range varies from 1 to 73 square miles, depending on topography, food availability, and the sex and age of the individual.

Carnivores

Bobcats (*Lynx rufus*) inhabit similar habitats as mountain lions. They primarily prey on cottontails (*Sylvilagus* spp.) but also rodents, small birds, deer, and amphibians (Fitzgerald et al. 1994, see Final EIS for reference materials). Home range is 8 to 30 square miles for males and 3 to 10 square miles for females.

Coyote (*Canis latrans*) inhabit most habitats in Colorado and are opportunistic hunters. Red fox (*Vulpes vulpes*), raccoon (*Procyon lotor*), long-tailed weasel (*Mustela frenata*), and American (pine) marten (*Martes americana*), which is discussed in Section 3.3.10, are also common inhabitants of the Project area (Denver Water 1998b, Fitzgerald et al. 1994, see Final EIS for reference materials).

Small and Medium-sized Mammals

A variety of small mammals are present in the Project area. Lagomorphs (rabbits and hares) common in the Project area include mountain cottontail (*Sylvilagus nuttallii*) and white-tailed jackrabbit (*Lepus townsendii*) (Fitzgerald et al. 1994).

Golden-mantled ground squirrels (*Spermophilus lateralis*) were observed in the Project area, and other species known to occur there include least chipmunk (*Eutamias minimus*), Colorado chipmunk (*Tamias quadrivittatus*), rock squirrel (*Spermophilus variegatus*), Abert's squirrel (*Sciurus aberti*), which inhabits ponderosa pine stands, and porcupine (*Erethizon dorsatum*) (Fitzgerald et al. 1994, see Final EIS for reference materials).

Other small rodents include northern pocket gophers (*Thomomys talpoides*), which may be present in the grassland areas. Deer mice (*Peromyscus maniculatus*) occur in almost all habitats in Colorado, while Mexican woodrat (*Neotoma mexicana*), southern red-backed vole (*Clethrionomys gapperi*), long-tailed vole (*Microtus longicaudus*), and montane vole (*Microtus montanus*) can be found in moist areas (Fitzgerald et al. 1994, see Final EIS for reference materials).

Montane shrew (*Sorex monticolus*) and masked shrew (*Sorex cinereus*) occur in moist habitats along streams and drainages, and dwarf shrews (*Sorex nanus*) may occur in coniferous forests and open woodlands (Fitzgerald et al. 1994, see Final EIS for reference materials).

A variety of bat species are known to inhabit the mixed conifer and/or ponderosa pine woodlands in the vicinity of the Project area where they may forage over open water or other areas and may roost in tree cavities or under bark (Adams 2003, see Final EIS for reference materials). These species include:

- Western small-footed myotis (*Myotis ciliolabrum*)
- Long-eared myotis (*Myotis evotis*)
- Little brown myotis (*Myotis lucifugus*)
- Fringed myotis (*Myotis thysanodes*)
- Long-legged myotis (*Myotis volans*)
- Hoary bat (*Lasiurus cinereus*)
- Big brown bat (*Eptesicus fuscus*)
- Townsend's big-eared bat (*Corynorhinus townsendii*).

Raptors

Numerous raptors forage over or nest in the mixed coniferous or rocky habitat in the vicinity of the Project area. Golden eagles (*Aquilla chrysaetos*) are known to nest at Forsythe Rock west of the Project area (Denver Water 1998b, see Final EIS for reference materials). Various hawk species including red-tailed hawk (*Buteo jamaicensis*) and northern goshawk (*Accipiter gentilis*) have the potential to nest at Gross Reservoir, but no raptor nests are currently known and none were observed during biological field studies conducted in 2005 and 2010. The USFS installed two osprey (*Pandion haliaetus*) nesting platforms in 1993; nesting has been attempted but no successful nesting has been observed. Ospreys from other nearby nesting areas forage at Gross Reservoir. Peregrine falcons (*Falco peregrinus*) are not known to nest in the Project area but may be present during foraging. No raptor nests were observed within the Project area during the 2018 nesting season. The raptor species known to occur in the Project area are listed in Table 30.

Table 30:
Raptors Likely or Known to Occur in the Project Area

Common Name	Scientific Name
Golden eagle	*Aquilla chrysaetos*
Bald eagle	*Haliaeetus leucocephalus*
Osprey	*Pandion haliaetus*
Prairie falcon	*Falco mexicanus*
Sharp-shinned hawk	*Accipiter striatus*
Cooper's hawk	*Accipiter cooperii*
Northern goshawk	*Accipiter gentilis*
Red-tailed hawk	*Buteo jamaicensis*
American kestrel	*Falco sparverius*
Peregrine falcon	*Falco peregrinus*
Turkey vulture	*Cathartes aura*
Flammulated owl	*Psiloscops (Otus) flammeolus*
Great-horned owl	*Bubo virginianus*
Northern pygmy owl	*Glaucidium gnoma*
Northern saw-whet owl	*Aegolius acadicus*

Source: Kingery (1998), Jones (2003) , see Final EIS for reference materials

Other Birds

In Colorado, the diversity and numbers of birds are highest in summer months, especially in the ponderosa pine/mixed conifer forest. Dusky grouse (*Dendragapus obscurus*), common ravens (*Corvus corax*), and American crows (*Corvus brachyrhynchos*) occur and possibly nest in the Project area. The Project area is within the overall range of wild turkeys (*Meleagris galloparvo*), and, therefore, they can be expected to occur around the existing reservoir. Winter range for the species is east of Gross Reservoir, and, therefore, no wild turkeys are expected to occur on the western side of Gross Reservoir in the winter (Huwer 2005, see Final EIS for reference materials).

Birds that may forage over the open water of the reservoir or its banks include common nighthawk (Chordeiles minor), tree swallow (*Tachycineta bicolor*), and spotted sandpiper (*Actitis macularia*) (Kingery 1998, see Final EIS for reference materials).

Songbirds known or likely to be present in the ponderosa pine/Douglas fir forest, wetland and riparian areas, and mountain grassland habitats are listed in Table 31. Several of these species, including pygmy nuthatch (*Sitta pygmaea*), warbling vireo (*Vireo gilvus*), and mountain bluebird (*Sialia cucrucoides*), are USFS Management Indicator Species (MIS) (see Table 32).

Table 31:
Common Songbirds in the Project Area by Habitat Type

Habitat Type	Common Species in Habitat	Habitat Type	Common Species in Habitat
Ponderosa Pine/ Douglas Fir	Chipping sparrow (*Spizella passerina*)	Wetland/Riparian	Mourning dove (*Zenaida macroura*)
	Mountain chickadee (*Poecile gambeli*)		Olive-sided flycatcher (*Contopus cooperi*)
	Northern flicker (*Colaptes auratus*)		Warbling vireo (*Vireo gilvus*)
	Pygmy nuthatch (*Sitta pygmaea*)		Yellow-rumped warbler (*Dendroica coronata*)
	Steller's jay (*Cyanocitta stelleri*)		MacGillivray's warbler (*Oporornis tolmiei*)
	Western tanager (*Piranga ludoviciana*)		Yellow warbler (*Dendroica petechial*)
	Western wood-pewee (*Contopus sordidulus*)		American dipper (*Cinclus mexicanus*)
	Williamson's sapsucker (*Sphyrapicus thyroides*)	Mountain Grassland	Vesper sparrow (*Pooecetes gramineus*)
	Western bluebird *(Sialia mexicana)*		Chipping sparrow (*Spizella passerine*)
	White-breasted nuthatch *(Sitta carolinensis)*		Mountain bluebird (*Sialia currucoides*)
	Hermit thrush (*Catharus guttatus*)		Brewer's blackbird (*Euphagus cyanocephalus*)
	Pine siskin (*Carduelis pinus*)		
	Townsend's solitaire (*Myadestes townsendi*)		
	Red-breasted nuthatch (*Sitta canadensis*)		

Source: Andrews and Righter (1992), Kingery (1998) , see Final EIS for reference materials.

Table 32:
Management Indicator Species for the Arapaho and Roosevelt National Forests

Management Indictor Species	Scientific Name	Habitat	Occurrence in Gross Reservoir Study Area
Mammals			
Rocky Mountain bighorn sheep	*Ovis canadensis*	Openings	Does not occur
Elk	*Cervus elaphus*	Young to mature forest and openings	Known to occur
Mule deer	*Odocoileus hemionus*	Young to mature forest and openings	Known to occur
Birds			
Golden-crowned kinglet	*Regulus satrapa*	Interior forest	May occur
Hairy woodpecker	*Picoides villosus*	Young to mature forest	Known to occur
Mountain bluebird	*Sialia cucrucoides*	Openings	Known to occur
Pygmy nuthatch	*Sitta pygmaea*	Old growth	Known to occur
Warbling vireo	*Vireo gilvus*	Aspen forest	Known to occur
Wilson's warbler	*Cardellina pusilla*	Montane riparian and wetlands	Likely to occur
Amphibians			
Boreal toad	*Anaxyrus boreas*	Montane riparian and wetland	Does not occur; special status species

Source: USFS (2010) , see Final EIS for reference materials.

Reptiles and Amphibians

Several species of reptiles and amphibians may occur in moist, riparian areas within the Project area. These species include tiger salamander (*Ambystoma tigrinum*), northern leopard frog (*Lithobates pipiens*), and western terrestrial garter snake (*Thamnophis elegans*) (Denver Water 1998b, Hammerson 1999, see Final EIS for reference materials). Bullsnakes (*Pituophis catenifer*) and western rattlesnakes (*Crotalus viridus*) inhabit the woodland and grassland areas, while milk snakes (*Lampropeltis triangulum*) may be present in ponderosa pine woodland areas (Hammerson 1999, see Final EIS for reference materials).

USFS Management Indicator Species

MIS are used by the USFS to monitor the efficacy of management practices in meeting habitat objectives. Table 32 provides the list of MIS designated by the ARNF and the habitats they represent. Note that Rocky Mountain bighorn sheep (*Ovis canadensis*) and boreal toad (*Anaxyrus boreas boreas*) do not occur in the Project area.

USFS Wildlife Habitats

The 1997 revision of the ARNF Land and Resource Management Plan (LRMP) (USFS 1997a, see Final EIS for reference materials) evaluated several key elements of biological diversity, including old growth forests, travel corridors for terrestrial wildlife, habitat effectiveness, and interior forests.

Areas of existing old growth were identified by the USFS based on surveys. All of the old growth in the Project area occurs at lower-elevation sites dominated by ponderosa pine. Key characteristics of low

elevation old growth on the ARNF include: large trees of 18+ inches diameter at breast height (dbh) with 15 or more trees per acre of 12+ inches dbh; large snags, including 2 or more snags per acre of 12+ inches dbh; large fallen trees; multi-storied canopy; overhead canopy closure of more than 20 percent; and the presence of large, old, declining live trees. Existing old growth occupies only 21.5 acres along the west edge of the Project area near Winiger Gulch and South Boulder Creek, a small portion of the Project area. About 12 percent of the major forest types on the ARNF are existing old growth. Most of the old growth is spruce-fir, one-third is lodgepole pine (*Pinus contorta*), and only 1 percent is ponderosa pine (USFS 1997b, see Final EIS for reference materials).

Old growth development areas are mature forests that are relatively close to becoming old growth (USFS 1997b, see Final EIS for reference materials). Areas designated by ARNF as old growth development occupy 450 acres above the existing reservoir, about half of the terrestrial habitat on NFS lands, and are located in the southwestern quarter of the Project area. Areas used for recreational activities, including Winiger Gulch, Forsythe Canyon, and the boat launch area, are not designated for old-growth development.

Two types of wildlife travel corridors were analyzed by the USFS, forested corridors and open corridors. Forested corridors maintain the connectedness of areas with relatively dense conifers. They include forested areas with a medium to dense canopy, a minimum width of 100 meters, a minimum area of 20 acres, and gaps or interruptions no wider than 100 meters. Open corridors maintain the connectedness of non-forested and non-vegetated areas (except water). They consist of shrublands, grasslands, and rock, with the same size restrictions. Forested corridors occupy most of the terrestrial habitat on NFS lands in the Project area (696 acres), while open corridors are restricted to a portion of Winiger Ridge and occupy about 32 acres. Forested corridors occupy 60 percent of the ARNF as a whole and are generally well-connected throughout the Forest, and open corridors occupy 21 percent (USFS 1997b, see Final EIS for reference materials).

Habitat effectiveness represents areas that are generally undisturbed by human presence by being buffered from regularly used roads and trails. Wildlife disturbance distances vary with intensity of human use, vegetation type, vegetation density, terrain, and location of the travelway. The ARNF modeled distances within which wildlife would be affected based on elk and deer disturbance distances, with the results ranging from 0 to 500 meters depending on vegetation screening and topography. Areas within the buffer distances of roads and trails were considered to be ineffective habitat. The Project area is located within the ARNF Thorodin Geographic Area, for which about 59 percent of the habitat is effective and the total road and trail density is 1.9 miles per square mile. In the Project area, effective habitat occurs on about 539 acres of land above the reservoir, about 56 percent of the terrestrial habitat on NFS land. Areas used by recreationists were considered to be none-effective, including Forsythe Canyon, Winiger Ridge, Winiger Gulch, and the boat launch area.

Interior forests are contiguous areas of relatively dense and large trees that are buffered from sizeable openings in the forest and from regular human disturbance along roads and trails. All interior forest occurs within effective habitat. Within the Project area, interior forest is limited to a few areas on the western side of the reservoir and occupies a total of 133 acres, about 14 percent of the USFS terrestrial

habitat. Interior forests occur on about 15 percent of the ARNF as a whole (USFS 1997b, see Final EIS for reference materials).

Sensitive Areas

Potential Conservation Areas. The CNHP designates Potential Conservation Areas (PCAs) based on habitats and ecological processes upon which a species or community depends for its continued existence. The CNHP ranks PCAs according to their biodiversity significance: outstanding significance (B1), very high significance (B2), high significance (B3), moderate significance (B4), and general significance (B5). PCA boundaries have no legal status but are used for planning and management decisions. PCAs located in the Project area are shown in Figure 6 in Exhibit 1 and discussed below (CNHP 2005, CNHP 2009, see Final EIS for reference materials).

- Winiger Gulch PCA (B3)—The Winiger Gulch PCA, as defined in the most recent version of CNHP's review of conservation resources in Boulder County (CNHP 2009, see Final EIS for reference materials), includes both Winiger Gulch and a portion of South Boulder Creek above Gross Reservoir. Winiger Gulch includes a good occurrence of thinleaf alder/mesic forb riparian shrubland along Winiger Gulch, good occurrence of foothills riparian shrubland (*Betula occidentalis*/*Maianthemum stellatum*), and an excellent occurrence of Sprengle's sedge (*Carex sprengelii*), a CNHP and USFS sensitive species.
- Boulder Foothills PCA (B2)—The Boulder Foothills PCA is located east and northeast of the Gross Reservoir Project area and overlaps a small portion of the Project area (<80 acres). It also contains a segment of the South Boulder Creek watershed downstream from Gross Reservoir. The Boulder Foothills PCA includes numerous occurrences of multiple CNHP-ranked birds, insects, natural communities, and plant species (CNHP 2009, see Final EIS for reference materials). Moist drainages within this area support many plant species that are primarily associated with eastern North America, including several species also found at Gross Reservoir.

Boulder County Environmental Conservation Areas. The Boulder County Comprehensive Plan (Boulder County 1986) designates Environmental Conservation Areas (ECAs), which are individual sites that are critical wildlife habitats, rare plant locations, plant communities of special concern, and wetlands that Boulder County considers important for protection. Two ECAs are present in the vicinity of the Project area.

- Winiger Ridge ECA—The Winiger Ridge ECA consists of 3,000 acres of montane forest bordering the west side of Gross Reservoir. This ECA was designated for high wildlife and environmental value because it is an important wildlife corridor for seasonal wildlife movement between higher and lower elevations. The ECA is critical range and a seasonal migration route for elk and is also mule deer winter range (Boulder County 1986, see Final EIS for reference materials). The habitat is dominated by Douglas fir, lodgepole pine, and ponderosa pine; blue spruce (*Picea pungens*) and Engelmann spruce (*Picea engelmannii*) occur on the north slopes and along Forsythe Creek.
- Hawkin Gulch/Walker Ranch/Upper Eldorado Canyon ECA—This ECA encompasses 9,500 acres of forested and grassland habitat, including South Boulder Creek below Gross Reservoir.

USFS Managed Areas

Approximately 10,000 acres on the west side of Gross Reservoir is managed by the USFS Roosevelt National Forest. The USFS management goals for the area are to maintain and enhance the flora and fauna in the Winiger Ridge critical elk winter range by implementing prescribed burns, while managing recreation in the area.

South Boulder Creek

Flow changes in streams have the potential to affect wildlife species dependent on wetlands, riparian habitats, or open water habitats. Characterization of wildlife species dependent on such habitats focused on those reaches that would experience a flow increase or decrease of greater than 10 percent (average annual, normal year), as determined from PACSM results. Using the criterion of a 10 percent flow change, the sections of South Boulder Creek above and below Gross Reservoir were identified as stream reaches that would experience increased and/or decreased flows. Total annual outflows from Gross Reservoir would increase under the Project. The general pattern would be flow decreases peaking in May or June and flow increases peaking in January for all years (i.e., average, dry, and wet years).

The vegetation along South Boulder Creek is predominantly Riparian Herbaceous and Riparian Shrub but also includes Riparian Deciduous and Riparian Evergreen communities. The classification of habitat associations is based on methods used to collect data for riparian and wetlands for the stream segments. Species associated with upland habitats would not be affected by flow changes and, thus, are not addressed here.

Birds

Table 33 lists bird species that are dependent on the riparian habitats that could occur within the South Boulder Creek study segments.

Table 33:
Bird Species Breeding in Riparian and Wetland Habitats

Species	Riparian Evergreen	Riparian Deciduous	Riparian Shrub	Riparian Herbaceous
Ruby-crowned kinglet *Regulus calendula*	✓			
Golden-crowned kinglet *Regulus satrapa*	✓			
Mountain chickadee *Poecile gambeli*	✓			
Yellow-rumped warbler *Dendroica cornata*	✓			
Western tanager *Piranga ludoviciana*	✓			
Cordilleran flycatcher *Empidonax occidentalis*	✓	✓		
American robin *Turdus migratorius*	✓	✓		
Broad-tailed hummingbird *Selasphorus platycercus*	✓	✓	✓	

Table 33:
Bird Species Breeding in Riparian and Wetland Habitats

Species	Riparian Evergreen	Riparian Deciduous	Riparian Shrub	Riparian Herbaceous
Swainson's thrush *Catharus ustulatus*	✓	✓	✓	
Western wood-pewee *Contopus sordidulus*		✓		
Northern flicker *Colaptes auratus*		✓		
House wren *Troglodytes aedon*		✓		
Warbling vireo *Vireo gilvus*		✓		
American kestrel *Falco sparverius*		✓		
Violet-green swallow *Tachycineta thalassina*		✓		
Yellow warbler *Dendroica petechia*		✓	✓	
MacGillivrays warbler *Oporornis tolmiei*		✓	✓	
Song sparrow *Melospiza melodia*		✓	✓	✓
Dusky flycatcher *Empidonax oberholseri*			✓	
Wilson's warbler *Cardellina pusilla*			✓	
Lincoln's sparrow *Melospiza lincolnii*			✓	
White-crowned sparrow *Zonotrichia leucophyrs*			✓	
Fox sparrow *Paserella iliaca*			✓	
Red-winged blackbird *Agelaius phoeniceu*				✓
Brewers blackbird *Euphagus cyanocephalus*				✓
Common snipe *Gallinago*				✓
Killdeer *Charadrius vociferous*				✓
Spotted sandpiper *Actitis macularia*				✓
Mallard *Anas platyrhynchos*				✓
Green-winged teal *Anas crecca*				✓

Source: Andrews and Righter (1992), Kingery (1998) , see Final EIS for reference materials

Mammals

Mammals associated with riparian and wetland habitats that could occur within the South Boulder Creek study segments are listed in Table 34.

Table 34:
Mammal Species Likely or Known to Occur in Riparian and Wetland Habitats

Species	Riparian Evergreen	Riparian Deciduous	Riparian Shrub	Riparian Herbaceous
Masked shrew *Sorex cinereus*			✓	✓
Montane shrew *Sorex monticolus*	✓	✓	✓	✓
Dwarf shrew *Sorex nanus*	✓	✓	✓	✓
Water shrew *Sorex palustris*	✓	✓	✓	✓
Little brown myotis *Myotis lucifugus*	✓			
Long-legged myotis *Myotis volans*	✓			
Snowshoe hare *Lepus americanus*			✓	
Beaver *Castor canadensis*		✓	✓	
Deer mouse *Peromyscus maniculatus*	✓	✓	✓	✓
Southern red backed vole *Clethrionomys gapperi*	✓		✓	
Long-tailed vole *Microtus longicaudus*		✓	✓	✓
Montane vole *Microtus montanus*		✓		✓
Meadow vole *Microtus pennsylvanicus*				✓
Common muskrat *Ondatra zibethicus*				✓
Western jumping mouse *Zapus princeps*		✓	✓	✓
Common porcupine *Erethizon dorsatum*	✓	✓	✓	✓
Red fox *Vulpes*	✓			✓
Raccoon *Procyon lotor*			✓	✓
Long-tailed weasel *Mustela frenata*	✓	✓	✓	✓
Mink *Mustela vison*	✓	✓	✓	✓

Table 34:
Mammal Species Likely or Known to Occur in Riparian and Wetland Habitats

Species	Riparian Evergreen	Riparian Deciduous	Riparian Shrub	Riparian Herbaceous
Moose *Alces*	✓		✓	✓
American elk *Cervus elephus*			✓	✓

Source: Andrews and Righter (1992), Kingery (1998) , see Final EIS for reference materials

Amphibians and Reptiles

Amphibians that would be likely to occur in riparian habitats of the South Boulder Creek stream segments include tiger salamander, western chorus frog (*Pseudacris triseriata*), and potentially northern leopard frog. Reptiles are less common in mountainous environments due to higher elevations and colder temperatures; however, western terrestrial garter snake is likely to be associated with stream segments because it occurs in almost any terrestrial or wetland habitat near flowing water (Hammerson 1999, CDOW 2011b, see Final EIS for reference materials).

Habitats and Sensitive Areas

The segment of South Boulder Creek downstream from Gross Reservoir is within the Hawkin Gulch/ Walker Ranch/upper Eldorado Canyon ECA. It is also mostly within the Boulder Foothills PCA, an area of very high biodiversity significance. Both areas are described above for Gross Reservoir.

PROJECT EFFECTS (TERRESTRIAL AND AQUATIC ANIMALS AND HABITAT)

Potential wildlife issues identified during scoping for the Moffat Collection System Project EIS included the impact of raising Gross Dam and the resulting expansion of the inundation area on elk and other wildlife on the western shores of Gross Reservoir.

Gross Reservoir

Terrestrial wildlife present in the Gross Reservoir area includes big game, other mammals, raptors, migratory birds, reptiles, and amphibians. Disturbed/unvegetated areas, while not high-quality wildlife habitat, do provide movement corridors and relatively contiguous habitat and are, therefore, included in the impact analysis. Most of the impacts to wildlife habitat would occur in the new inundation area (between 7,282 and 7,406 feet) and would result from site preparation. All trees and wood would be removed from the inundation area and from the shoreline up to elevation 7,406 feet. The acres of impact include the area above the expanded pool. Small areas of wetland and riparian vegetation would also be affected. Direct impacts to wildlife would result from loss or degradation of habitat, mortality from ground-disturbing activities, and from vegetation clearing and inundation of natural habitat. Indirect impacts consist of displacement of wildlife by noise and disturbance resulting from on-site construction, quarrying, and transport of materials and people.

Table 35:
Direct Impacts to Wildlife Habitat in the Project Area

Wildlife Habitat	Direct Impacts to Wildlife Habitat (acres)	
	Permanent	Temporary
Ponderosa Pine	169.9	7.4
Ponderosa Pine/ Douglas fir Mix	253.0	42.5
Grassland/ Forb Mix	32.9	2.1
Disturbed/ Unvegetated	8.9	3.6
Open Water	0.0	33.7
Talus Slope/Rock Outcrop	0.4	0.0
Total	465.1	89.3

Note: The calculations of the noted acres assume disturbance between the current reservoir pool elevation (7,282 feet) and elevation 7,410 feet. This includes disturbance associated with the expanded reservoir including the Environmental Pool (elevation 7,406 feet).

Big Game

Big game, including mule deer, elk, mountain lion, and black bear, would lose habitat because of permanent and temporary losses of habitat during construction and reservoir expansion under the Project.

Mule deer, mountain lion, and black bear occur at the Gross Reservoir site year-round. Direct losses of habitat would include 465.1 acres of permanent impacts and 89.3 acres of temporary impacts. Mule deer herds inhabiting the Gross Reservoir area are not likely to be adversely affected by the reservoir expansion because no crucial seasonal habitats are present, and the affected area represents a very small part of the habitat available to DAU 27 herd. The Project would affect about 544 acres of summer range, which would have a minor effect on the mule deer herd.

Impacts to mountain lion and black bear habitat would be minimal because the impacted area represents only a small portion of the typical home range occupied by individuals of these species. In addition, mountain lions prey mostly on mule deer, and their prey base is not expected to be reduced.

Elk are present in the Gross Reservoir area during the winter, and three types of crucial seasonal habitats are present: elk migration corridor, severe winter range, and winter concentration areas. A summary of impacts to these habitats is presented in Table 36. Severe winter range and winter concentration areas are separate categories that overlap in some areas and cannot be added together to derive a total area of elk impact. Elk migration corridors and severe winter range are separate categories, but all of the construction and operation impacts would occur in both habitats.

Table 36:
Direct Impacts to Elk Seasonal Habitats in the Project Area

Type of Impact	Direct Impacts to Elk Seasonal Habitats (acres)	
	Elk Severe Winter Range and Migration Corridor	Elk Winter Concentration Area
Permanent	465.1	269.0
Temporary	89.3	52.1
Total Impacts	544.4	321.1

Note: The calculation of acreages assumes disturbance between the current reservoir pool elevation (7,282 feet) and elevation 7,410 feet. This includes disturbance associated with the expanded reservoir including the Environmental Pool (elevation 7,406 feet).

The direct loss of elk winter concentration areas represents about 1.3 percent of this habitat in the map unit, of which 0.2 percent would be temporary impacts. The loss of severe winter range represents 1.8 percent of this habitat in the affected map unit, of which 0.3 percent would be temporary impacts. Impacts would be less than 1 percent to these habitats across the entire herd unit, a minor impact.

The direct loss of elk winter concentration areas represents about 1.3 percent of this habitat in the map unit, of which 0.2 percent would be temporary impacts. The loss of severe winter range represents 1.8 percent of this habitat in the affected map unit, of which 0.3 percent would be temporary impacts. Impacts would be less than 1 percent to these habitats across the entire herd unit, a minor impact.

Gross Reservoir is near the eastern end of a migration corridor that extends from elk summer concentration areas west of Nederland to winter concentration areas around and north of the reservoir. The migration corridor extends around the reservoir, including the north and south shores. About 7.0 percent of the migration corridor would be lost due to the Project, of which about 1.1 percent would be temporary impact. Permanent loss of portions of the migration corridor would likely cause changes in elk migration patterns, and would be a moderate impact.

Year-round construction activities at the dam and nearby areas would displace big game from the eastern side of the reservoir. Although Denver Water would use confined charge blasting to reduce noise, operation of the quarry would contribute to displacement. The distance that animals move to avoid human disturbance depends on the species and/or individual, topography, vegetation cover, and intensity of the disturbance. The amount of displacement is difficult to estimate but is likely to be one-quarter to one-half mile or more, thereby involving hundreds of acres adjacent to the construction areas on the east side of the reservoir and areas along the western shore facing the dam and quarry. Displacement is not likely to affect use of most of the Winiger Ridge area. Construction would occur year-round, including the winter when the area would normally be used as elk winter range, concentration area, and severe winter range. This displacement would occur each winter for 5.5 years during Project construction including offsite and ancillary improvements to support the dam construction. Tree removal would follow USFS requirements to avoid critical wildlife seasons. During operation, big game are unlikely to exhibit any changes in behavior from current conditions.

The only construction activities on the western, northern, and southern sides of the reservoir would be clearing and disposal of woody vegetation from the new reservoir footprint. This activity would also displace big game but would occur mostly during the summer and fall. Clearing and disposal of trees is expected to take 6 to 8 months and is unlikely to affect wintering elk. Activities in the dam area are unlikely to cause displacement of big game from the west side of the reservoir because of the distance from construction activity and noise.

Construction activities on the east side of the reservoir could affect movement of elk near the reservoir and displace them to adjacent areas, but movement on the west side of the reservoir and most of the corridor is unlikely to be affected. During operation, the expanded reservoir would back up water in South Boulder Creek and other tributaries and would create greater obstacles for movement. Under the Project, approximately 2,495 feet of South Boulder Creek and approximately 2,160 feet of Winiger Gulch would be inundated. Inundation of these streams is likely to result in changes in movement for elk and deer. Inundation of South Boulder Creek above the reservoir could affect movement of elk and deer near Pinecliffe because the canyon between the enlarged reservoir and Pinecliffe is narrow and steep and may be difficult to cross. The new reservoir arms would be relatively narrow and big game may continue to cross them, especially in the spring when the reservoir would be at a lower elevation. Loss of habitat and potential change of use patterns may force elk and deer to adjacent private lands, which could increase CPW obligations for game damage compensation. Management of nuisance wildlife issues and public safety is a CPW priority; hunting is a primary tool for managing herd size, but closure of areas in Boulder County near Gross Reservoir to hunting makes it more difficult to achieve adequate harvest of big game.

Other short-term direct impacts to big game would occur from potential collisions with haul trucks and other vehicles along access routes including CR 77S, SH 72, SH 93, and SH 128 due to the increases in traffic from construction. Tree removal activities likely would affect FS 97 and FS 359. Approximately 202 construction worker vehicle trips and 44 to 74 supply delivery trips would occur during the peak-hour, as described in the Transportation Analysis. The increase in traffic on CR 77S may result in an increase in collisions with big game and other wildlife but is not likely to adversely affect local populations. Portions of SH 72 and SH 93 that are potential haul routes for construction of the Gross Reservoir expansion are in areas used year-round by mule deer and are, therefore, frequently crossed by deer. Although vehicle collisions are a safety concern, they would have negligible effect on big game populations.

Carnivores and Small and Medium-sized Mammals

Direct impacts to small and medium-sized mammals include habitat loss and mortality from ground-disturbing construction activity. Small animals in the immediate area of construction activity would likely be killed by crushing or burial during construction. More mobile species, including medium-sized animals, could avoid the construction zones but would be temporarily displaced by construction. Temporary displacement could result in increased mortality from vehicle collisions and increased resource competition.

As discussed under Big Game, the increased water level up the reservoir fingers at Winiger Gulch and South Boulder Creek would create a barrier to movement for these species, especially small mammals that would have to travel long distances to move around the water. An indirect impact of enlarging the reservoir to small and medium-sized mammals would be fragmentation of habitat.

Numerous bats inhabit the mixed conifer and ponderosa pine woodlands in the Project area. The primary impacts to these species would be loss of roosting trees around the perimeter of the reservoir and disturbance of roosting bats during construction and vegetation clearing activities. However, the enlarged reservoir would create additional open water foraging habitat for some bat species.

Raptors

Although no raptor nests were observed during field surveys, several species listed in Table 30 may nest in the vicinity of the reservoir and could be affected by construction. Clearing of vegetation during reservoir site preparation has the potential to remove trees with stick nests used by hawks or cavity nests used by owls. The Project does not involve construction on cliffs and is very unlikely to affect cliff nesting species such as falcons and is not expected to affect the osprey nesting platforms at Gross Reservoir.

All raptors are protected under the Migratory Bird Treaty Act (MBTA), and removal or destruction of an active nest would be a violation of the Act. Impacts would be avoided or minimized by use of pre-construction surveys to identify active nests in the Project footprint. If nests are found in the construction area, they would be removed during the non-breeding season when they are not being used. Removal of inactive nests during vegetation clearing would have no direct impacts on raptors but could affect use of breeding territories during the next breeding season. Some species, such as red-tailed hawk and golden eagle, typically have multiple nests within their territory, and breeding would likely occur at one of the alternate nests. Other species, such as great-horned owl and sharp-shinned hawk, often build or use new nests each year, and loss of an old nest site would have no effect. Impacts would be greatest for species that have high nest fidelity and that use the same nest for many years, such as bald eagle and osprey, which are not known to nest at Gross Reservoir.

Direct impacts could occur during construction from disturbance from human activity around an active raptor nest. Depending on several factors such as species, the type of activity, topography, and individual sensitivity, disturbance could result in loss of eggs or young due to nest abandonment. CPW has recommended buffer zones and seasonal restrictions that range from 0.25 to 0.5 mile for nests of various raptor species, including golden eagle, red-tailed hawk, osprey, and northern goshawk (CDOW 2008b, see Final EIS for reference materials). In addition to buffers and seasonal restrictions for human encroachment, CPW recommendations generally include no surface occupancy (no new structures) within buffer zones. The CPW recommendations do not address some species that may occur, including owls, sharp-shinned hawk, and Cooper's hawk. If raptor nests are discovered during raptor surveys, seasonal buffers would be established and coordinated with CPW to avoid or minimize impacts to nesting raptors.

Under the Project, loss of habitat from inundation would be limited to a 150- to 300-foot-wide strip along most of the reservoir perimeter. Most of the affected area is forest or woodland, and loss of habitat would reduce foraging habitat both for forest birds and for species that forage in ponderosa pine woodlands. There would be increases in open water and shoreline habitat. The Project is not expected to adversely affect populations of sensitive raptor species such as northern goshawk and flammulated owl (*Psiloscops* [*Otus*] *flammeolus*).

Other Birds

Direct impacts to other birds would consist of loss of habitat from vegetation clearing and inundation, as well as disturbance during construction activities. Birds primarily affected by vegetation clearing include those species as inhabiting ponderosa pine and ponderosa pine/Douglas fir woodland habitats.

As described for raptors, disturbance to nesting birds and young or removal or destruction of an active nest are violations of the MBTA. Vegetation clearing around the reservoir shoreline and in other construction areas should be timed to avoid the nesting season of migratory birds and waterfowl (generally March 1 through July 31). Construction of Gross Dam and other facilities would occur primarily between May and September, which would likely result in impacts to migratory birds. In Denver Water's Moffat Collection System Project *Fish and Wildlife Mitigation Plan*, which has been approved by the Colorado Wildlife Commission (CWC), Denver Water has committed to using pre-construction surveys to identify active nests within the Project footprint and to timing of activities to avoid the required nest buffers during breeding season.

Operation of the enlarged reservoir would benefit waterfowl due to the increased surface area of the water body. Under the Project, the reservoir expansion would provide an additional 400 acres of open water habitat, depending on water level. Shorebirds, such as spotted sandpiper, may utilize the shoreline for foraging. Nesting habitat along the shoreline for waterfowl and other birds would be limited due to the fluctuating water levels.

Reptiles and Amphibians

Since most of the reptile and amphibian species in the Project area occur in riparian habitats, the primary impact to these species would be crushing or burial from earth-moving equipment during construction. Areas such as the inlets into the reservoir at South Boulder Creek and Winiger Gulch would be inundated, resulting in loss of habitat. Reptiles and amphibians would be able to move to avoid inundation during reservoir filling. After reservoir expansion, the fluctuating water levels would make creation of new riparian/wetland habitat unlikely except at creek inlets.

USFS Wildlife Habitats

Impacts to USFS wildlife habitats (expressed as acres of impact to various habitats) are summarized in Table 37. In forested habitats (forested corridors, interior forest, inventoried and developing old growth), both permanent and temporary impacts would remove habitat and would be considered long-term. With the exception of developing old growth, Project impacts would affect the local availability of several types of habitat but would have a minor effect over a larger area.

Table 37:
Impacts to USFS Wildlife Habitats in the Project Area

Type of Habitat/Impact	Impacts to USFS Wildlife Habitats (acres)
Inventoried ponderosa pine/Douglas fir old growth	1.2
Low elevation old growth development area	195.4
Forested corridors	223.5
Open corridors	4.4

Table 37:
Impacts to USFS Wildlife Habitats in the Project Area

Type of Habitat/Impact	Impacts to USFS Wildlife Habitats (acres)
Permanent disturbance	196.8
Temporary disturbance	2.0
Total disturbance	198.8
Interior forest	16.5

Note: The calculation of the noted acres assumes disturbance between the current reservoir pool elevation (7,282 feet) and elevation 7,410 feet. This includes disturbance associated with the expanded reservoir including the Environmental Pool (elevation 7,406 feet).

The Project would affect 1.2 acres of inventoried old growth. This represents about 6 percent of the inventoried old growth in the Project area and less than 0.1 percent of the 1,600 acres of old growth ponderosa pine on the ARNF (USFS 1997b, see Final EIS for reference materials). The Project would also affect 195.4 acres of old growth development areas, which is about 43 percent of these areas in the Project area and 0.3 percent of the 72,700 acres of ponderosa pine/Douglas fir old growth development areas on the ARNF. Losses of inventoried old growth and developing old growth would occur from inundation and tree clearing along the edge of the reservoir. The amount of loss of old growth development areas may be in conflict with the ARNF management goal for the Thorodin Geographic Area, i.e., to “emphasize old-growth recruitment and retention” (USFS 1997b, see Final EIS for reference materials). In addition, effects on existing old growth conflicts with Forest-wide direction in the ARNF LRMP, specifically operational goal 118, which is to “retain all existing Douglas fir and ponderosa pine old growth and increase amounts in the future” (USFS 1997b, see Final EIS for reference materials).

Two types of wildlife travel corridors were analyzed by the USFS, forested corridors and open corridors. Forested corridors occupy more than 750,000 acres (about 60 percent) of the entire ARNF (USFS 1997b, see Final EIS for reference materials) and most of the 696 acres of NFS lands in the Project area. The Project would affect 223.5 acres of forested corridors, which is 32 percent of the forested corridor on NFS lands in the Project area. Losses of forested corridor at Gross Reservoir would occur adjacent to the existing reservoir and would not result in an overall loss of connectedness except along the newly inundated portion of South Boulder Creek.

Open corridors occupy over 26,000 acres (21 percent) of the entire ARNF (USFS 1997b, see Final EIS for reference materials). The Project would also affect 4.4 acres of open corridors, about 14 percent of the 32 acres of open corridors in the Project area, which are restricted to a portion of Winiger Ridge and are poorly connected to other areas of open corridor. The small area of open corridor that would be affected is adjacent to the reservoir. Impacts of the Project on open corridors would not reduce the level of connectedness.

The Project would affect 198.8 acres of effective habitat on NFS lands, about 37 percent of the effective habitat on NFS lands in the Project area, about 6 percent of the effective habitat on NFS land in the Thorodin Geographic Area and a very small part of the approximately 860,000 acres of effective habitat on the ARNF (about 67 percent of the ARNF). The Project would reduce the habitat effectiveness on NFS land in the Thorodin Geographic Area from about 59 percent to about 55.5 percent. Losses of effective

habitat would occur primarily from inundation; there would not be any new roads or trails that would increase road and trail density or alter the locations of effective habitat. Recreational facilities to be inundated would be relocated above the new normal water line. Although recreational use may increase, the overall distribution of recreation would be similar to current conditions. Most of the NFS lands in the Project area would continue to be effective habitat. However, the Project may conflict with Forest-wide direction in the ARNF LRMP, specifically operational goal 95, which is to "retain the integrity of effective habitat areas."

The approximate area of interior forest on the ARNF is about 190,000 acres (USFS 1997b, see Final EIS for reference materials). The Project would affect 16.5 acres of interior forests, about 12 percent of the interior forest on NFS land in the Project area. All impacts would occur on the periphery of mapped areas of old growth near the existing reservoir.

USFS Management Indicator Species

Construction and operation of Gross Reservoir would have negligible to moderate impacts to the various USFS MIS. As discussed above, impacts to mule deer would be minor, and impacts to elk would be moderate. Impacts to each of the other MIS are described below.

Pygmy nuthatch is an indicator for existing and potential old growth and is most often associated with mature ponderosa pine stands (USFS 1997b, see Final EIS for reference materials). Pygmy nuthatch pairs or families occupy year-round territories that vary from 1.3 to 20.1 acres in size (Ghalambor and Dobbs 2006, see Final EIS for reference materials) and average about 3 acres per breeding pair (USFS 1997b, see Final EIS for reference materials). The estimated number of breeding pairs in Colorado is 51,000 to 399,000 pairs (Kingery 1998, see Final EIS for reference materials).

The Project would affect 1.2 acres of inventoried old growth and 195.4 acres of developing old growth, all of which is ponderosa pine or ponderosa pine/Douglas fir forest and potential habitat for pygmy nuthatch. This acreage represents about one-third of the habitat available within the Project area. Based on the average territory size, the Project could affect about 65 pairs or families, assuming that all of the existing and developing old growth at Gross Reservoir is occupied.

The removal of 196.6 acres of suitable habitat would likely reduce the local population of pygmy nuthatch but would have a minor effect to the regional population.

Golden-crowned kinglet is an indicator for interior forest and is considered to be uncommon on the ARNF (USFS 1997b). Nesting occurs primarily in mature, dense spruce-fir forest at elevations above 7,600 feet, while wintering occurs primarily in Douglas fir and ponderosa pine. Golden-crowned kinglet may occur in the Project area during migration and winter (Andrews and Righter 1992, see Final EIS for reference materials) but is not likely to breed there.

The Project would affect only 16.5 acres of interior forest that could be suitable breeding habitat for golden-crowned kinglet. Because the Gross Reservoir is situated at the lower end of the elevation range where this species breeds, there is a low potential for breeding habitat to be affected by the Project. Therefore, the Project is expected to have a negligible effect on this species.

Hairy woodpecker is an indicator for young to mature forest and is known to occur in the Project area. The estimated population of hairy woodpecker in Colorado is 28,000 to 160,000 pairs (Kingery 1998, see Final EIS for reference materials). Home range is about 6 to 9 acres per pair (USFS 1997b, see Final EIS for reference materials). The Project would remove about 268 acres of forest on NFS lands, which represents habitat for about 30 to 43 pairs. This would reduce the local population of this species but would have a minor effect to the regional population.

Mountain bluebird is an indicator for forest openings. The Project would permanently affect about 42 acres of open grasslands and disturbed areas that are potential habitat for mountain bluebirds. Clearing of trees in areas of temporary disturbance may create about 50 acres of new habitat after construction is completed and the areas are revegetated. However, mountain bluebirds usually nest in old woodpecker holes or natural cavities in dead trees, and bluebirds would be unlikely to occur in these newly created clearings unless snags are present either in the cleared area or in the adjacent forest or unless nest boxes are provided. The Project would reduce the local population of this species but would have a minor effect to the regional population.

Warbling vireo is an indicator for aspen forests and also nests in cottonwoods and in riparian shrub (Kingery 1998, see Final EIS for reference materials). The Project would not affect any aspen forest or cottonwoods but would affect about 5.6 acres of riparian shrub. According to nesting densities referenced in Kingery (1998, see Final EIS for reference materials), this area of riparian shrub is equivalent to the breeding territories of 1 to 2 pairs of warbling vireos. Therefore, the Project is expected to have a negligible effect on warbling vireo populations.

Wilson's warbler is an indicator for montane riparian and wetland habitat. Nesting occurs from about 8,000 to 12,000 feet elevation, with Wilson's warblers overlapping with yellow warblers from 8,000 to 10,000 feet (Andrews and Righter 1992, see Final EIS for reference materials). The Project area is below 8,000 feet, and the primary occurrence of Wilson's warblers there is likely to be during migration. About 5.6 acres of riparian shrubland would be affected by the Project. Based on the limited habitat and the likely absence of breeding in the area, the Project is likely to have negligible effects to Wilson's warbler.

There would be no impacts to Rocky Mountain bighorn sheep or boreal toad in the Gross Reservoir area because neither species occurs there.

Sensitive Areas

PCAs designated by the CNHP and ECAs designated by Boulder County are shown in Exhibit 1, Figures 11, Sensitive Areas and Wildlife Corridors, and Figure 6, Environmental Conservation Areas, from the Boulder County Comprehensive Plan, respectively. These PCAs are considered important for protection by the CNHP and Boulder County and would be directly impacted by vegetation removal and inundation around the perimeter of the reservoir. Impacts to sensitive areas (expressed as acres of impact to the CNHP PCA and the Boulder County ECA) are summarized in Table 38.

Table 38:
Direct Impacts to Sensitive Areas in the Project Area

Sensitive Area	Direct Impacts to Sensitive Areas (acres)	
	Permanent	Temporary
Winiger Gulch PCA	71.8	0.0
Winiger Ridge ECA	243.4	0.0
Total	315.2	0.0

Note: The calculation of acreages assumes disturbance between the current reservoir pool elevation (7,282 feet) and elevation 7,410 feet. This includes disturbance associated with the expanded reservoir including the Environmental Pool (elevation 7,406 feet).
ECA = Environmental Conservation Area
PCA = Potential Conservation Area

Under the Project, direct impacts to the Winiger Gulch PCA include inundation of 71.8 acres (3.8 percent of the total PCA), and direct impacts and to the Winiger Ridge ECA include inundation of 243.4 acres (7 percent of the total ECA). Two rare plant communities occur in the Winiger Gulch PCA and would be affected.

Summary of Project Effects (Gross Reservoir)

Ground disturbance and inundation from the Project would permanently affect 465 acres of wildlife habitat and temporarily affect 89 acres at Gross Reservoir. About 90 percent of the permanent impact would occur in ponderosa pine forest and mixed ponderosa pine/Douglas fir forest. Land use within the Gross Reservoir area is stable, with only minor development or changes planned, as indicated by individual residential building/improvement permits. The area around Gross Reservoir is currently dominated by natural habitats and is expected to continue to be mostly natural.

Construction activities from the Project would temporarily displace big game and other wildlife during construction, including construction of the dam and clearing of woody vegetation from around the new shoreline of the expanded reservoir.

The direct loss of elk seasonal habitat would be 1 to 2 percent of the elk winter concentration area and severe winter range currently used by the herd unit. Gross Reservoir is near the eastern end of a migration corridor, and construction activities and the enlarged reservoir are likely to affect elk movement patterns near Pinecliffe. This may result in changed use patterns in winter habitats and could potentially result in increased conflicts between big game and private landowners. The Project would also result in loss of habitat for small and medium-sized mammals, raptors, other birds, and reptiles and amphibians, and the enlarged reservoir may affect movements of some of these species.

The Project would affect several types of wildlife habitats of interest in the ARNF, including old growth, forested and open corridors, effective habitat, and interior forests. The Project would have minor impacts to several USFS MIS, including pygmy nuthatch, hairy woodpecker, and mountain bluebird, and negligible impacts to golden-crowned kinglet, warbling vireo, and Wilson's warbler.

Mountain pine beetle could potentially also affect forest habitats and species in the Project area. Ponderosa pine is the most common tree at Gross Reservoir and is susceptible to mountain pine beetle.

The mountain pine beetle outbreak that began in 1996 in northern Colorado expanded into ponderosa pine forests east of the Continental Divide. Wildfires also have the potential to substantially affect forested habitats at Gross Reservoir. Because of fire suppression, current forests are more susceptible to fires than in the past, and increased growth of Douglas fir within ponderosa pine forests has increased the potential for crown fire, which is more damaging. The USFS, Denver Water, and other agencies have conducted and will continue to implement programs to reduce the potential for wildfire.

The Project would occupy portions of two sensitive areas, the Winiger Gulch PCA and the Winiger Ridge ECA. Dispersed recreation may also affect these areas.

South Boulder Creek

The Project does not include any construction activities along stream segments, and the analysis of impacts is, therefore, focused on effects to habitat that may result from changes in stream flows. Hydrologic impacts are based on a comparison of the Project with the existing system at full use.

Wetland and riparian habitats occur in areas of greater moisture provided by complex interactions between stream flows, groundwater, precipitation, and the physical characteristics of the stream channel and its floodplain. The riparian/wetland analysis focuses on two primary mechanisms that may affect riparian vegetation: 1) lowering of groundwater tables to a degree that causes plant mortality and 2) changes in the width of the stream that is regularly inundated by stream flows. The Project is designed to capture surface water flows only during periods of higher runoff in wet or average years, and increased diversions would generally not occur in dry years or during periods of low flows. Flow changes resulting from the Project are within the range of normal variability, and flows already vary substantially from dry year to wet year and over the course of a season.

The groundwater analysis indicates that flow changes along the stream segments would cause localized, minimal effects to the water table that would not be any larger than stream elevation changes and would be well within the range of normal seasonal fluctuations. The small changes in the water table may cause a slight change in wetland species and in upland or facultative species on the banks, but effects are expected to be minimal. Given the small amount of change and the complexity of riparian areas, changes are likely to be small in magnitude and patchy in distribution.

Modeling of impacts from stream flow changes is based on detailed hydraulic and vegetation data collected at South Boulder Creek representative sampling sites SBC1 upstream of Gross Reservoir and SBC3 downstream from Gross Reservoir.

At South Boulder Creek sampling site SBC1, the 2-year flow elevation would increase by about 1.6 inches and the 2-year width would increase by about 0.6 feet (approximately 0.3 foot on each side of the channel) compared with the existing system at full use (Table 26). The area affected over the 559-foot reach would be less than 0.01 acre, or approximately 0.1 acre when extrapolated over a 1-mile distance. Comparable 5-year and 10-year elevation increases would be about 2 inches and 3 inches, respectively, and comparable 5-year and 10-year width increases would be about 0.1 foot at both locations. In each case, the area affected would be approximately 0.01 acre when extrapolated over a 1-mile distance.

At SBC1, the width affected by overbank flooding under the Project would be narrow, about 0.4 foot for the 5-year flow and 0.6 foot for the 10-year flow, which are lower than overbank flooding under the existing system at full use of 1.2 and 1.3 feet, respectively. The average width of the existing riparian area, excluding the area within the banks, is about 15 feet. The area of riparian vegetation therefore extends well beyond the area of flooding associated with the 10-year flow, and the area of overbank flooding would cover only about 4 percent of the riparian area.

At South Boulder Creek sampling site SBC3, the 2-year flow elevation would decrease by about 2 inches and the 2-year width would decrease by about 4.7 feet (approximately 2.35 feet on each side of the channel) compared with the existing system at full use (Table 29). The area affected over the 446-foot reach would be 0.05 acre, or 0.57 acre when extrapolated over a 1-mile distance. Comparable 5-year and 10-year elevation reductions would be about 2 inches and 2.4 inches, respectively, and comparable 5-year and 10-year width reductions would be about 2 feet and 2.4 feet, respectively (Table 29). These decreases in flows could result in a gradual narrowing of the stream banks, which would decrease hydrology for wetlands within the banks. However, longer-term floods may remove accumulated sediment and reverse the narrowing. Where narrowing occurred, vegetation would respond by gradually adjusting its location, moving downgradient to remain in the same hydrologic zone. Changes are likely to be very slow in most areas. The zone of reduced hydrology may show a change in composition to riparian species with somewhat lower water requirements, or upland species such as conifers. Wetlands and riparian areas that are maintained primarily by groundwater discharge would not be affected. Reductions in the 5- and 10-year flows would affect vegetation communities that extend above the area affected by 10-year flows and are probably supported by groundwater discharge.

At SBC3, the width affected by overbank flooding under the Project would be relatively narrow, about 5.8 feet for the 5-year flow and 7.1 feet for the 10-year flow, which are higher than overbank flooding for the existing system at full use of 2.5 and 4.4 feet, respectively. The average width of the existing riparian area, excluding the area within the banks, is about 24 feet. The area of riparian vegetation therefore extends well beyond the area of flooding associated with the 10-year flow, and the area of overbank flooding would cover less than 30 percent of the riparian area.

The analysis of changes to wetlands and riparian habitats characterizes changes to riparian and wetland habitats at South Boulder Creek resulting from implementation of the Project as minor or negligible, with changes more likely to involve a shift in composition rather than a loss of habitat. These small changes could potentially affect food availability or cover for riparian wildlife species. Changes in habitat quality are likely to be small and patchy and relatively subtle in most places. These changes are not likely to affect overall distribution or populations of bird, mammal, reptile, and amphibian species.

South Boulder Creek below Gross Reservoir flows through the Hawkin Gulch/Walker Ranch/Upper Eldorado Canyon ECA and the Boulder Foothills PCA, but flow changes would not affect the resources for which these areas were identified.

Summary of Project Effects (South Boulder Creek)

The analysis of effects to riparian and wetland habitat focuses on two primary mechanisms that may affect riparian vegetation: 1) lowering of groundwater tables to a degree that causes plant mortality and 2) changes in the width regularly inundated by stream flows.

The groundwater analysis indicates that flow changes along the river segments would cause localized, minimal effects to the water table that would not be any larger than stream elevation changes and would be well within the range of normal seasonal fluctuations. Given the small amount of change and complexity of riparian areas, changes in streamside vegetation are likely to be small in magnitude and patchy in distribution.

The analysis of changes to wetlands and riparian habitats characterizes changes to riparian and wetland habitats as minor or negligible, with changes more likely to involve a shift in composition rather than a loss of habitat. These small changes could potentially affect food availability or cover for riparian wildlife species but are not likely to affect overall distributions or populations of bird, mammal, reptile, and amphibian species.

South Boulder Creek downstream from Gross Reservoir flows through the Hawkin Gulch/Walker Ranch/upper Eldorado Canyon ECA and the Boulder Foothills PCA, but flow changes would not affect the resources for which these conservation areas were identified.

Conclusions supported by the FERC in its review of the Project impacts related to terrestrial wildlife and habitat (Final SEA, Sections 5.1.5 and 5.1.5.2) were as follows

> *We [FERC] did not identify any elements of Denver Water's proposal which would cause effects to terrestrial resources in the project area, to include vegetation and wetlands, wildlife, and special status species, to exceed the levels identified in the 2014 Final EIS.*
>
> *We [FERC] found that effects to these resource would be reduced through use of Denver Water's currently-proposed quarry at Osprey Point as the project's primary quarry rather than the Final EIS quarry site on Forest Service land. Effects to terrestrial resources would also be reduced through implementation of mitigation measures and plans proposed by Denver Water or required by certain Forest Service 4(e) conditions, some of which were named in the sections above. The mitigation measures and plans that would help to reduce effects to terrestrial resources include the following: Road Maintenance Plan (condition 10), Invasive Plant and Noxious Weed Species Management Plan (condition 17), Special Status Species and Sensitive Areas (condition 18), Fire Management and Response Plan (condition 20), Raptor Protection Measures (condition 21), Special Status Plants Relocation Plan (condition 22), Pit Development and Reclamation Plan (condition 26), Tree Removal Plan (condition 27), and Reclamation and Revegetation Seed Mixes and Mulch Materials Plan (condition 28). To ensure the effectiveness of the measures in these plans, some of which were named in the sections above, we [FERC] recommend that the plans finalized be in consultation with the agencies identified in its application and the entities identified in the applicable Forest Service conditions, and that the plans be filed for Commission [FERC] approval.*

Approval of an Erosion and Sediment Control Plan by the Commission's San Francisco Regional Office prior to any land-disturbing or construction activities, as described above, would further reduce effects to terrestrial resources by helping to control erosion.

The Final EIS found inundation of the enlarged reservoir would result in moderate, direct long-term effects on wildlife and associated habitat through the permanent loss or modification of range, migration corridor use, and winter concentration areas for large mammals such as elk. It found that temporary wildlife displacement during construction, especially on the east side of reservoir, would occur, but that these effects would not likely be adversely or permanently affect overall wildlife populations. Nesting avian species may be affected during construction but these effects would be minor and short-term. Also, although some minor, long-term loss of habitat for forest birds would occur, operation of the reservoir would provide beneficial loafing and foraging habitat for resident and migratory waterfowl.

The enlarged reservoir would create additional open water foraging habitat that would benefit some species such as raptors, waterfowl, bats, and aquatic furbearers. Following the initial filling of the reservoir, most affected animal species animals would modify their home ranges and foraging practices to account for the new reservoir level. Therefore, effects on wildlife would be moderate but short-term, dissipating over time, and are consistent with the determinations in the Final EIS.

Effects to wildlife and wildlife habitat in the Gross Reservoir Project area would also be reduced and mitigated through development of the plans and measures required by the Forest Service, as well as utilizing specific raptor protection measures (through condition 21) and the off-license conveyance of the 539- acre Toll Property to the Forest Service, as described earlier. Compliance with these requirements would reduce effects to wildlife identified for the Gross Reservoir Project area in the Final EIS, and resulting in overall minor, beneficial effects.

MITIGATION (TERRESTRIAL WILDLIFE)

Denver Water's License Amendment Application to the FERC evaluated all mitigation measures for terrestrial wildlife (Exhibit 5) in Table 5.1-1 as provided below.

Per the Denver Water/USFS Settlement Agreement, Denver Water will mitigate permanent impacts to wildlife habitat through the preservation (through USFS protection and administration of NFS lands) of 539 acres of diverse wildlife habitat, including elk and mule deer summer range and migration corridors, potential habitat for lynx (federally threatened and state endangered species), habitat for boreal toad (state endangered and USFS sensitive species), and a wide range of habitats for native wildlife such as coyote, American marten, weasel, elk, moose, mule deer, snowshoe hare, broad-tailed hummingbird, red-naped sapsucker, warbling vireo, and other small mammals and birds.

Per the USFS Section 4(e) Condition 21 (Raptor Protection Measures) from the Denver Water/USFS Settlement Agreement: Denver Water will replace the two existing osprey nest platforms in Gross Reservoir and conduct pre-construction raptor surveys.

Per the Corps 404 Permit condition adopting mitigation identified in the 2011 FWMP developed between Denver Water and CPW, Denver Water will contact the USFWS, Office of Migratory Birds, for permitting requirements prior to the removal or destruction of any nests.

The FERC's analysis evaluated the effects of all mitigation measures (FERC Final SEA, Section 5.1.5.2) and concluded as follows.

> *The Final EIS identified the wildlife species potentially present within Gross Reservoir project vicinity, including those species present within the Osprey Point Quarry area. Effects of the proposed modification of the Gross Dam and associated actions on wildlife were evaluated in the Final EIS. As noted in the Final EIS, direct and indirect effects on wildlife, such as the loss or degradation of habitat and disturbance or displacement of wildlife, would occur from reservoir enlargement, quarry operation, temporary access roads and landing pads, and relocation of recreation areas.*
>
> *Inundation of additional shoreline could reduce opportunities for wildlife foraging, nesting, movement, and other daily or seasonal behavior. Shorelines, including along South Boulder Creek and nearby tributaries, would become inundated from the Environmental Pool elevation, which may create an additional barrier to movement and habitat fragmentation for smaller sized mammals that would have to travel longer distances to move around the new inundation zones. However, the enlarged reservoir would create additional open water foraging habitat that would benefit some species such as raptors, waterfowl, bats, and aquatic furbearers. Following the initial filling of the reservoir, most affected animal species animals would modify their home ranges and foraging practices to account for the new reservoir level. Therefore, effects on wildlife from the new reservoir filling would be moderate but temporary, dissipating over time, and are consistent with the determinations in the Final EIS.*
>
> *In comments filed on the February 6, 2018 Supplemental EA, multiple commenters raise concerns about effects on wildlife from increased noise levels and lighting during construction, including tree removal activities. They also raise concerns that some aspects of the project would result in increases in permanent habitat fragmentation from construction.*
>
> *Denver Water proposes measures to reduce effects of construction on ambient noise levels and lighting. Denver Water proposes to reduce noise by modifying the equipment or the work area to make it quieter. However, we [FERC] expect noise effects, including helicopter noise, to be short-term and moderately adverse, as determined in the Corps' Final EIS. Based on our analysis, changes in noise levels associated with Denver Water's proposal would not result in effects substantially different from those identified in the Final EIS for both wildlife and area residents. Further, the proposed use of a quarry on Denver Water's land would significantly reduce the number of vehicle trips to transport materials from off-site from 22 vehicle trips per day to 6 vehicle trips per day, thereby reducing construction-related noise and disturbance to wildlife. However, if the proposed methods for tree removal are modified, a moderate, short-term increase in noise and the number of vehicle trips to transport disposal materials may occur. Transportation, Traffic, and Public Safety, measures included in the Tree Removal Plan required by Forest*

Service 4(e) condition 27 would reduce effects of tree removal and disposal operations on wildlife.

Denver Water proposes to minimize upward diffusion of light during construction by ensuring that yard lights used for nighttime lighting of facilities are downcast. This would reduce night sky effects from stray lighting. This would also help to minimize effects of project lighting on wildlife movement and behavior during construction.

Realignment of permanent roads and development of temporary roads and landing pads would create new breaks in habitat structure and affect animal movement. Roads have been a component of the Gross Reservoir area for many years, and wildlife are accustomed to traffic. Additions of new road segments would cause temporary disbursement from the area during construction, but these effects would be short term and minor given available habitat elsewhere in the immediate area. Helicopter pads would be within cleared areas, which would generally be avoided by wildlife during tree removal activities. Following construction, Denver Water would restore any temporary roads or landing pads in areas above the inundation level. Most of the effects of the project, on habitat fragmentation would be short term, lasting during the construction period, and of minor severity due to available habitat.

Development and use of the new quarry site at Osprey Point, located entirely within the inundation zone of the reservoir rather than on Forest Service lands would, generally, reduce short-term, moderate noise impacts related to construction activities, blasting, and traffic effects to wildlife. Other short-term direct impacts to wildlife, such as potential collisions with haul trucks and other vehicles along construction access routes, also would be reduced through use of the new quarry location. Although a significant portion of the truck traffic required for transport of aggregate materials from offsite locations would no longer necessary, some collisions with wildlife could still occur, but would have less of an effect on local wildlife populations in the project area. Further, because the new quarry site would be located entirely on Denver Water lands, effects on Roosevelt National Forest lands would be greatly reduced.

Denver Water proposes to develop a variety of resources management plans to minimize project effects including those that would address traffic, noise, and air quality during construction. Commission policies require Denver Water to consult with resource management agencies, including the Forest Service, FWS, and Colorado Parks and Wildlife to finalize these plans and provide evidence of consultation and rationale for why any agency recommendations were not included in the final plans, and copies of agency approvals where necessary. Effects on wildlife and wildlife habitat in the project area would be reduced and mitigated through development of the plans and measures required by the Forest Service, described earlier in this section, as well as using specific raptor protection measures (through condition 21) and the off-license conveyance of the 539-acre Toll Property to the Forest Service, as described earlier. Compliance with these requirements would reduce effects on wildlife identified for the Gross Reservoir Project area in the Final EIS, and result in overall minor, beneficial effects.

AFFECTED ENVIRONMENT (SPECIAL STATUS WILDLIFE SPECIES)

Special status species include federal- and state- listed threatened, endangered, and candidate species; USFS Region 2 sensitive species; Bureau of Land Management (BLM) sensitive species; and CNHP-listed species.

Federally listed species are protected under the Endangered Species Act (ESA), while state-listed species are protected under Colorado state law. Information about the potential occurrence of federal- and state-listed endangered and threatened species is presented below. A list of federal- and state-listed species that may occur in the Project area, along with their status and habitat affiliation are provided in Table 39, and more detailed information for those species with potential to occur in the Project area is presented below.

Table 39:
Federal- and State-Listed Endangered or Threatened Species—Wildlife Species

Name	Status*	Habitat	Potential for Occurrence in the Study Area**		
			Gross Reservoir	South Boulder Creek above Gross Reservoir	South Boulder Creek below Gross Reservoir
Birds					
Burrowing owl *Athene cunicularia*	ST, BLM, USFS	Nests in abandoned prairie dog burrows in summer	1		
Eskimo curlew *Numenius borealis*	FE	Migrates through Nebraska in wet meadow habitat along South Platte River		1	1
Interior least tern *Sterna antillarum athalassos*	FE, SE	Migrants occur at reservoirs, lakes, and rivers with bare, sandy shorelines	1	1	1
Mexican spotted owl *Strix occidentalis lucida*	FT, ST	Mixed conifer forests and pinyon-juniper woodland with narrow, shady, sandstone canyons at 4,400-6,800 feet	1		
Mountain plover *Charadrius montanus*	FP, ST, BLM, USFS	Breeds in shortgrass prairie. Often associated with prairie dog colonies and heavy grazing	1		
Piping plover *Charadrius melodus*	FT, ST	Wetlands, lakeshores, and marshes. Rare migrant on eastern plains to foothills between April and May	1	1	1
Whooping crane *Grus americana*	FE, SE	Rare migrant in wetlands, wet meadows, broad drainage bottoms, and reservoir edges; in areas with minimal human disturbance	1	1	1
Yellow-billed cuckoo *Coccyzus americanus* (western Distinct Population Segment)	FP, SC, BLM, USFS	Riparian forest		1	1

Table 39:
Federal- and State-Listed Endangered or Threatened Species—Wildlife Species

Name	Status*	Habitat	Potential for Occurrence in the Study Area**		
			Gross Reservoir	South Boulder Creek above Gross Reservoir	South Boulder Creek below Gross Reservoir
Mammals					
Canada lynx *canadensis*	FT, SE	Contiguous old-growth spruce, fir, and lodgepole pine forests with deep snow and snowshoe hare	1	3	1
North American wolverine *Gulo*	FP, SE, USFS	Rare inhabitant of alpine and subalpine habitats	1		
Preble's meadow jumping mouse *Zapus hudsonius preblei*	FT, ST	Front Range up to 7,600 feet in well-developed plains riparian vegetation with adjacent, undisturbed upland grassland near water	2	1	5
River otter *Lontra canadensis*	ST, USFS	Riparian habitats with permanent water	1	1	1
Amphibians					
Boreal toad *Anaxyrus boreas*	SE, BLM, USFS	Damp areas dominated by lodgepole pine, aspen, or Englemann spruce-subalpine fir forests	1	2	1
Fishes					
Bonytail chub *Gila elegans*	FE, SE	Historically occurred in Colorado River drainage; currently only near Grand Junction		1	1
Colorado pikeminnow *Ptychocheilus lucius*	FE, ST	Historically occurred in Colorado River; currently found on west slope only		1	1
Common shiner *Luxilus cornutus*	ST	Rare in Colorado; records from early 1980s from mainstem South Platte in Denver but considered very rare	1	1	1
Greenback cutthroat trout *Oncorhynchus clarki stomias*	FT, ST	Prefers cold, clear, gravely headwater streams in the Arkansas and South Platte river drainages	2	1	1
Humpback chub *Gila cypha*	FE, ST	Historically occurred in Colorado River; found on west slope only		1	1
Lake chub *Couesius plumbeus*	SE	Lake habitats; spawn in streams. Occur in St. Vrain River and two reservoirs in Clear Creek County	1	1	1
Northern redbelly dace *Chrosomus eos*	SE	Remaining populations in West Plum Creek; in submerged vegetation in slow-moving streams	1	1	1
Pallid sturgeon *Scaphirhynchus albus*	FE	Known population in Mississippi River. Not present in Colorado.		1	1
Razorback sucker *Xyrauchen texanus*	FE, SE	Historically occurred in Colorado River; currently found on west slope only		1	1

Table 39:
Federal- and State-Listed Endangered or Threatened Species—Wildlife Species

Name	Status*	Habitat	Potential for Occurrence in the Study Area**		
			Gross Reservoir	South Boulder Creek above Gross Reservoir	South Boulder Creek below Gross Reservoir
Invertebrates					
Pawnee montane skipper *Hesperia leonardus montana*	FT	Occurs in the South Platte Canyon, southwest of Denver	1		

Sources: federal species USFWS 2012; state species CDOW 2011c

* Status: FT = Federally Threatened, FE = Federally Endangered, FP = Proposed for Listing, FC = Candidate for Federal Listing, ST = State of Colorado Threatened, SE = State of Colorado Endangered,
USFS = U.S. Forest Service Region 2 sensitive, BLM = Bureau of Land Management sensitive

** Codes to Occurrence in Study Area:

1 = Not present—Habitat is unsuitable or outside current known range.

2 = Unlikely—Based on marginal habitat, rarity of occurrence and/or range. Also includes areas where habitat is suitable, but not found during presence/absence surveys or considered unlikely to occur by detailed habitat evaluation.

3 = Potentially present—Habitat suitable or marginal. Wide-ranging species may occur occasionally during foraging or migration but Study Area do not have important habitat. No documentation of presence for sedentary species.

4 = Known or likely to occur: 4A—Habitat suitable, (animals) may occur regularly during foraging or migration; 4B—(animals) may breed in Study Area.

5 = Known or likely to occur, key habitat features present.

Other Special Status Species, as described below, include USFS Region 2 sensitive species (USFS 2011, see Final EIS for reference materials); ARNF plant species of local concern (USFS 2010, see Final EIS for reference materials); and CNHP-listed species (CNHP 2013, see Final EIS for reference materials). Table 40 presents these species, their status, habitat, and potential to occur in the Project area. For South Boulder Creek, only those species inhabiting aquatic or riparian environments associated with the stream are given.

Information on special status species was obtained from field visits, CNHP element occurrence data, the Natural Diversity Information Source (NDIS) website of species' ranges, USFS data, previous studies and reports, and literature searches. Habitats that support special status species were further identified using Geographic Information System (GIS) to overlay aerial photographs on Project area boundaries.

Table 40:
Other Special Status Species—Wildlife Species

Name	Status*	Habitat	Potential for Occurrence in the Study Area**		
			Gross Reservoir	South Boulder Creek above Gross Reservoir	South Boulder Creek below Gross Reservoir
Birds					
American bittern *Botaurus lentiginosus*	USFS	Summer resident of eastern plains and mountain parks. Inhabits wetlands with tall emergent vegetation.	1	1	1
American peregrine falcon *Falco peregrinus anatum*	SC, BLM, USFS, G4T4/S2B	Nests on cliffs, forages over many habitats.	3	4	4
American three-toed woodpecker *Picoides dorsalis*	USFS	Subalpine and montane forests, usually in areas of dead or dying conifers.	3		
American white pelican *Pelecanus erythrorhynchos*	BLM, G3/S1B	Summers on large reservoirs. No breeding in Study Area.	2	1	1
Bald eagle *Haliaeetus leucocephalus*	Bald and Golden Eagle Protection Act, SC, BLM, USFS, G5/S1B,S3N	Large bodies of open water near tall trees and prairie dog colonies, especially in winter.	3	1	1
Barrow's goldeneye *Bucephala islandica*	G5/S2B	Winter on reservoirs and rivers; summer in mountain reservoirs and ponds in forested areas.	2	1	1
Black tern *Chlidonias niger*	USFS	Associated with aquatic habitats containing emergent vegetation on the plains and in mountain parks.	1	1	1
Black swift *Cypseloides niger*	BLM, USFS, G4/S3B	Nests on cliffs or behind high waterfalls. Forage at high elevations.	3		
Boreal owl *Aegolius funereus*	USFS, G5/S2	Mature mixed spruce-fir forest interspersed with meadows at elevations above 9,000 feet.	1		
Brewer's sparrow *Spizella breweri*	USFS	Usually in sagebrush or other shrubs vegetation; on migration may occur in woody, brushy or weedy areas.	1		
Ferruginous hawk *Buteo regalis*	SC, BLM, USFS, G4/S3B,S4N	Grasslands with scattered trees; concentrate in prairie dog towns in winter.	1		
Flammulated owl *Psiloscops (Otus) flammeolus*	USFS	Nest in tree cavities in old-growth ponderosa pine/Douglas fir; in Boulder County, roost in mixed conifer and dense shrubs along small streams in summer.	4		
Greater sandhill crane *Grus canadensis tabida*	SC, G5T4/S2B,S4N	May occur in migration on mudflats around reservoirs in moist meadows and agricultural areas.		1	1

Table 40:
Other Special Status Species—Wildlife Species

Name	Status*	Habitat	Potential for Occurrence in the Study Area**		
			Gross Reservoir	South Boulder Creek above Gross Reservoir	South Boulder Creek below Gross Reservoir
Lewis' woodpecker *Melanerpes lewis*	USFS, G4/S4	Riparian cottonwood forest, open ponderosa pine forest.	2		
Loggerhead shrike *Lanius ludovicianus*	USFS	Grassland with scattered trees, rural areas with abandoned farmyards.	1		
Long-billed curlew *Numenius americanus*	SC, BLM, USFS, G5/S2B	May occur in migration in shortgrass prairie.	1		
Northern goshawk *Accipiter gentilis*	BLM, USFS, G5/S3B	Nests in mature ponderosa pine, mixed-conifer, and spruce-fir forests with canopy closure greater than 60%.	4		
Northern harrier *Circus cyaneus*	USFS	Grassland, agricultural areas, and marshes.	1		
Olive-sided flycatcher *Contopus borealis*	USFS	Nests in mature spruce-fir and Douglas fir forests; dependent on riparian habitat.	3		
Ovenbird *Seiurus aurocapillus*	G5/S2B	Rare migrant in lowland riparian forest, shrublands, and wooded urban areas.	2	1	1
Purple martin *Progne subis*	USFS	In Colorado, nests mainly in old growth aspen on western slope, occurs over riparian areas, open agricultural areas and reservoirs during migration.	2		
Snowy egret *Egretta thula*	G5/S2B	Reservoirs, grassy marshes, wet meadows, and rivers. May occur during migration in Project sites.	1	1	1
White-faced ibis *Plegadis chihi*	BLM, G5/S2B	May occur in migration in wet meadows, marsh edges, and reservoir shorelines.	1	1	1
White-tailed ptarmigan *Lagopus leucurus*	USFS, G5/S4	Alpine tundra; may winter below tree line in areas with willows or alders near alpine habitats.	1		
Mammals					
American marten *Martes americana*	USFS	Old-growth lodgepole pine and spruce-fir forests.	1		
Black-tailed prairie dog *Cynomys ludovicianus*	SC, BLM, USFS, G4/S3	Short and mixed grass prairie along Front Range.	1		
Dwarf shrew *Sorex nanus*	G4/S2	Foothills, montane and subalpine habitats above 5,500 feet.	3		
Fringed myotis *Myotis thysanodes*	BLM, USFS, G4G5/S3	Ponderosa pine woodlands and oakbrush.	3		
Pygmy shrew *Sorex hoyi*	USFS, G5T2T3/S2	Subalpine, prefer areas interspersed with wetlands and dry upland forests.	1		
Rocky Mountain bighorn sheep *Ovis canadensis*	USFS	Open areas with grass and low shrub, near escape terrain and topographic relief.	1		

Table 40:
Other Special Status Species—Wildlife Species

Name	Status*	Habitat	Potential for Occurrence in the Study Area**		
			Gross Reservoir	South Boulder Creek above Gross Reservoir	South Boulder Creek below Gross Reservoir
Swift fox *Vulpes velox*	SC, BLM, USFS, G3/S3	Shortgrass prairie.	1		
Townsends big-eared bat (pale subspecies) *Corynorhinus townsendii pallescens*	SC, BLM, USFS, G4T4/S2	Roosts in caves and abandoned mines in shrublands and open montane forests up to 9,500 feet.			
Amphibians					
Northern leopard frog *Lithobates pipiens*	SC, BLM, USFS, G5/S3	Usually under 9,500 feet near permanent water, including margins of ponds, lakes, streams, and in marshes.	2	1	1
Wood frog *Lithobates sylvatica*	SC, USFS, G5/S3	Subalpine ponds, marshes, stream margins and adjoining wet meadows, willows and forests.		1	1
Reptiles					
Common garter snake *Thamnophis sirtalis*	SC	Marshes, ponds, and stream edges.	1	1	1
Fishes					
Colorado River cutthroat trout *Oncorhynchus clarki pleuriticus*	SC, BLM, USFS, G4T3/S3	Primarily isolated to headwater streams and lakes.		1	1
Iowa darter *Etheostoma exile*	SC, G5/S3	Streams and ponds in NE Colorado, as well as Elevenmile Canyon Reservoir and Plum Creek in Douglas County (NDIS 2011, see Final EIS for reference materials). Record from North Fork South Platte.		1	1
Mountain sucker *Catastomus platyrhynchus*	SC, BLM, USFS, G5/S2?	Lotic water, from small montane streams to large rivers. Have been collected in lakes and reservoirs. Common in steams with low gradient segments that consist of a mix of riffles, pools, and runs.		1	1
Roundtail chub *Gila robusta*	SC, BLM, USFS, G3/S2	Only in Colorado River basin/Upper Colorado River in western Colorado.		1	1
Invertebrates					
Rocky Mountain capshell (mollusk) *Acroloxus coloradensis*	SC, USFS, G3/S1	Known in Colorado from a small number of mountain lakes between 8,000 and 9,800 feet.	1	1	1
Cylindrical papershell (mollusk) *Anodontoides ferussacianus*	SC, G5/S2	Mud or sandy substrates of lakes and quiet streams; hosts for larvae are warmwater fish.	1		

Table 40:
Other Special Status Species—Wildlife Species

Name	Status*	Habitat	Potential for Occurrence in the Study Area**		
			Gross Reservoir	South Boulder Creek above Gross Reservoir	South Boulder Creek below Gross Reservoir
Swampy lymnaea (mollusk) *Lymnaea stagnalis*	G5/S2	Warm, shallow ponds, lakes and marshes in mountainous areas.	3		
Glass physa (mollusk) *Physa skinneri*	G5/S2	Shallow bodies of water, either perennial or seasonal, such as temporary ponds, and backwaters along streams.	1		
Banded physa (mollusk) *Physa utahensis*	G5T22/S1	No specific distribution available. In water.	3		
Umbilicate sprite (mollusk) *Promenetus umbilicatellus*	G4/S3	Occurs in lakes/reservoirs.	3		
Sandhill fritillary (butterfly) *Boloria selene sabulocollis*	G5T2/S1S2	Wet meadows, bogs, and marshes. Feed on nectar of *Solidago* sp. and black-eyed susan.	2		
Moss's elfin (butterfly) *Callophrys mossii schryveri*	G4T3/S2S3	Rocky outcrops, woody canyons, cliffs at elevations from 5,600 to 8,000 feet. Larval host plant is Sedum.	2		
Mottled dusky wing (butterfly) *Erynnis martialis*	G3/S2S3	Open woodland, prairie hills, open brushy fields. Larval host plant is *Ceanothus.*	2		
Painted damsel (damselfly) *Hesperagrion heterodoxum*	G5/S1	No specific habitat information available. Near water.	2		
Arogos skipper (butterfly) *Atrytone arogos*	G3/S2	Relatively undisturbed mixed and tallgrass prairies; larval host plants are big bluestem, little bluestem, and switchgrass. Primarily in foothill canyons and low ridges, not prairie.	2		
Ottoe skipper (butterfly) *Hesperia ottoe*	USFS, G3G4/S2	Unplowed, native mid and tall-grass prairie. Caterpillar food plant is little and big bluestems, or side-oats grama. Adults nectar at native thistles and other flowers.	1		
Cross-line skipper (butterfly) *Polites origenes*	G4G5/S3	Open grassy areas, prairies hills, powerline cuts, and forest openings. Larvae feed on little bluestem and other grasses.	2		
Hops feeding azure (butterfly) *Celastrina humulus*	G2G3/S2	Feeds on host plant, wild hops, in upland shrubland areas.	1		
Hudsonian emerald (dragonfly)	USFS, G5/S2S3	Spring-fed mountain wetlands, ponds and lakes with boggy edges and sedge meadows.	1		

Table 40:
Other Special Status Species—Wildlife Species

Name	Status*	Habitat	Potential for Occurrence in the Study Area**		
			Gross Reservoir	South Boulder Creek above Gross Reservoir	South Boulder Creek below Gross Reservoir
Somatochlora hudsonica					
Rhesus skipper (butterfly) *Polites rhesus*	G4/S2S3	Short and mixed-grass prairie. Caterpillar host plant is blue grama; adults nectar on *Astragalus* sp. and yellow composites.	1		
Regal fritillary (butterfly) *Speyeria idalia*	USFS, G3/S1	Tall-grass prairie and other open sites including damp meadows, marshes, and wet fields. Caterpillar host plant is violet. Adults nectar on milkweeds and thistles.	1		

Source: Species lists and status from CDOW 2010, USFS 2010, USFS 2011, BLM 2009, CNHP 2013
*Status:
ARNF = Species of local concern for the Arapaho & Roosevelt National Forests and Pawnee National Grassland.
BLM = Listed as sensitive by Bureau of Land Management.
SC = Colorado Parks and Wildlife special concern.
USFS = U.S. Forest Service Region 2—Threatened, Endangered and Sensitive Plants and Animals. Sensitive species are those for which population viability is a concern as evidenced by: a) significant current or predicted downward trends in population numbers or density; or b) significant current or predicted downward trends in habitat capability that would reduce a species' existing distribution. USFS Management Indicator Species (MIS) are discussed in Sections 3.9, 4.6.9, and 5.9 except where they are also special status species (e.g., boreal toad).
CNHP Rank Definition:
G1 = Critically Imperiled—At very high risk of extinction due to extreme rarity (often 5 or fewer populations), very steep declines, or other factors.
G2 = Imperiled—At high risk of extinction due to very restricted range, very few populations (often 20 or fewer), steep declines, or other factors.
G3 = Vulnerable—At moderate risk of extinction due to a restricted range, relatively few populations (often 80 or fewer), recent and widespread declines, or other factors.
G4 = Apparently Secure—Uncommon but not rare; some cause for long-term concern due to declines or other factors.
G5 = Secure—Common; widespread and abundant.
S1 = Critically Imperiled—Critically imperiled in the nation or State/province because of extreme rarity (often 5 or fewer occurrences) or because of some factor(s) such as very steep declines making it especially vulnerable to extirpation from the State/province.
S2 = Imperiled—Imperiled in the nation or State/province because of rarity due to very restricted range, very few populations (often 20 or fewer), steep declines, or other factors making it very vulnerable to extirpation from the nation or State/province.
S3 = Vulnerable—Vulnerable in the nation or State/province due to a restricted range, relatively few populations (often 80 or fewer), recent and widespread declines, or other factors making it vulnerable to extirpation.
S4 = Apparently Secure—Uncommon but not rare; some cause for long-term concern due to declines or other factors.
S5 = Secure—Common, widespread, and abundant in the nation or State/province.
T = Status of intraspecific taxa (subspecies or varieties) are indicated by a "T-rank" following the species' global rank.
? = Uncertainty about the rank, could be higher or lower.

**Codes to Occurrence in Study Area:
1 = Not present—Habitat is unsuitable or outside current known range.
2 = Unlikely—Based on marginal habitat, rarity of occurrence and/or range. Also includes areas habitat is suitable, but not found during presence/absence surveys or considered unlikely to occur by detailed habitat evaluation.

Table 40:
Other Special Status Species—Wildlife Species

Name	Status*	Habitat	Potential for Occurrence in the Study Area**		
			Gross Reservoir	South Boulder Creek above Gross Reservoir	South Boulder Creek below Gross Reservoir

3 = Potentially present—Habitat suitable or marginal. Wide-ranging species may occur occasionally during foraging or migration but Study Area do not have important habitat. No documentation of presence for sedentary species.
4 = Known or likely to occur.
5 = Known or likely to occur, key habitat features present.
N/A = Not applicable

Gross Reservoir

Preble's meadow jumping mouse (Preble's) (*Zapus hudsonius preblei*) and greenback cutthroat trout (*Onchorhynchus clarki stomias*) have been documented to occur or have potential habitat at Gross Reservoir. A number of Other Special Status Species, including USFS Region 2 sensitive species, are also known or likely to occur. Bald eagle (*Haliaeetus leucocephalus*), previously a state-listed species, has been down-listed to a state species of special concern and is discussed below under Other Special Status Species.

Federal- and State-Listed Species

Preble's meadow jumping mouse. "Preble's" inhabits well-developed plains riparian vegetation with adjacent, undisturbed upland grassland communities and nearby water sources (Figure 4 in Exhibit 1). Suitable Preble's habitat is typically a dense community of grasses, forbs, and shrubs although a taller shrub and tree canopy may be present. The species hibernates near riparian zones, usually from September or October to May (CNHP 1999, see Final EIS for reference materials).

Preble's is native only to the Rocky Mountains-Great Plains interface of eastern Colorado and southeastern Wyoming. The western boundary of Preble's distribution is limited to areas below 7,600 feet in elevation. Preble's has been extirpated from the Denver Metropolitan Area, which separates the northern and southern extents of its range (CNHP 1999, see Final EIS for reference materials). In Colorado, Preble's is known to occur in seven counties: Weld, Larimer, Boulder, Jefferson, Douglas, Elbert, and El Paso.

In September 2005, three areas of potential habitat were evaluated as to their potential suitability for Preble's: Forsythe Canyon, Winiger Gulch, and the Gross Reservoir inlet on South Boulder Creek (Ensight 2005, see Final EIS for reference materials). Forsythe Canyon and South Boulder Creek did not have suitable Preble's habitat. The steep, narrow profile and rocky terrain at Forsythe Canyon does not have suitable vegetation to support Preble's, and the South Boulder Creek inlet does not have enough riparian vegetation to support the species (Ensight 2005, see Final EIS for reference materials).

Of the three areas evaluated, only Winiger Gulch has suitable habitat to support Preble's; however, the affected areas at Winiger Gulch are near the upper elevational limit of Preble's distribution in Colorado

(Ensight 2005, see Final EIS for reference materials). Furthermore, any population of Preble's in Winiger Gulch would have been isolated from the known downstream population (see South Boulder Creek, below) by the presence of Gross Reservoir for more than 50 years. Therefore, if Preble's did inhabit upper Winiger Gulch prior to the construction of Gross Reservoir, the population is now likely to be extinct (Ensight 2005, see Final EIS for reference materials). The USFWS has concurred that populations of Preble's are not likely to be present in the Project area.

There is no designated critical habitat in the Project area.

Greenback cutthroat trout. Greenback cutthroat trout are found primarily in headwater streams in the Arkansas River and South Platte River drainages. Suitable habitat consists of clear, swift-flowing, gravelly headwater mountain streams and lakes with cover such as overhanging banks and vegetation. The species historically occurred throughout the mountain and foothill areas of these drainages but today exist only in about 5 percent of their native range (CDOW 2008a, see Final EIS for reference materials). Greenback cutthroat trout occur at 62 sites, of which 20 populations are believed to be stable and self-sustaining (Rogers 2012, see Final EIS for reference materials). The most stable populations are within the South Platte drainage in Rocky Mountain National Park.

CPW stocked greenback cutthroat trout in Gross Reservoir in 2002 and 2004. Net sampling in 2007 did not find any greenback cutthroat trout, and they appear to be relatively rare if still present. After the 2002 and 2004 stocking events, problems were discovered with the genetic purity of a number of greenback cutthroat trout populations (Metcalf et al. 2007, see Final EIS for reference materials), and it is likely that the cutthroat trout stocked at Gross Reservoir were hybrids of greenback and Colorado River cutthroat trout (*Oncorhynchus clarkii pleuriticus*) (Swigle 2008, see Final EIS for reference materials). Gross Reservoir is not considered to be a recovery water for this species, and a number of other fish species and hybrids are regularly stocked at Gross Reservoir.

Other Special Status Species

Several Other Special Status species are likely to occur at Gross Reservoir (see Table 40). These species are mostly USFS Region 2 sensitive species. Four species, including northern leopard frog (*Lithobates pipiens*), American peregrine falcon (*Falco peregrinus*), Townsend's big-eared bat (*Plectotus townsendii pallescens*), and bald eagle are also Colorado state species of special concern.

Northern goshawk (*Accipiter gentilis*)**.** Surveys conducted in 2010 indicated that the Project area around Gross Reservoir is used by the northern goshawk, at least on Winiger Ridge. The Gross Reservoir area seems to be limited in its potential as breeding habitat for the species, largely because of the lack of tree stands with dense canopy cover on moderate terrain. Dense stands of forest around Gross Reservoir typically are limited to steep, north-facing slopes, which are not typically used as nesting habitat by the northern goshawk. The Project area likely provides suitable foraging or post-fledgling habitat, but the extent of use could not be confirmed by the 2010 field surveys.

Northern leopard frog. Surveys for this species were conducted in 2010. The surveys found no northern leopard frogs or suitable breeding habitat and only limited areas of marginally suitable habitat for adult frogs.

American peregrine falcon. Peregrine falcons may occur during foraging or migration but are unlikely to occur regularly. There are no prominent cliffs that appear to be suitable for nesting peregrine falcons, and no nest sites have been identified. Known nesting sites are located about 3 miles away.

Flammulated owl (*Psiloscops* [*Otus*] *flammeolus*)**.** Surveys for flammulated owls were conducted at Gross Reservoir in 1997, but none were observed (FERC and USDA 1999, see Final EIS for reference materials). However, the ponderosa pine forests in the Project area provide suitable habitat for flammulated owls, and they are considered likely to occur there.

Townsend's big-eared bat. Roosting habitat (caves, mines) is not known to be present in the t area, but suitable foraging habitat, including forested and riparian habitats, is present. There is a good potential for occurrence because this species has been reported at several locations in western Boulder County.

Fringed myotis (*Myotis thysanodes*)**.** The Project area does not include any known caves or mines that could be used as maternity roosts or hibernacula by this bat species, but suitable foraging and day roosting habitat is present. The Project area has a large amount of potential day and night roosting habitat in the form of rock crevices and scattered ponderosa pine and Douglas fir snags.

American three-toed woodpecker (*Picoides dorsalis*)**.** This species may occur at Gross Reservoir although typical habitat (dead or burned forest) is limited. This species was observed about 1 mile west of the Project area in 1999 where a prescribed burn had been conducted the previous year (FERC and USDA 1999, see Final EIS for reference materials).

Black swift (*Cypseloides niger*)**.** There are no reports of black swift nesting at Gross Reservoir, but they may occasionally forage over the Project area.

Dwarf shrew (*Sorex nanus*). Dwarf shrew is not a USFS sensitive species, but is considered to be rare and imperiled (S2) by the CNHP. Although it has not been reported in Boulder County, this species is reported from a wide variety of habitats in the mountains of Colorado above 5,800 feet and may occur in the Project area (NDIS 2011, see Final EIS for reference materials).

Olive-sided flycatcher (*Contopus cooperi*)**.** The Project area is within the general range of this species, and the forests adjacent to the Project area provide potential habitat.

Bald eagle. In addition to being a state special concern species and a USFS sensitive species, the bald eagle is federally protected under the Bald and Golden Eagle Protection Act. In Colorado, nest trees are located in various forest types from old growth ponderosa pine to linear patches of riparian woodland. Nests and roosts are usually located in tall trees near water in areas free of human activity and development. Roost sites are trees that provide diurnal and/or nocturnal perches for less than 15 wintering bald eagles (NDIS 2011, see Final EIS for reference materials). Figure 12 in Exhibit 1 shows bald eagle habitat within the Project area. A bald eagle was observed flying over Gross Reservoir during site visits conducted in September 2005, and commenters on the Moffat Collection System Project Draft EIS reported having seen bald eagles at Gross Reservoir. Although bald eagles occur there occasionally, they are not known to nest or roost in the Project area.

In its comments on the Moffat Collection System Project Draft EIS, the USFS identified a number of USFS sensitive and local concern plant species that were known to occur or could be present in the Project area. Surveys for USFS Region 2 sensitive plant species and ARNF plant species of local concern were conducted during the summer of 2010, and the results are summarized below and provided in Table 40. The 2010 surveys found more occurrences of most previously reported species but did not find any new plant species of concern. All of the observed species are associated with riparian areas and adjacent lower slopes along Forsythe Creek, Winiger Creek, and other drainages. One species (dwarf raspberry [*Rubus arcticus* var. *acaulis*]) is a USFS Region 2 sensitive species, and the other species are ARNF plant species of local concern.

One additional special status plant species, Sprengel's sedge (*Carex sprengelii*), was first found by the CNHP in 2007 (CNHP 2009, see Final EIS for reference materials).

South Boulder Creek

Characterization of special status species focused on the river segment of South Boulder Creek that extends from the outlet of Moffat Tunnel to Eldorado Springs near Denver Water's South Boulder Diversion Canal. The vegetation along this segment of South Boulder Creek is predominantly riparian herbaceous and shrub but also supports riparian deciduous (mostly upstream of the Town of Rollinsville) and evergreen communities. Preble's, boreal toad, and Canada lynx have ranges that include or potential habitat in this river segment.

Federal- and State-Listed Species

Preble's meadow jumping mouse. The east portion of South Boulder Creek from Gross Reservoir to the South Boulder Diversion Canal is within the elevational range of Preble's meadow jumping mouse. The habitat in this area consists of mature forest with scattered shrubs, but Preble's may occur, and this area is considered to be potential habitat (Denver Water 2003a, see Final EIS for reference materials).

No surveys have been conducted on South Boulder Creek upstream of Eldorado Canyon; however, Preble's have been captured downstream of the Project area along South Boulder Creek. A large area of occupied habitat occurs along South Boulder Creek and irrigation ditches on City of Boulder open space.

Canada lynx. Canada lynx may occur in riparian habitats along South Boulder Creek upstream of Gross Reservoir. According to a map of lynx satellite locations (Shenk 2009, see Final EIS for reference materials), this portion of South Boulder Creek in Gilpin County and on the edge of Gilpin and Boulder counties has low use density.

Boreal toad. Marginally suitable boreal toad habitat is present along South Boulder Creek. Surveys conducted for boreal toad on South Boulder Creek just south of the Boulder-Gilpin county line found no toads (Denver Water 1998b, see Final EIS for reference materials). Subsequent surveys have not located boreal toads along South Boulder Creek (Keinath and McGee 2005, see Final EIS for reference materials). There are no known breeding sites in areas along South Boulder Creek that are monitored for boreal toad.

Information regarding habitat surveys is also supported by the FERC in its review of the Project impacts, (FERC Final SEA, Section 5.1.6) stating:

> *The Final EIS reviewed federally-listed threatened and endangered species that have the potential to occur, or have been documented, in the Gross Reservoir area. The only species identified in the Final EIS were the threatened Preble's meadow jumping mouse (Zapus hudsonius preblei), and threatened greenback cutthroat trout (Onchorhynchus clarki stomias).*
>
> ***Preble's Meadow Jumping Mouse***
>
> *The Final EIS reviewed that Preble's meadow jumping mouse inhabits well developed plains riparian vegetation with adjacent, undisturbed upland grassland communities and nearby water sources. The mouse is native only to the Rocky Mountains-Great Plains interface of eastern Colorado and southeastern Wyoming, and the western boundary of its distribution is limited to areas below 7,600 feet in elevation. In Colorado, the mouse is known to occur in seven counties: Weld, Larimer, Boulder, Jefferson, Douglas, Elbert, and El Paso. There is no designated critical habitat in the Gross Reservoir area. The Final EIS reviewed [identified] that, in September 2005, three areas in the Gross Reservoir Project area were evaluated for potential habitat suitability for the mouse: Forsythe Canyon, Winiger Gulch, and the Gross Reservoir inlet on South Boulder Creek. Of the three locations at Gross Reservoir, only Winiger Gulch was found to have suitable habitat. However, the affected areas at Winiger Gulch are near the upper elevation limit of the mouse's distribution in Colorado; also, any population in Winiger Gulch would have been isolated from known downstream populations, below Gross Reservoir along South Boulder Creek, by construction of Gross Reservoir for more than 50 years. Therefore, any population that did inhabit upper Winiger Gulch prior to construction is now likely extinct. The Final EIS indicated that Preble's meadow jumping mouse is not known or expected to be present at Gross Reservoir, and would not be likely to be adversely by the proposed construction and reservoir enlargement.*
>
> ***Greenback Cutthroat Trout***
>
> *The Final EIS reviewed that greenback cutthroat trout are found primarily in headwater streams in the Arkansas River and South Platte River drainages, with suitable habitat consisting of clear, swift-flowing, gravelly headwater mountain streams and lakes with cover such as overhanging banks and vegetation. Currently, the most stable populations are within the South Platte drainage in Rocky Mountain National Park. Critical habitat has not been designated for greenback cutthroat trout. The Final EIS reviewed that greenback cutthroat trout have been stocked in Gross Reservoir in 2002 and 2004, but that net sampling in 2007 did not find any fish, and that they seem to be relatively rare if still present. However, problems have been discovered with the genetic purity of a number of greenback cutthroat trout populations, and it is likely that the fish stocked at Gross Reservoir were hybrids of greenback and Colorado River cutthroat trout. Because of this, Gross Reservoir is not considered to be a recovery water for federally listed greenback cutthroat trout.*

Other Special Status Species

American peregrine falcon. American peregrine falcon may forage along South Boulder Creek both above and below Gross Reservoir. A known nesting area is located downstream, and another nesting area is located within several miles of the creek above the reservoir.

Other Special Status Species that may occur in aquatic or riparian habitat are listed in Table 40.

PROJECT EFFECTS (SPECIAL STATUS WILDLIFE SPECIES)

Scoping for the Moffat Collection System Project EIS identified several potential special status species issues related to Project construction and to stream flow changes, including:

- Impact on Preble's meadow jumping mouse (Preble's) habitat
- Coordination with the USFWS regarding:
    - River restoration, flow and channel modifications, wetlands, and habitat fragmentation regarding species' habitat requirements
    - Impact on boreal toad habitat and populations.

Under Section 7 of the ESA, federal agencies are required to consult with the USFWS prior to authorization of any action that may affect endangered or threatened species or critical habitat. The Corps met with the USFWS in January 2008 to initiate Section 7 consultation on the Project for the Moffat Collection System Project Final EIS. A request for formal consultation and a Biological Assessment (BA) were provided to the USFWS on February 20, 2009. The USFWS issued a Biological Opinion (BO) on July 31, 2009, which evaluated and proposed management for any potential impacts to federal threatened or endangered species under the ESA specifically for Denver Water's Project for the Moffat Collection System Project.

The Corps submitted a request for re-initiation of consultation on August 14, 2012, in response to a February 16, 2010, letter from the USFWS commenting on the Corps Draft EIS. After some discussion, the USFWS indicated that it would provide two BOs for the Project, one addressing depletions to the Platte River and the Colorado River, as well as additional information on Preble's meadow jumping mouse, and the second addressing impacts to greenback cutthroat trout in the Fraser and Williams Fork river basins. The Corps submitted a Revised BA for depletions and Preble's on August 14, 2013, and a Final BO from the USFWS was provided on December 6, 2013, which replaced the 2009 BO. Except for species beyond the scope of the Project, the conclusions in that BO are summarized by species in the following sections.

A technical report was prepared to assist the USFS in meeting its guidelines and policies for management of sensitive species; the report specifically addresses USFS Region 2 sensitive animal and plant species and communities of local concern in the ARNF.

Gross Reservoir

The calculation of acres of impact in this section assumes disturbance between the current reservoir pool elevation (7,282 feet) and elevation 7,410 feet. This includes disturbance associated with the expanded reservoir for the Environmental Pool for mitigation (elevation 7,406 feet).

Federal- and State-Listed Species

As shown in Table 39, one federally listed species, the greenback cutthroat trout, has the potential to occur in Gross Reservoir. Preble's is not known or expected to be present at Gross Reservoir, and, therefore would not be affected by construction and expansion of the reservoir.

Greenback Cutthroat Trout. The USFWS concurred that construction and operation of the expanded reservoir are "not likely to adversely affect" this species (Exhibit 5). Although greenback cutthroat trout were stocked in Gross Reservoir in 2002 and 2004, they were not found in 2007. Hatchery-raised fish are unlikely to live more than 5 years, and it is unlikely that any would be present at the time of construction. In addition, the greenback cutthroat trout stocked at Gross Reservoir appear to be of hybrid origin, and they were stocked to support a recreational fishery and not as part of a recovery effort. There is no evidence that greenback cutthroat trout have reproduced in the reservoir.

Prebles' Meadow Jumping Mouse. The USFWS concluded in the cover letter to the Corps for their Biological Opinion for the Project, "We concur with your determination of "not likely to adversely affect" for the Preble's meadow jumping mouse (*Zapus hudsonius preblei*) in Colorado." Based on the FERC's review and the concurrence provided by the USFWS, the FERC concluded in the Final SEA that the Project is not likely to adversely affect Preble's meadow jumping mouse.

Other Special Status Species

Impacts to Other Special Status Species listed in Table 40 from expansion of Gross Reservoir would include direct and indirect, permanent and temporary impacts. The primary direct impact would be loss of habitat from reservoir expansion and from placement of associated facilities.

Seven of the 11 special status wildlife species are migratory birds, including northern goshawk, flammulated owl, bald eagle, American tree-toed woodpecker, olive-sided flycatcher, American peregrine falcon, and black swift.

Northern goshawk was observed on the west side of the reservoir in 2010. No nests were found, but the Project area likely provides suitable foraging and/or post-fledging habitat, at least on Winiger Ridge. Disturbance to nesting goshawks would be avoided or minimized by seasonal restrictions on construction activity in the vicinity of a goshawk nest during the nesting season or by surveys to identify active nests and the use of buffer zones. CPW recommends a seasonal restriction on human activity within one-half mile of active nests from March 1 through September 15 (CDOW 2008b, see Final EIS for reference materials).

Construction activities could also temporarily displace individuals during operation of heavy equipment and removal of timber, and inundation of the reservoir would result in a loss of foraging habitat. The Project would result in the loss of about 473 acres of forested habitat, which may affect the availability of

prey. This habitat is distributed around the existing reservoir, and an unknown portion of it may be used by northern goshawk. Goshawk home range size reported in North American is about 1,235 to 9,885 acres (about 1.93 to 15.4 square miles) (Kennedy et al. 2003, see Final EIS for reference materials), and, therefore, the loss of habitat may represent a large or small proportion of a foraging territory.

The estimated northern goshawk population in Colorado is 1,250 breeding pairs (Kingery 1998, see Final EIS for reference materials). Displacement during construction and loss of habitat from inundation may have minor to moderate effects to one pair of northern goshawk, but it not likely to affect regional populations.

Flammulated owl is likely to occur in the Project area because it is within the known range of the species and includes typical habitat. Tree clearing and other construction activities have the potential to disturb and displace flammulated owls although they are reported to be tolerant of human activity (McCallum 1994, see Final EIS for reference materials).

Flammulated owls are neotropical migrants that are on their breeding range in Colorado from about late April/early May through October and are actively nesting in May, June, and July. Tree clearing would be avoided between March 1 and July 31, which generally covers the nesting period although some young may fledge in early August. Surveys for flammulated owls would be conducted prior to tree clearing if clearing is scheduled to occur between May 10 and August 10, and seasonal buffer zones would be established around nests.

Clearing and inundation would result in the loss of 473 acres of forest, about half of which consists of suitable mature ponderosa pine and Douglas fir forest. The Project would affect only 1 acre of old growth forest, which is preferred by this species. Densities of flammulated owls are typically less than one territory per 100 acres and are often 0.5 territory or less per 100 acre (McCallum 1994, see Final EIS for reference materials), and, therefore, the impacted area is equivalent in size to 1 to 2 territories although it could contain portions of several territories. Territories often appear to be clumped with suitable but unoccupied habitat between them. Home ranges of flammulated owls have been reported as 27 to 45 acres in one study in central Colorado (Linkhart et al. 1998, see Final EIS for reference materials), but territories were not contiguous and that Project area included a large component of old ponderosa pine and Douglas fir.

The estimated population of flammulated owls in Colorado is 1,800 to 5,000 pairs (Kingery 1998, see Final EIS for reference materials). Removal of trees at Gross Reservoir followed by inundation would have negligible to moderate effects to flammulated owls in and near the construction area but would not be likely to affect regional populations.

American three-toed woodpecker and **olive-sided flycatcher** may occur in forested and riparian areas around the reservoir. Construction could temporarily displace individuals during operation of heavy equipment, and inundation of the reservoir would result in a loss of potential habitat. As with other migratory bird species, impacts to nesting birds would be minimized by avoidance of tree clearing between March 1 and July 31, which encompasses the breeding season. Preconstruction surveys for

nests of these and other migratory bird species would be conducted if tree clearing were scheduled between these dates. Disturbance and removal of habitat would affect individual woodpeckers and flycatchers but would have negligible effects on regional populations.

Bald eagles may occur around Gross Reservoir during foraging or migrating. Bald eagles do not nest at Gross Reservoir, and, therefore, there would be no effects to nesting bald eagles. During construction, disturbance from equipment operation and earth-moving activities may temporarily disturb foraging bald eagles and may also affect the availability of prey species. Expansion of the reservoir and the associated increase in surface water area are unlikely to adversely impact bald eagles.

American peregrine falcon and **black swift** have the potential to occur at Gross Reservoir during and after construction but are unlikely to occur regularly. Construction may have temporary, minor indirect impacts on these birds due to noise and disturbance associated with earth-moving and construction activities. Construction would not impact peregrine falcon nesting because known nesting locations are approximately 3 miles away from the reservoir. Black swift may be present on the reservoir during foraging.

Northern leopard frog was not found in surveys in 2010 and is unlikely to occur in drainages and inlets along the reservoir. Vegetation clearing and inundation of the expanded reservoir would remove marginally suitable habitat in these areas.

Impacts to **dwarf shrew** would primarily be loss of habitat and, if they are present, possible crushing of individuals during construction.

Impacts to **fringed myotis** and **Townsend's big-eared bat** would be limited since these species forage at night. However, individuals at day roosts located near construction activity may be displaced to other areas. Known Townsend's big-eared bat roosts are located approximately 2 miles from the reservoir site, and, therefore, construction and operation would not impact roosting individuals.

South Boulder Creek

Federal- and State-Listed Species

Preble's Meadow Jumping Mouse. A population of Preble's is present downstream from Gross Reservoir along lower South Boulder Creek (USFWS 2006, see Final EIS for reference materials). Water released from Gross Reservoir via lower South Boulder Creek is diverted at the existing South Boulder Diversion Canal diversion structure. Under the Project, 985 AF of water would be diverted from lower South Boulder Creek. Denver Water would not divert lower South Boulder Creek native water between November and March if diversion cause water flow to drop below 7 cfs downstream of the South Boulder Diversion Canal diversion point.

Boreal Toad. Boreal toads are unlikely to occur along South Boulder Creek upstream of Gross Reservoir, where habitat is marginally suitable and there are no known breeding sites.

Other Special Status Species

American peregrine falcon nests along or near several of the river segments and is likely to forage along the rivers. Flow changes are unlikely to change the availability of prey or foraging conditions.

Northern leopard frog has the potential to occur along all river segments but is more likely to occur in ponds and wetlands than in the rivers themselves. Predatory fish in the rivers are likely to strongly limit use of this habitat. Flow changes in South Boulder Creek under the Project would affect relatively narrow areas along the river banks and are not expected to affect availability of pond habitat.

Conclusions supported by the FERC in its review of the Project impacts relating to endangered species (Final SEA, Sections 5.1.5 and 5.1.5.2) were as follows.

> *The Final EIS reviewed federally-listed threatened and endangered species that have the potential to occur, or have been documented, in the Gross Reservoir area. The only species identified in the Final EIS were the threatened Preble's meadow jumping mouse (Zapus hudsonius preblei), and threatened greenback cutthroat trout (Onchorhynchus clarki stomias).*
>
> *Regarding threatened greenback cutthroat trout, the FWS, in its June 17, 2016 BO, clarified that any greenback cutthroat present in Gross Reservoir are not considered a protected population under the ESA. Regarding threatened Preble's meadow jumping mouse, The FWS, in its December 6, 2013 BO, concurred with the Corps' determination that enlarging Gross Reservoir is not likely to adversely affect the Preble's meadow jumping mouse because, although it has the potential to occur in the project area, it is not known or expected to be present. Based on our review of the information, we [FERC] conclude that Denver Water's proposed action before the Commission involving raising Gross Dam and Denver Water's proposal to enlarge Gross Reservoir [the Project] is not likely to adversely affect Preble's meadow jumping mouse.*

Summary of Project Effects (Special Status Species)

Construction of the Project facilities at Gross Reservoir would not have adverse effects to federally listed species. Construction activities at Gross Reservoir, however, may affect individuals or habitat of USFS sensitive wildlife species including northern goshawk and flammulated owl, but the Project would not result in a loss of viability of these species in the ARNF and would not cause a trend to federal listing or loss of viability range-wide. Local populations of several additional species of local concern would be adversely affected but involve species that are more widely distributed in the ARNF.

Preble's Meadow Jumping Mouse. Preble's occurs along South Boulder Creek downstream from the South Boulder Diversion Canal. Under the Project, average annual flows would decrease by 3 percent in average years. Average annual flows would be reduced by an average of 8 percent in wet years, with nearly all of the flow reductions occurring in May and June when flows are highest. There would be minimal change in dry years. These changes are not likely to adversely affect habitats used by these species downstream of Eldorado Springs, where riparian habitat occurs along irrigation ditches and laterals as well as along South Boulder Creek.

Canada Lynx. Canada lynx may occasionally use riparian areas along the western portion of South Boulder Creek. Changes in flows under the Project would have negligible to minor effects to riparian habitat. Because lynx primarily use forested areas and have large home ranges, small and localized changes in riparian habitat would be unlikely to affect Canada lynx.

Boreal Toad. Boreal toads are unlikely to occur along South Boulder Creek upstream of Gross Reservoir, where habitat is marginally suitable and there are no known breeding sites.

Other Special Status Species. Stream flow changes resulting from operation of the Project are expected to have no or negligible adverse effect to Other Special Status Species. Flow changes would not noticeably affect availability of suitable habitat for aquatic or riparian species.

Conclusions supported by the FERC in its review of the Project impacts relating to sensitive species (Final SEA, Sections 5.1.4) were as follows.

> ***Aquatic Sensitive Species***
>
> *Sections 3.10 and 5.10 of the Final EIS described and evaluated the aquatic sensitive species that could occur and be affected by the project. Forest Service 4(e) condition 18 requires Denver Water to prepare a BE [Biological Evaluation] for any future proposed actions, other than the currently proposed construction and ground-disturbing activities associated with enlargement of Gross Reservoir, that may affect Forest Service special status species. Within any BE prepared under the condition, Denver Water would develop and implement, with approval from the Forest Service, procedures to monitor and minimize adverse effects on Forest Service special status species. While condition 18 is not one of the conditions that the Forest Service identifies as being specific to Denver Water's proposal, compliance with the condition would help minimize effects of future actions on Forest Service special status aquatic species*
>
> ***Special Status Wildlife***
>
> *The Final EIS addressed effects of construction and operation on special status wildlife species, including sensitive bird species such as raptors and migratory birds. As explained in in its amendment application, Denver Water proposes to replace the two existing osprey nest platforms on Gross Reservoir to mitigate for nesting tree loss from reservoir enlargement. Denver Water would also conduct pre-construction raptor surveys and contact FWS's Office of Migratory Birds for permitting requirements before any work that could remove or destroy any nests, consistent with Forest Service 4(e) condition 21 (raptor protection measures).*
>
> *Additional protection for nesting sensitive bird species would include scheduling of tree clearing of trees around the reservoir outside of the breeding season in accordance requirements in the Tree Removal Plan required by Forest Service 4(e) condition 27. If an active nest is located, protective buffer zones would be established to avoid disturbance while nesting. Buffer zones and seasonal timing restrictions would be developed in consultation with the Forest Service and Colorado Parks and Wildlife to avoid direct disturbance. These restrictions and mitigation measures would avoid or minimize effects on special status raptors. Potential disturbance to nesting avian species during construction would be minor and short-term. Also, while some minor long-term loss of*

habitat for forest birds would occur from tree clearing, operation of the reservoir would provide beneficial loafing and foraging habitat for resident and migratory waterfowl.

Section 3.9.1 of the Final EIS identifies the big game species present in the vicinity of Gross Reservoir. Increasing the dam height, including establishing the proposed Environmental Pool, would enlarge the surface area of the reservoir from 418 acres to 842 acres, resulting in a loss of 465 acres of elk winter range and migration corridor and 269 acres of winter concentration area. Elk migration corridors and severe winter range are separate categories, but proposed construction and operation impacts would occur in both habitats. However, direct loss of elk winter concentration areas and severe winter range in the Gross Reservoir area would be less than 2 percent of these habitats.

Mule deer herds inhabiting the Gross Reservoir area are not likely to be adversely affected by the reservoir enlargement because no crucial seasonal habitats are present, and the affected area represents a very small part of the overall habitat. The proposed project would not affect mule deer winter concentration areas, severe winter range, or migration corridors, but would affect about 544 acres of mule deer summer range that would have a temporary minor effect on the mule deer herd. Because there is available habitat elsewhere in the project vicinity and neither species depends on riparian or wetland habitat, overall effects on elk and mule deer populations would be temporary and minor. Mountain lion and black bear habitat would be minimally affected because the impacted area represents only a small portion of the typical home range occupied by individuals of these species.

Forest Service 4(e) condition 27 (Tree Removal Plan) includes measures to consider key winter range timing for elk (December 1 through March 30) to protect big game. Year-round construction activities at the dam and nearby Osprey Point Quarry would temporarily displace big game from the eastern side of the reservoir, but this is not likely to adversely affect overall populations because the migration corridor extends around the reservoir, including the north, west, and south shores. Construction activities, including Osprey Point Quarry activity, on the east side of the reservoir could affect use patterns of these game species temporarily. However, movement of elk and mule deer near the reservoir would be diverted to the west side of the reservoir where most of the corridor is unlikely to be affected. This displacement would occur each winter during the construction period for 4 years. During operation, big game are unlikely to exhibit any changes in behavior from current conditions.

As indicated above, effects to wildlife and wildlife habitat in the Gross Reservoir Project area, including special-status species, would be reduced and mitigated through development of the plans and measures required by the Forest Service, and the off-license conveyance of the 539-acre Toll Property to the Forest Service.

Overall, we [FERC] find that approval of Denver Water's license amendment would not cause effects to terrestrial resources in the Gross Reservoir Project area to exceed those determined in the Final EIS, and effects would in fact be minimized through Denver Water's compliance with the plans and measures referenced above.

> ***Threatened and Endangered Species***
>
> *In agreement with the determinations in the Corps' Final EIS, we [FERC] did not identify any possible effects to federally-listed threatened or endangered species in the Gross Reservoir area beyond those identified in the Final EIS. The Preble's meadow jumping mouse is the only federally-listed species that could potentially occur in the area. Based on our review and concurrence provided by the FWS, we [FERC] conclude that Denver Water's proposal before the Commission is not likely to adversely affect Preble's meadow jumping mouse.*

The USFWS concluded in the cover letter to the Corps for their Biological Opinion for the Project, "We concur with your determination of "not likely to adversely affect" for the Preble's meadow jumping mouse (Zapus hudsonius preblei) in Colorado."

Conclusions supported by the USFWS in its review of the Project impacts combined with mitigation (Corps ROD, Attachment G) were as follows.

> *The Service [USFWS] concludes that the proposed Moffat Collection System Project [the Project] is consistent with the Tier I PBO for effects to listed species and critical habitat addressed in the Tier I PBO. After reviewing site species information, including: I) the scope of the Federal action, 2) the environmental baseline, 3) the status of the whooping crane, interior least tern, piping plover, pallid sturgeon, and the western prairie fringed orchid in the central and lower Platte River and the.ir potential occurrence within the Project area, as well as whooping crane critical habitat, 4) the effects of the Project, and 5) any cumulative effects, it is the Service's biological opinion that the Project, as described, is not likely to jeopardize the continued existence of the federally endangered whooping crane, interior least tern, and pallid sturgeon, or the federally threatened northern great plains population of the piping plover, or western prairie fringed orchid in the central and lower Platte River. The Federal action is also not likely to destroy or adversely modify designated critical habitat for the whooping crane.*

MITIGATION (SPECIAL STATUS WILDLIFE SPECIES)

Denver Water's License Amendment Application to the FERC (Exhibit 5) evaluated all mitigation measures for sensitive species (Table 5.1-1) as provided below.

Denver Water will mitigate permanent impacts to sensitive species through the preservation (through USFS protection and administration of NFS lands) of 539 acres of diverse wildlife habitat types as described above.

The following aquatic species and habitat information and analysis was gathered for preparation of Denver Water's License Amendment Application to the FERC (Sections 3.11).

AFFECTED ENVIRONMENT (AQUATIC RESOURCES)

This section describes the affected environment for aquatic biological resources in the Project area, including fish, benthic macroinvertebrates, and aquatic habitat. The area of interest includes Gross Reservoir, which would be affected by the Project by raising the reservoir level, and South Boulder Creek, which would potentially be affected through changes in hydrology.

Much of the information on aquatic biological resources was obtained from existing agency sources. During scoping and initial planning for the Moffat Collection System Project, several data gaps were identified that required supplemental data collection for the Moffat Collection System Project Final EIS. This section summarizes more detailed information that may be found in the Aquatic Biological Resources Technical Report (GEI 2013, see Final EIS for reference materials).

Gross Reservoir

Gross Reservoir is located on the mainstem of South Boulder Creek, approximately 22 miles (34.7 km) upstream of its confluence with Boulder Creek. Forsythe Canyon and Winiger Gulch are two small tributary streams to Gross Reservoir, and portions of these streams would be inundated with an expanded reservoir.

Habitat

Gross Reservoir is a steep-sided reservoir, with limited shallow-water areas near the shoreline. At bankfull (surface elevation of 7,282 feet), the reservoir is approximately 330 feet deep, with a surface area of 169 hectares (418 acres) (Miller Ecological Consultants, Inc. 1997, see Final EIS for reference materials). The elevation of the reservoir fluctuates approximately 48 feet within a year as drawdowns use stored water. The deep water, small size, and seasonal fluctuation limit the available habitat for aquatic biological resources in Gross Reservoir (Miller Ecological Consultants, Inc. 1997, see Final EIS for reference materials).

Gross Reservoir is classified as Aquatic Life Cold Class 2 for aquatic life uses. It has moderate water clarity and low to moderate levels of chlorophyll *a*, and it meets CDPHE WQCD standards for temperature, dissolved oxygen, and pH. Gross Reservoir is on Colorado's Monitoring and Evaluation List for aquatic life use because of elevated levels of mercury in fish tissue, like many other Front Range reservoirs in Colorado.

Fish

CPW commonly sampled Gross Reservoir with experimental gill nets, which have a variety of mesh sizes, and collected fish over a wide range of sizes. This is a typical sampling method for reservoirs in Colorado that is adequate for collecting the variety of species present. Gill net data collected in 1982 through 1996 revealed a diverse fish community in Gross Reservoir (Table 41). Twelve species and two hybrid varieties have been collected over this period including both coldwater and warmwater fishes. CPW stocks the reservoir annually with a variety of species. Rainbow trout and splake are stocked nearly every year. Kokanee salmon were stocked in 2001, 2003, and 2004. Greenback cutthroat trout were stocked in 2002 and 2004, and cutthroat/rainbow trout hybrids were stocked in 2003 and 2004. All of the stocked fish were small, usually less than 4 inches long.

Longnose suckers, white suckers, and rainbow trout have dominated the gill net catch, with the three species combined consistently averaging over 70 percent of the total catch. Other fish species comprised smaller proportions of the fish community (Table 41).

Lake trout, longnose sucker, and white sucker probably maintain self-sustaining, naturally reproducing populations in Gross Reservoir. Several species were represented by only a few individuals and are not

maintained in the reservoir by natural reproduction or stocking by CPW. Only a few brook and brown trout have been collected, and they probably migrated downstream into the reservoir from stream populations in upper South Boulder Creek and in tributaries to the reservoir. Likewise, only a single longnose dace was present during 2 years. This species prefers stream habitat but can occasionally be found in lakes. Black bullheads and channel catfish are normally found only in warm waters, and the presence in Gross Reservoir of a single individual of each of these species only in 1 year was probably the result of an illegal introduction.

Table 41:
Gross Reservoir Fish Population Data 1982 to 2010

Species	Percent of Total Catch								
	1982-1983	1986-1987	1989-1992	1994-1995	1996	2000	2007	2008	2010
Brook trout	<1	0	0	0	0	0	0	1	0
Brown trout	<1	<1	<1	<1	0	1	2	4	4
Black Bullhead	<1	0	0	0	0	0	0	0	0
Channel Catfish	0	0	1	0	0	0	0	0	0
Cutthroat trout	0	0	0	<1	3	0	0	0	0
Kokanee salmon	3	16.5	<1	1	0	0	0	0	3
Lake trout	3.5	1.5	1	12.5	6	11	2	1	3
Longnose dace	<1	0	0	0	0	5	0	0	0
Longnose sucker	44.5	47	36.5	11	14	3	26	33	37
Rainbow trout	6	1	9	13.5	29	18	10	23	20
Snake River cutthroat trout	0	0	0	0	0	0	0	0	3
Splake	0	0	0	0	<1	0	27	5	1
Tiger muskie	0	0	4.5	14	4	0	1	1	0
White sucker	41	33.5	47	47.5	44	62	32	32	29

Source: Chadwick and Associates (1986), Miller Ecological Consultants (1997), CDOW (2011b) , see Final EIS for reference materials
Note: < = less than

Fish surveys were conducted in the two inlet streams to Gross Reservoir, Forsythe Canyon and Winiger Gulch. Forsythe Canyon was sampled in 1985 and 2010, and fish were absent. Forsythe Canyon is likely too small and has insufficient flow to support fish. During sampling in 2010, there was just a trickle of water with some dry sections between pools. There is also a waterfall approximately 150 feet upstream of the reservoir that would prevent fish from moving from the reservoir past this point on the stream. Winiger Gulch is also a small stream but apparently has more permanent flow and can support fish. Winiger Gulch was also sampled in 1985 and 2010, and brook trout, brown trout, and rainbow trout were present during both years. Total fish density was estimated to be 3,647 fish per hectare in 1985 and 2,200 fish per hectare in 2010. In 1985, most of the fish were small, either young-of-the-year (YOY) or juvenile fish, and in 2010 all fish were YOY. All three species inhabit Gross Reservoir and likely Winiger Gulch is used for spawning and rearing young fish for the reservoir populations of these species. Five other tributaries enter Gross Reservoir, but they are ephemeral and dry for much of the year and do not support fish.

Benthic Macroinvertebrates

Sampling data for Gross Reservoir are not available. However, the Rocky Mountain capshell snail (*Acroloxus coloradensis*) is a species of limpet that has isolated populations in the United States and Canada (Anderson 2005, see Final EIS for reference materials). Currently this species is only known from one location in Montana and six locations in Colorado, specifically the Routt and Roosevelt National Forests, Rocky Mountain National Park, and one private lake in Boulder County (Riebesell et al. 2001, see Final EIS for reference materials). This mollusk is likely not present in Gross Reservoir. The Rocky Mountain capshell snail is designated as a species of concern by CPW.

Much of the basic ecology of the species is unknown (Anderson 2005, see Final EIS for reference materials). Rocky Mountain capshell snail habitat preferences include cold mountain streams, but this species has also been found in slow-moving streams in Canada. This species is not found above 9,394 feet. Rocky Mountain capshell snails tend to prefer high water calcium concentrations and high conductivity (Riebesell et al. 2001, see Final EIS for reference materials). A study of several lakes in British Columbia showed that the Rocky Mountain capshell snail inhabits a variety of substrates, including woody debris, rocks, decaying cattail leaves, and submerged leaf packs (Lee and Ackerman 2000, see Final EIS for reference materials).

South Boulder Creek

Characterization of existing aquatic biological resources focused on stream segments that would experience an average annual flow increase or decrease of greater than 10 percent and streams where the annual change in flow is minimal but changes during several months of an average year are greater than 10 percent. South Boulder Creek above Gross Reservoir falls into the first category, and South Boulder Creek below Gross Reservoir falls into the second category. Therefore, descriptions of aquatic resources are provided for the river reaches along South Boulder Creek from the Moffat Tunnel outflow downstream to Gross Reservoir and from Gross Reservoir downstream to the South Boulder Diversion Canal.

Fish populations in South Boulder Creek have been sampled periodically by CPW or by Chadwick Ecological Consultants, Inc. (CEC) since the 1960s (Miller Ecological Consultants, Inc. 1997, Chadwick and Associates 1986, GEI 2013, see Final EIS for reference materials). South Boulder Creek contains several species of trout, along with suckers and longnose dace. Resident, naturally reproducing rainbow trout is the dominant fish species present in South Boulder Creek. Whirling disease has been identified as present within the South Boulder Creek watershed.

Benthic macroinvertebrate populations in South Boulder Creek were sampled at two sites in the Project area during the fall of 1984 and spring of 1985.

South Boulder Creek is classified as Aquatic Life Cold Class 1 and has CS-II temperature standards.

South Boulder Creek above Gross Reservoir

The Project would increase average annual flow by more than 10 percent in South Boulder Creek upstream from Gross Reservoir.

Habitat. PHABSIMs were developed for brook and rainbow trout for two segments of South Boulder Creek upstream of Gross Reservoir in 1985 (Chadwick and Associates 1986, see Final EIS for reference materials). Miller Ecological Consultants (1997, see Final EIS for reference materials) re-evaluated and updated these relationships, indicating that habitat availability for most life stages of brook and rainbow trout is highest at flows in the range of approximately 50 to 200 cfs. In the canyon between Pinecliffe and Gross Reservoir, habitat availability for brook and rainbow trout is highest over a broad range of flows from 100 to 800 cfs.

A geomorphic survey was conducted on South Boulder Creek upstream of Rollinsville. This stream was classified as a steep, wide stream; average bankfull width was 13 meters, and average bankfull width was 0.7 meter. The only habitat type observed was riffle, and the predominant substrate types were cobble and boulders; sand was uncommon and not accumulating. The stream banks were stable because the stream is channelized between the railroad grade and the Moffat Tunnel Road in this reach but also because the banks support some vegetation.

Fish. Resident rainbow trout are the main component of the fishery upstream of Gross Reservoir, with cutthroat trout, brook trout, and brown trout also present in smaller numbers (Table 42). White suckers and longnose suckers are also present. Total fish density averages 814 fish per hectare. Trout species represent the largest proportion of biomass in this stream (fish biomass data were only available for 1985, 1988, and 1991).

Table 42:
Fish Population Data, Percent of Total Catch, and Summary Parameters for South Boulder Creek above Gross Reservoir (1963 through 1991)

Species/Date (Sites)	1963 (2)	1974[1] (1)	1984 (1)	1985 (2)	1988 (1)	1991 (2)
Brook trout	86.8%	0	21.4%	68.7%	43.5%	17.5%
Brown trout	0	0	0	0	0	0.2%
Cutthroat trout	1.5%	0	0	1.4%	0	10.1%
Longnose sucker	0	0	7.1%	1.7%	0	7.3%
Rainbow trout	0	82 captured	71.4%	28.1%	56.5%	61.3%
White sucker	0	0	0	0	0	36.4%
Unid. Sucker	2.6%	present	0	0	0	0
Average density (fish/ha)	N/R	N/A	N/A	173	905	1,363
Density Range (fish/ha)	N/R	N/A	N/A	50-295	N/A	872-1,853
Average biomass (kg/ha)	N/R	N/A	N/A	22.4	40.1	38
Biomass Range (kg/ha)	N/R	N/A	N/A	2.6-42.2	N/A	24.2-51.7

Table 42:
Fish Population Data, Percent of Total Catch, and Summary Parameters for South Boulder Creek above Gross Reservoir (1963 through 1991)

Species/Date (Sites)	1963 (2)	1974[1] (1)	1984 (1)	1985 (2)	1988 (1)	1991 (2)

Source: Chadwick and Associates (1985), Chadwick and Associates (1986), Miller Ecological Consultants (1997) , see Final EIS for reference materials

Notes:
1 Data from 1974 reflect number captured because insufficient data were reported to estimate total density and biomass.
Number of sites represented in each time period are shown in parentheses.
% = percent
fish/ha = fish per hectare
kg/ha = kilograms per hectare
n/r = not reported
N/A = not applicable

Benthic Macroinvertebrates. Upstream of Gross Reservoir, density estimates averaged 2,349 organisms per square meter, represented by an average of 29 taxa per site. Taxonomic groups include Ephemeroptera, Plecoptera, Trichoptera, Coleoptera, Diptera, and Oligochaeta (Chadwick and Associates 1986, see Final EIS for reference materials), the typical groups for streams in the mountains of Colorado (Ward 1986, Ward 1994, Ward et al. 2002, see Final EIS for reference materials). Five families found here prefer erosional habitats, but most of the insect taxa are from families with no preference for erosional or depositional habitats. Shannon-Weaver Diversity Index (H') values range from 2.61 to 3.15, indicating healthy, balanced benthic macroinvertebrate communities (Table 43).

Table 43:
Benthic Macroinvertebrate Data for South Boulder Creek above Gross Reservoir (1984 and 1985)

Parameter/Date	1984	1985
Density (number/m^2)	1,652	3,046
Taxa richness (number)	25	33
Diversity (H')	2.61	3.15

Source: Chadwick and Associates (1986) , see Final EIS for reference materials
Notes:
m^2 = square meter
H' = a dimensionless measure of the diversity or evenness of the distribution of bugs among the species

South Boulder Creek below Gross Reservoir

The Project would increase average annual flow by less than 10 percent in South Boulder Creek downstream from Gross Reservoir, but, during parts of the year, changes in Project operations could change flows by more than 10 percent.

Habitat. PHABSIMs were developed for brook and rainbow trout for one segment of South Boulder Creek downstream from Gross Reservoir in 1985 (Chadwick and Associates 1986, see Final EIS for reference materials). Miller Ecological Consultants, Inc. (1997, see Final EIS for reference materials) re-evaluated and updated these relationships for South Boulder Creek downstream from Gross Reservoir, indicating

that habitat availability for the younger life stages of rainbow trout (fingerlings and juveniles) is highest at flows between 50 and 200 cfs; for adult trout maximum habitat levels are in the range of 400 to 800 cfs.

A geomorphic survey was conducted on South Boulder Creek downstream from Gross Reservoir. This stream was classified as a steep, narrow-type stream; average bankfull width was 19 meters, and average bankfull depth was 1 meter. The habitat types in this reach were variable and included step-pool complexes and riffles. The bed material consisted of cobble, boulders, and bedrock outcroppings. The active channel also contains significant amounts of coarse sand and fine gravel. The stream banks are mostly stable, but bank failure was observed in localized areas.

Fish. Resident rainbow trout comprise the bulk of the fishery in the section of South Boulder Creek downstream from Gross Reservoir and upstream of the South Boulder Diversion Canal. A few brown trout are also present, along with longnose sucker, white sucker, and longnose dace (Table 44). Total fish density averages approximately 2,412 fish per hectare. Biomass estimates are not available except for 1983 through 1985, when biomass averaged 127 kilograms per hectare.

Table 44:
Fish Population Data, Percent of Total Catch, and Summary Parameters for South Boulder Creek below Gross Reservoir (1976 through 1996)

Species/Date (Sites)[1]	1976 (3)	1983-85 (4)	1988 (1)	1991 (1)	1995 (1)[2]	1996 (2)
Brown trout	0	0	0	<1%	58%	15%
Cutthroat/rainbow trout hybrid	0	32%	0	0	0	0
Longnose dace	2%	2%	9%	9%	0	5%
Longnose sucker	0	1%	5%	13%	5%	9%
Rainbow trout	98%	65%	86%	78%	14%	71%
White sucker	0	0	0	<1%	23%	0
Average density (fish/ha)	N/R	2,594	2,583	2,492	267 captured[2]	1,979
Density range (fish/ha)	N/R	1,557-3,557	N/A	N/A	N/A	1,172-2,786
Average biomass (kg/ha)	N/R	126.6	N/R	N/R	46 kg	N/R
Biomass range (kg/ha)	N/R	87-201	N/A	N/A	N/A	N/R

Source: Chadwick and Associates (1985), Chadwick and Associates (1986), CDOW (2006b), Miller Ecological Consultants (1997) , see Final EIS for reference materials

Notes:

1 Number of sites represented in each time period are shown in parentheses.

2 Data from 1995 reflect number captured because insufficient data were reported to estimate total density or biomass.

< = less than

% = percent

fish/ha = fish per hectare

kg/ha = kilograms per hectare

N/A = not reported

N/A = not applicable

Benthic Macroinvertebrates. Downstream from Gross Reservoir, density estimates averaged 2,118 organisms per square meter, represented by an average of 28 taxa per site (Table 45). Taxonomic groups included Ephemeroptera, Plecoptera, Trichoptera, Coleoptera, Diptera, and Oligochaeta (Chadwick and Associates 1986, see Final EIS for reference materials), the typical groups for streams in the mountains of Colorado (Ward 1986, Ward 1994, Ward et al. 2002, see Final EIS for reference materials). Five families found here prefer erosional habitats, but most of the taxa were from insect families with no preference for erosional or depositional habitats. Shannon-Weaver Diversity Index (H') values ranged from 3.22 to 3.38, indicating healthy, balanced benthic macroinvertebrate communities (Table 45).

Table 45:
Benthic Macroinvertebrate Data for South Boulder Creek below Gross Reservoir (1984 and 1985)

Parameter/Date	1984	1985
Density (number/m²)	2,164	2,072
Taxa richness (number)	30	25
Diversity (H')	3.38	3.22

Source: Chadwick and Associates (1986)
Notes:
m^2 = square meter
H = a dimensionless measure of the diversity or evenness of the distribution of bugs among the species.

New Zealand mud snail populations have been identified in South Boulder Creek; however, the only currently known population is at its confluence with Boulder Creek downstream from the Project area (CDOW 2007, see Final EIS for reference materials).

PROJECT EFFECTS (AQUATIC RESOURCES)

Approach to Impacts Analysis

The Project involves changes in the hydrologic regime, including changes to reservoir storage and the quantity and timing of flows that may affect the quality and amount of habitat available for fish and invertebrates in Gross Reservoir and in South Boulder Creek. Most of the impacts to aquatic biological resources would be indirect and long term through changes in stream flow, reservoir operation, or the suitability of these water bodies to support aquatic life.

The assessment of Project Effects focuses on changes in fish and invertebrate species composition and abundance parameters. The analysis also incorporates information from other resource areas because changes in channel morphology, water quality, sedimentation, and riparian vegetation all influence the suitability of a stream to support aquatic resources. Differences in these aspects of the aquatic environment were incorporated using professional judgment of the suitability of the stream to support aquatic life.

Impacts to aquatic biological resources could be beneficial or adverse depending on increases or decreases in the status of the aquatic resources under the Project. Projected changes in flow and modeled habitat (WUA) were a primary component of this impacts analysis, using professional judgment

about potential effects of each change on the suitability of the water body to maintain fish and invertebrate populations.

The parameters that were the focus of this analysis of fish populations were the number and abundance (density) of self-sustaining species in the stream, which are widely used in Colorado to describe fish communities. Self-sustaining species are fish species that maintain populations through natural reproduction and, as such, are directly affected by changes in habitat availability, water quality, hydrology, riparian vegetation, channel morphology, and other ecological factors. Stocked fish are also affected by these changes, but their population levels are controlled to a large extent by management decisions by agencies such as CPW.

The parameters used in the effects analysis of benthic invertebrates were the number of species present, species composition, including analysis of both taxonomic and functional diversity, and the abundance of invertebrates, which are widely used in Colorado to describe invertebrate communities; total number of taxa is included in the Colorado Multimetric Macroinvertebrate Index (MMI) as a component metric. These benthic invertebrate community parameters are sensitive to changes in habitat availability and water quality. There are many opportunities for invertebrate species introductions in streams primarily because many insects can fly between streams as a method of dispersal. Therefore, changes in the suitability of the habitat in a stream may affect invertebrate species composition to a greater degree than would be the case for fish.

Determination of Impacts Intensity

An incremental approach to impacts assessment, which assumes a greater intensity of impacts resulting from a greater change in conditions, was used to assess the intensity of impacts. Impacts intensity varies from no impact to negligible, minor, moderate, and major and is described in Table 46 in terms of likely changes to fish and benthic invertebrate communities as predicted from changes in flow and modeled habitat (WUA). Information from other resource areas, including channel morphology, sediment characteristics, water quality, and riparian vegetation, was also incorporated into the analysis.

Differences of less than 10 percent are likely within the margin of error of the hydrologic and statistical data and would be unlikely to result in adverse or beneficial impacts on fish populations. Therefore, if key WUA metrics decrease or increase by 10 percent or less and there are no substantial changes to channel morphology, water quality, etc., the effects of the Project are considered to be no impact and there is likely to be no change in aquatic biological resources.

Table 46:
Aquatic Biological Resources Impact Intensity

Impact Intensity	Intensity Description
Negligible	The Project would likely result in a slight change to a fish or benthic invertebrate community, but the change would likely not be of measurable or perceptible consequence. Community metrics would fluctuate within the current range of natural variability.
Minor	The Project would likely result in a beneficial or adverse change to a fish or benthic invertebrate community. The change may be small, but measurable and similar to the current range of natural variability. There would likely be no change in species composition for fish and little change in species composition for benthic macroinvertebrates.

Table 46:
Aquatic Biological Resources Impact Intensity

Impact Intensity	Intensity Description
Moderate	Beneficial or adverse Impacts on the abundance of fish and benthic macroinvertebrates, their habitat, or the natural processes sustaining them would likely be detectible and readily apparent and outside the current range of natural variability. In coldwater streams and reservoirs there likely would be no change in fish species composition. In warmwater streams and reservoirs there likely would be changes in the number of the less common species. For benthic invertebrates there would be changes in species composition and other community metrics.
Major	The Project would likely result in a substantial and readily apparent beneficial or adverse change to abundance and species composition of the fish and benthic invertebrate communities outside the current range of natural variability.

Impacts are considered negligible impacts when differences in WUA metrics are less than 10 percent and there are slight changes in other components, such as flow or channel morphology, that would tend to be either favorable or unfavorable but not substantial. Differences in WUA parameters of less than 10 percent would be unlikely to result in adverse or beneficial impacts on aquatic biota because natural variability in hydrologic and biological data renders a change of less than 10 percent undetectable. Negligible impacts would indicate that fish and invertebrate populations would continue to fluctuate within normal historical ranges. Negligible impacts also result when one or more of the WUA metrics has differences of 10 percent or more but are judged to have no detectible effect on fish. This is the case when the differences result in a combination of a small number of favorable or unfavorable changes to WUA among the different fish species and life stages with no consistent trend.

If a difference in WUA metrics is more than 10 percent, the change is graded according to professional judgment. The impact intensity takes into account the magnitude of the change in a WUA metric, the risk of crossing an ecological threshold and causing a large change in fish or benthic macroinvertebrate species composition or abundance, and projected changes in water quality, temperature, channel morphology, sediment characteristics, and riparian vegetation. Minor impacts would result in small changes to aquatic resources, i.e., there would likely be no change in fish species composition fish and little change in benthic macroinvertebrate species composition. Moderate impacts would result in detectible and readily apparent changes outside the current range of natural variability. Major impacts would likely result in a substantial and readily apparent change in abundance and species composition of the fish and benthic invertebrate communities far outside the current range of natural variability.

Gross Reservoir

Gross Reservoir is stocked with fish to support recreational fishing and contains a mixture of a few abundant species and many less common species of both self-sustaining and stocked fish. This evaluation focuses on the potential effects of the Project on the suitability of Gross Reservoir to support self-sustaining and stocked species of fish. Since the fish community of Gross Reservoir is managed with stocked species, there are more opportunities for additional species to become established compared to the more stable species composition in cold water streams.

Under the Project, the final surface area of the enlarged reservoir, including the Environmental Pool for mitigation, would be approximately 842 acres, over twice that of the existing reservoir. Water quality of

the enlarged reservoir would be suitable for supporting fish. One change to the limnology of Gross Reservoir would be changes in water quality associated with decaying organic matter inundated by expansion of the reservoir. Although this effect will be minimized by removal of vegetation before inundation, phosphorus and chlorophyll *a* concentrations are expected to increase for a short time after inundation before returning to pre-Project levels. This increased productivity could cause a temporary increase in fish densities, as was observed in a Washington reservoir (Stables et al. 1990, see Final EIS for reference materials). When nutrient and dissolved oxygen levels stabilize after the inundation of new habitat, the increased volume of the reservoir may support larger fish populations. This would be a moderate beneficial impact to the reservoir fishery, since the enlarged reservoir would support more fish than the existing reservoir and may also provide opportunities for additional species of fish to become established.

The enlarged reservoir is expected to have short-term increases in levels of methylmercury, in part due to the inundation of terrestrial vegetation by the expanded reservoir. Although this effect would be minimized by the removal of vegetation before inundation, there may be increases in fish tissue levels of mercury for an undetermined period following reservoir expansion. Therefore, the enlarged Gross Reservoir likely would continue to be on the State of Colorado's Impaired Water Body List (Section 303[d] List) for high levels of mercury in fish tissues like many other East Slope reservoirs in Colorado.

Forsythe Canyon and Winiger Gulch are two small tributaries to Gross Reservoir, and portions of these streams would be inundated with an expanded reservoir. The effects of inundation are calculated up to 7,406 feet, which includes disturbance associated with the expanded reservoir including the Environmental Pool.

Approximately 1,350 feet of Forsythe Canyon and 2,160 feet of Winiger Gulch would be inundated. The Corps considered there to be a major adverse impact to the fish and/or macroinvertebrate communities in these streams. Approximately 5,000 feet of upstream South Boulder Creek would also be inundated with the expanded reservoir, which would transform this section of stream habitat into reservoir habitat. The Corps considered this to represent a major adverse impact to this section of the stream but a moderate beneficial impact to the reservoir.

The expansion of Gross Reservoir could affect the Rocky Mountain capshell snail if it is present. However, because this species can tolerate a wide range of temperatures and can inhabit a wide range of substrates, it is likely that it would colonize new habitat as water levels rise.

Construction activities during expansion would not substantially affect the normal operation of Gross Reservoir. The fish and invertebrate communities in the reservoir would continue to function as normal.

South Boulder Creek

In most of the coldwater streams in the Project area, fish communities consist of one dominant trout species and several less common species of trout, as well as suckers. The species composition is generally stable, and there are limited opportunities for additional native or introduced species to become established. Therefore, impacts to Project area streams would not affect fish species composition very

much except where the Corps considered there to be moderate to major changes in the suitability of the stream to support fish.

PHABSIM data were available for three segments of South Boulder Creek. Segments 1 and 2 include the stream between the Moffat Tunnel outflow and Gross Reservoir, and Segment 3 is downstream from the reservoir. Predicted changes in fish habitat availability resulting from the Project have been assessed by comparing the Project with the existing system at full use.

South Boulder Creek above Gross Reservoir

PHABSIM data are available for South Boulder Creek upstream of Gross Reservoir at the gage near Rollinsville (PACSM Node 57100) for Segment 1 and at the Pinecliffe gage (PACSM Node 57120) for Segment 2 (Chadwick and Associates 1986, see Final EIS for reference materials).

Under the Project, mean monthly flows would be higher in these two segments during the runoff period and similar to flows under the existing system at full use in other months. In average years, the average annual flows would be 11 percent higher at Rollinsville and 10 percent higher at Pinecliffe, and mean monthly flows in June and July would be as much as 22 percent higher. At the Pinecliffe gage, average annual peak flows would increase by 117 cfs (16 percent). In dry years, average annual flows would not change. In wet years, flows would be 18 percent and 14 percent higher on an annual basis in Segments 1 and 2, respectively.

With the higher mean monthly flows during runoff in Segment 1 under the Project, brook trout minimum adult habitat availability (expressed as WUA) would decrease by 13 percent in wet years; all other changes in minimum habitat availability would be 4 percent or less. Decreases in average habitat availability would be 3 percent or less for all life stages in all year types.

For rainbow trout in Segment 1, minimum habitat availability would decrease by 13 percent for adults and 18 percent for fry in wet years, but changes in minimum WUA would be 3 percent or less for all other life stages, regardless of year type. Changes in average WUA are negligible for all life stages in all year types. In Segment 2, changes in minimum and average WUA would be 3 percent or less for all life stages in all year types.

High flows would occur more often under the Project than under the existing system at full use. The 5-year and 10-year floods would be expected to occur every 4 and 7 years, respectively, under the Project. As a result, bank erosion could increase, and further stabilization could become necessary. No changes in water quality would occur that could affect aquatic resources.

Although changes in trout habitat availability would mostly be minimal, increased bank instability in Segments 1 and 2 of South Boulder Creek could alter habitat somewhat. The increased runoff flows could also result in minor adverse impacts on benthic invertebrate populations wherein the density of macroinvertebrates could decrease or macroinvertebrate community composition could shift toward species that prefer fast-moving water.

South Boulder Creek below Gross Reservoir

PHABSIM data are available for South Boulder Creek downstream from Gross Reservoir (PACSM Node 57140) (Chadwick and Associates 1986, see Final EIS for reference materials).

Under the Project, annual flows in South Boulder Creek below Gross Reservoir would increase by 9 percent in average years, 17 percent in dry years, and 14 percent in wet years (see Moffat Collection System Project Final EIS (Corps 2014). Peak flows would be reduced by approximately 65 cfs (13 percent) in average years. Under the Project, flows in average, dry, and wet years would be substantially different from the hydrographs under the existing system at full use, which has flows that are highest in spring and extremely low in winter. Flows would increase from November through February, with the greatest increases (nearly 800 to 900 percent) in January and February, and flows during runoff would be up to approximately 27 percent lower with the Project.

As illustrated in Chart 10, with the existing system under full use, the minimum habitat availability (expressed as WUA) for rainbow trout adults and juveniles occurs in the late winter and during spring runoff. Under the Project, minimum habitat availability would increase up to 126 percent. For adults, increases would be 31 percent in median years and 126 percent in dry years. Minimum habitat availability for fry would increase by 48 percent in median years. Minimum habitat availability for juveniles would also increase: predicted increases range from 11 percent in wet years to 53 percent in dry years.

Average habitat availability would also increase for some life stages in all year types: adult average habitat availability would increase by 17 percent in median years, by 22 percent in dry years, and by 14 percent in wet years. Changes for other life stages in dry and wet years would be 7 percent or less.

Winter flows would increase under the Project, but highest runoff flows would be reduced by approximately 13 percent. The 5-year and 10-year floods would not be expected to occur under the Project. These changes may decrease bank instability in South Boulder Creek below Gross Reservoir and thereby reduce the need for further bank stabilization efforts. Under the Project, no changes to water quality would occur that could affect aquatic resources except for temperature. Water temperatures throughout the year are expected to be lower compared to the existing system under full use conditions due to the expansion of Gross Reservoir. Temperatures during the growing season for trout would be several degrees cooler and would be less favorable for growth. Cooler temperatures are expected throughout this stream reach downstream to the South Boulder Creek Diversion Canal as there is little warming of the water in this segment.

The increases in winter flows would result in large increases in rainbow trout habitat availability, and the small decreases in spring runoff flows would decrease conditions that may be stressful to early life stages of this species. The higher winter flows would likely alleviate winter low-flow habitat limitations. However, the cooler temperatures throughout the year would limit trout growth and survival and likely dampen the beneficial effects of greater habitat availability.

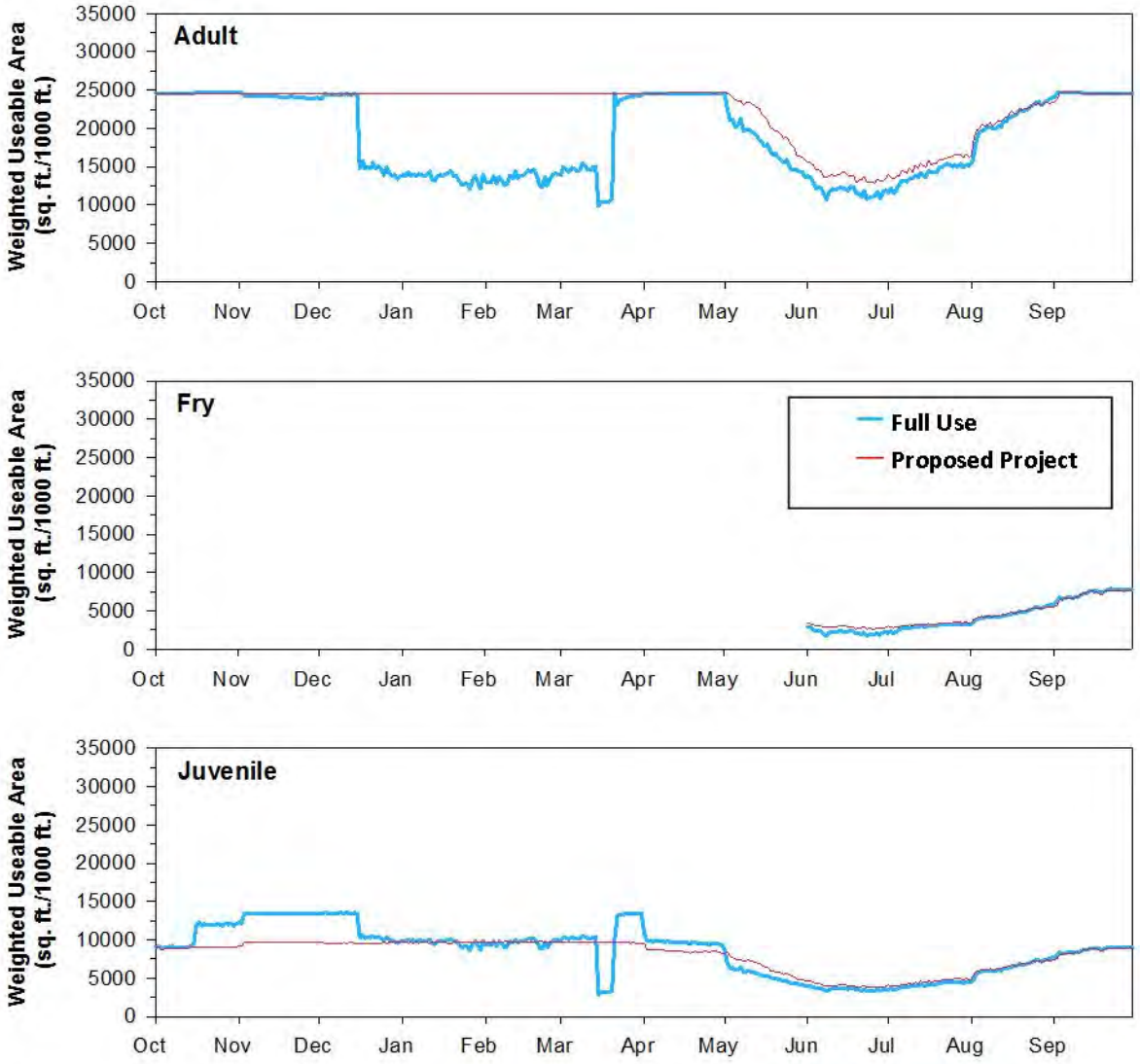

Chart 10:
WUA for Three Life Stages of Rainbow Trout in South Boulder Creek below Gross Reservoir for a Median Year under the Planned Project and Under the Existing System at Full Use

Invertebrate communities in streams typically consist of a few abundant species and many less common species, such that as much as 33 percent of the taxa found in a stream can be found less than 5 percent of the time (Resh et al. 2005, see Final EIS for reference materials). Higher winter flows and reduced peak flows would also provide more uniform flow conditions for benthic invertebrates. With less dramatic drying of the stream in winter months, this section of South Boulder Creek may support a higher density of macroinvertebrates or a more species-rich community, including more species that prefer or need faster currents. Community metrics such as diversity and the number of EPT species may increase.

The increases in habitat availability for rainbow trout and macroinvertebrates indicate that the Project would have a minor beneficial impact on aquatic resources in South Boulder Creek below Gross Reservoir.

Conclusions supported by the FERC in its review of the Project impacts related to aquatic animal and habitat impacts (Final SEA, Section 5.1.4) were as follows.

> *The Final EIS found that enlargement of the reservoir would cause a short-term, beneficial increase in reservoir productivity that would result in higher fish densities. It also found that the additional shoreline habitat resulting from the enlargement would increase reservoir fish population fish diversity and abundance through increases in available habitat.*
>
> *The steep shoreline slopes that surround Gross Reservoir exhibit slight erodibility. The limited existing shallow shoreline aquatic habitat would be subject to disturbance, siltation and increases in turbidity that could occur from shoreline erosion during both tree clearing and reservoir filling. Precipitation and other factors would affect the degree of erosion and the amount of habitat affected by turbidity and sedimentation, and the timing of such effects. Fishes and other motile aquatic organisms that occupy affected nearshore habitats and littoral areas would likely move to nearby areas of the reservoir with suitable habitat. However, once the reservoir is filled, shoreline erosion and any resulting turbidity and sedimentation would likely occur at rates similar to existing conditions, and new nearshore aquatic habitat would be created. Any adverse effects to aquatic habitat from increases in turbidity and sedimentation caused by tree clearing and initial reservoir filling would vary by location according to areas of disturbance, and would be temporary.*
>
> *Reservoir filling and operation using the new increased elevations could have short-term minor localized negative effects on some fisheries and macroinvertebrates in the first seasons in which the reservoir is filled to its new higher elevation. However, any such temporary effects would likely be outweighed by beneficial long-term effects of increases in available reservoir habitat area.*
>
> *Enlarging Gross Reservoir would inundate vegetated shoreline areas, resulting in decomposition of large amounts of organic material. Methylmercury could then bioaccumulate and biomagnify in tissue of fish in Gross Reservoir. Collectively, implementation of Denver Water's tree removal plan and compliance with WQC condition 13 would reduce the likelihood of significant elevations in mercury levels in fish, and would also help to protect human health.*
>
> *There is no evidence of significant levels of entrainment at the Gross Reservoir Project. This is likely due to the location of the intakes. The intakes are centered at an elevation of 6,992 feet, 290 feet below the current normal water surface elevation of the reservoir (7,282 feet). Because the depth of the intakes would increase when the reservoir elevation is raised, the level of fish entrainment when compared to existing conditions would be very unlikely to increase.*
>
> ***Aquatic Invasive and Nuisance Species***
>
> *Section 3.11.1.7 of the Final EIS identified the nuisance and aquatic invasive species that have the potential to occur in the project area. These include the parasite Myxobolus cerebralis, which*

causes whirling disease in salmonid fishes; New Zealand mudsnail, zebra mussels, and quagga mussels; and the filamentous algae didymo Didymosphenia geminate. Of these, whirling disease and New Zealand mudsnail have already been documented in the project area. Forest Service 4(e) condition 17 requires Denver Water to develop, in consultation with the Forest Service, FWS, and Colorado Parks and Wildlife, an aquatic invasive species management and monitoring plan, which includes provisions for reporting monitoring results and for developing modifications to the plan if the status of aquatic invasive species in the project area changes. While condition 17 is not one of the conditions that the Forest Service identifies as being specific to Denver Water's proposal, compliance with the condition would help to identify, monitor, and control changes in invasive species that may be tied to enlargement of Gross Reservoir, and would therefore have long-term benefits to fish and aquatic resources.

Aquatic Sensitive Species

Sections 3.10 and 5.10 of the Final EIS described and evaluated the aquatic sensitive species that could occur and be affected by the project. Forest Service 4(e) condition 18 requires Denver Water to prepare a BE [Biological Evaluation] for any future proposed actions, other than the currently-proposed construction and ground-disturbing activities associated with enlargement of Gross Reservoir, that may affect Forest Service special status species. Within any BE prepared under the condition, Denver Water would develop and implement, with approval from the Forest Service, procedures to monitor and minimize adverse effects on Forest Service special status species. While condition 18 is not one of the conditions that the Forest Service identifies as being specific to Denver Water's proposal, compliance with the condition would help minimize effects of future actions on Forest Service special status aquatic species.

MITIGATION (AQUATIC RESOURCES)

Denver Water's License Amendment Application to the FERC evaluated all mitigation measures for sensitive species (Exhibit 5, Table 5.1-1) as provided below.

Per the Denver Water/USFS Settlement Agreement, Denver Water will mitigate permanent impacts to sensitive species through the preservation (through USFS protection and administration of NFS lands) of 539 acres of diverse wildlife habitat types as described above.

Per the 401 Certification Condition 13 adopting mitigation identified in the 2011 FWMP developed between Denver Water and CPW, Denver Water will monitor mercury in fish tissue in Gross Reservoir with assistance from CDPHE and CPW. If the fish tissue analysis indicates that a Fish Consumption Advisory (FCA) is required, Denver Water will work with CDPHE and CPW to provide public education, including the posting of FCA signs at Gross Reservoir.

Per the Corps 404 Permit condition adopting mitigation identified in the 2011 FWMP developed between Denver Water and CPW, the 2010 Intergovernmental Agreement (IGA) between Denver Water and the cities of Boulder and Lafayette, and the Environmental Pool mandated by FERC: Denver Water will establish a 5,000-AF Environmental Pool in Gross Reservoir to augment flows during low flow periods, thereby benefiting 17 miles of aquatic habitat in South Boulder Creek from Gross Dam to its confluence with Boulder Creek. The Environmental Pool will enhance flows in South Boulder Creek below Gross

Reservoir and will provide flows in the lower section of South Boulder Creek, which currently goes dry due to diversions by other water users.

Per 401 Certification Condition 12, Denver Water will monitor the health of aquatic macroinvertebrates at three sites downstream from Gross Reservoir.

The FERC analysis evaluated the effects of all mitigation measures (Final SEA and concluded the following.

> *The Final EIS described and evaluated the aquatic sensitive species that could occur and be affected by the project. Forest Service 4(e) condition 18 requires Denver Water to prepare a BE [Biological Evaluation] for any future proposed actions, other than the currently proposed construction and ground-disturbing activities associated with enlargement of Gross Reservoir, that may affect Forest Service special status species. Within any BE prepared under the condition, Denver Water would develop and implement, with approval from the Forest Service, procedures to monitor and minimize adverse effects on Forest Service special status species. While condition 18 is not one of the conditions that the Forest Service identifies as being specific to Denver Water's proposal, compliance with the condition would help minimize effects of future actions on Forest Service special status aquatic species.*

8-507.D.7.b.iv, Terrestrial and Aquatic Plant Life

Riparian and wetland vegetation are addressed in Section 8-507.D.7.b.ii.e of this 1041 permit application. Aquatic habitat is addressed in Section 8-507.D.7.b.iii of this 1041 permit application.

The Corps, FERC, USFWS, and CPW relied on the field surveys described in the Corps' Final EIS for their reviews and approvals of the Project. These surveys are listed below:

- Vegetation in the Project area was surveyed and mapped in late August and September of 2005 and June of 2006. In areas of potential permanent disturbance, such as the reservoir sites and other aboveground facilities, the sites were traversed on foot to identify plant community associations and dominant species. Areas of temporary disturbance, such as conveyance facilities, were primarily observed by a vehicle reconnaissance. Areas of special interest identified during the vehicle reconnaissance, such as riparian communities, were also surveyed by foot. Observations of plant communities were compared with the cover type classification system used by the Colorado Natural Diversity Information Source, which is a hierarchical classification system based on A Land Use and Land Cover Classification System for Use with Remote Sensor Data.
- Two methods were used to describe the affected environment for riparian and wetlands areas. The Project was evaluated using field studies within the proposed or representative affected areas to delineate wetlands and other waters and to map riparian woodland and shrubland communities. The river segments were evaluated using the second method because they cover a much larger area and would be affected only by changes in river flows during Project operation (i.e., no ground-disturbing activities). This method consisted of using existing CPW riparian mapping data, combined with detailed field studies at 12 sample sites.

Denver Water evaluated Boulder County's plan species of concern list and assessed the probability of occurrence for each in Exhibit 18.

The following terrestrial and aquatic plant life information and analysis was gathered for Denver Water's License Amendment Application (Section 3.3.7) for the FERC.

AFFECTED ENVIRONMENT (TERRESTRIAL AND AQUATIC PLANT LIFE)

Gross Reservoir currently occupies 418 acres that were originally a combination of ponderosa pine-Douglas fir forests and riparian shrublands along South Boulder Creek and its tributaries.

It is likely that much of the Gross Reservoir area has had timber cutting or fires in the past, and there is only a small amount of old growth forest. Suppression of wildfires for several decades has caused an increase in tree densities in ponderosa pine and mixed conifer forests in Colorado and also the encroachment of Douglas fir into ponderosa pine forests, resulting in increased fuel loadings and high intensity stand-replacing fires (Colorado State Forest Service 2010, see Final EIS for reference materials).

Ponderosa pine is the most common tree at Gross Reservoir and is susceptible to mountain pine beetle, which is currently the most damaging forest insect in Colorado. The outbreak that began in 1996 in northern Colorado has mostly affected lodgepole pine but has recently expanded into ponderosa pine forests east of the Continental Divide. In 2010, there were approximately 229,000 acres of ponderosa pine infestation compared to 22,000 in 2009 (Colorado State Forest Service 2011a, see Final EIS for reference materials). Mountain pine beetle activity in ponderosa pine is expected to continue over the next several years, with areas of older and dense trees the most affected. There appears to have been little or no activity in the Gross Reservoir area through 2010, but aerial mapping shows nearby activity in 2010, including north and west of the reservoir in lodgepole pine and limber pine, and southeast of the reservoir in ponderosa pine (Colorado State Forest Service 2011b, see Final EIS for reference materials). Because of wind dispersal, mountain pine beetle may show up in any ponderosa pine stand along the northern Front Range.

Vegetation types, noxious weeds, and sensitive plant communities that occur in the Project area are described in the following sections.

Vegetation Types

The Gross Reservoir Project area is characterized by conifer forests, rangelands, riparian areas, and mountainous terrain. Upland vegetative communities in the Gross Reservoir Project area include a grass/forb rangelands, coniferous forest land, talus slopes and rock outcrops, disturbed soil, and standing water. Small areas of riparian vegetation are present, some of which have been identified as sensitive plant communities.

Vegetation in the Project area was surveyed and mapped in late August and September of 2005 and June of 2006. In areas of potential permanent disturbance, such as the reservoir sites and other aboveground facilities, the sites were traversed on foot to identify plant community associations and dominant species. Areas of temporary disturbance were primarily observed by vehicle reconnaissance.

Areas of special interest identified during the vehicle reconnaissance, such as riparian communities, were also surveyed by foot. Observations of plant communities were compared with the cover type classification system used by the Colorado Natural Diversity Information Source, which is a hierarchical classification system based on *A Land Use and Land Cover Classification System for Use with Remote Sensor Data* (Anderson et al. 1976, see Final EIS for reference materials).

Grass/Forb Rangelands

The two types of grass/forb rangelands represented at Gross Reservoir are the Grass/Forb Mix Community and Disturbed Rangeland.

The Grass/Forb Mix Community occurs primarily on the eastern shore of the reservoir although small patches of this community frequently intermingle with the Ponderosa Pine (*Pinus ponderosa*) Community. The boundaries between these communities are obscured by a high degree of vegetative similarity, the primary difference being the presence of a forested overstory in the Ponderosa Pine Community. Shrubs, forbs, and grasses occur in nearly equal proportions. Clumps of wax currant (*Ribes cereum*) and Fendler's ceanothus (*Ceanothus fendleri*) intermingle with forbs and grasses. Common forb species include hairy false golden aster (*Heterotheca villosa*), fringed sage (*Artemisia frigida*), sulphur buckwheat (*Erigonum umbellatum*), and common yarrow (*Achillea millefolium*). Common grass species include Colorado wildrye (*Leymus ambiguus*), cheatgrass (*Bromus tectorum*), Porter's brome (*Bromus porteri*), and mountain muhly (*Muhlenbergia montana*). Common noxious weed species in the rangeland areas at Gross Reservoir include common mullein *(Verbascum thapsus)*, cheatgrass, and musk thistle (*Carduus nutans*). Small areas of disturbed soil occur within the grass/forb community on the western portion of the Project area (Winiger Gulch) as a result of off-highway vehicle (OHV) use and erosion.

Disturbed Rangelands occur on the western portion of the Project area where a prescribed burn was conducted several years ago in a ponderosa pine community and a grass/forb community. Native plants such as fringed sage, hairy false golden aster, white sagebrush (*Artemisia ludoviciana*), geranium (*Geranium* spp.), Colorado wildrye, mountain muhly, bluebunch wheatgrass (*Pseudoroegneria spicata*), and sedge (*Carex* spp.) are common, but invasive species such as cheatgrass, common mullein, and musk thistle make a significant contribution to the relative cover in some locations. Additional disturbance to these areas include OHV use, recreational trails, litter, and erosion.

Coniferous Forest Land

The two types of coniferous forest lands represented at Gross Reservoir are the Ponderosa Pine and Ponderosa Pine/Douglas Fir (*Pseudotsuga menziesii*) Mix communities.

The ponderosa pine stands have an aggregated structure of sparsely forested areas and rangelands. These areas are typically found on xeric (dry) slopes that have southern, eastern, or western aspects. Based on field observations, these areas have a 10 to 30 percent tree canopy cover and an average basal area of 53 square feet per acre. The Ponderosa Pine Community located on the southern peninsula of the western lakeshore is an especially good example of a historical ponderosa forest. The structure and composition of this area reflects conditions that were common prior to settlement in the 1860s; there are also numerous old growth trees with fire scars, which provide an opportunity for further research on Front Range fire intervals. Within this community type, ponderosa pine is the dominant tree, but Douglas

fir and Rocky Mountain juniper (*Juniperus scopulorum*) also occur. Shrubs are common in the understory. Dominant shrub species include wax currant, Fendler's ceanothus, skunkbrush sumac (*Rhus trilobata*), Woods' rose (*Rosa woodsii*), common juniper (*Juniperus communis*), and yucca (*Yucca glauca*). Forbs make the largest contribution to understory cover. Dominant forb species include fringed sage, white sagebrush, hairy false golden aster, sulphur buckwheat, and geranium. Grasses and sedges are slightly less abundant in the understory. Dominant grass and sedge species include mountain muhly, Colorado wildrye, blue grama (*Bouteloua gracilis*), prairie Junegrass (*Koeleria macrantha*), cheatgrass, and sedge. Noxious weed species do not make a significant contribution to the relative cover in the Ponderosa Pine Community. Weed species found within this community include common mullein, cheatgrass, Canada thistle (*Cirsium arvense*), and houndstongue (*Cynoglossum officinale*). Variation in forest density has little effect on understory species composition.

The Ponderosa Pine/Douglas Fir Mix stands have dense canopies of mixed conifer trees that have suppressed understory production. These areas are typically found on moderately mesic (moist) slopes that have northern or western aspects. Based on field observations, tree canopy cover is greater than 30 percent, and the average basal area is 65 square feet per acre. Ponderosa pine and Douglas fir are the dominant trees and occur in nearly equal proportions. Some Rocky Mountain juniper and Rocky Mountain maple (*Acer glabrum*) trees are also present in the canopy. Common shrub species include wax currant, chokecherry (*Prunus virginiana*), kinnikkinnik (*Arctostaphylos uva-ursi*), and common juniper. Dominant forb species include white sagebrush, hairy false golden aster, fringed sage, and bigflower cinquefoil (*Potentilla fissa*). Dominant grass and sedge species include sedge, Colorado wildrye, squirreltail (*Elymus elymoides*), and Porter's brome. Noxious weed species do not make a significant contribution to the relative cover. Weed species found within the Ponderosa Pine/Douglas Fir Mix Community include common mullein, cheatgrass, Canada thistle, musk thistle, and houndstongue.

Talus Slopes and Rock Outcrops

Talus slopes and rock outcrops are areas that are nearly 100 percent rock. Small areas of rock can be found throughout the Project area and are typically associated with slopes that exceed 75 percent. Talus slopes and rock outcrops occur in small patches intermingled with forests.

Disturbed Soil

Disturbed soil includes areas where human activities, such as excavation and disposal sites, have created bare ground and the vegetative cover is less than 10 percent. This community type is found west of Gross Dam where construction activities have resulted in a barren area and east of the boat launch where recreation activities have impacted the vegetation. Forbs make the largest contribution to the relative cover in disturbed areas. Dominant forb species include yellow sweetclover (*Melilotus officinalis*), hairy false golden aster, field sagewort (*Artemisia campestris*), white sagebrush, and fringed sage. Grasses make a minor contribution to the relative cover in disturbed areas. Common grass species include Canada bluegrass (*Poa compressa*), fescue (*Festuca* spp.), cheatgrass, and Porter's brome. Noxious weed species associated with disturbed soil include cheatgrass and common mullein.

Standing Water

The reservoir surface at its current capacity is approximately 418 acres. As the reservoir is drawn down, previously inundated areas become exposed that are generally devoid of vegetation. These areas periodically support annual vegetation, particularly following periods of prolonged drawdown.

Riparian

Riparian areas include forested riparian, shrub riparian, and herbaceous riparian communities along the Gross Reservoir shoreline and in surrounding drainages. Riparian communities include areas that are considered to be wetlands under the jurisdiction of the U.S. Army Corps of Engineers (Corps) under Section 404 of the Clean Water Act and moist woodlands or shrub communities adjacent to creeks, wetlands, and the reservoir shoreline.

The reservoir shoreline vegetation contains small, scattered patches of riparian woodland, shrubland, and emergent wetlands. Shoreline woodlands comprise widely spaced plains cottonwood (*Populus deltoides*) and narrowleaf cottonwood (*Populus angustifolia*), with pockets of thinleaf alder (*Alnus incana*). Shoreline riparian shrub communities consist mostly of very small pockets of sandbar willow (*Salix exigua*). Reservoir shoreline emergent wetlands are dominated by creeping bentgrass (*Agrostis stolonifera*), woolly sedge (*Carex pellita*), fowl mannagrass (*Glyceria striata*), reed canarygrass (*Phalaris arundinacea*), and panicled bulrush (*Scirpus microcarpus*).

Riparian vegetation also occurs along Winiger Gulch and Forsythe Canyon on the west side of the reservoir, along several unnamed drainages on the south side of the reservoir, and along some portions of South Boulder Creek above and below the reservoir. Riparian woodlands associated with drainages are commonly dominated by plains cottonwood and narrowleaf cottonwood, very tall thinleaf alder, and water birch (*Betula occidentalis*). Several conifer species are also present, including Douglas fir, lodgepole pine (*Pinus contorta*), blue spruce (*Picea pungens*), and Engelmann spruce (*Picea engelmanni*). Wet riparian shrublands are dominated by thinleaf alder, water birch, Missouri River willow (*Salix eriocephala*), sandbar willow, and park willow (*Salix monticola*). Moist riparian shrublands along drainages are diverse, with a mix of various willows, serviceberry (*Amelanchier alnifolia*), water birch, redosier dogwood (*Cornus sericea*), cliffbush (*Jamesia americana*), ninebark (*Physocarpus monogyrus*), chokecherry, various gooseberries (*Ribes* spp.), Woods' rose, and roundleaf snowberry (*Symphoricarpos rotundifolius*), along with patches of dense herbaceous vegetation. Emergent wetlands associated with the drainages are commonly dominated by giant angelica (*Angelica ampla*), common spikerush (*Eleocharis palustris*), field horsetail (*Equisetum arvense*), fowl mannagrass, and American speedwell (*Veronica americana*).

Noxious Weeds

Noxious weeds are plant species not native to Colorado that have negative impacts on crops, native plant communities, livestock, and/or the management of natural or agricultural systems. Noxious weeds are officially designated as such by the State of Colorado and/or by individual counties. Management of noxious weeds is required under Executive Order (EO) 13112—Invasive Species, State of Colorado EO D 006 99—Development and Implementation of Noxious Weed Management Programs and the Colorado Noxious Weed Act (Colorado Revised Statutes [CRS.] 35-5.5-101-119 CRS 2003). The Colorado

Noxious Weed Act requires all persons to use integrated methods to manage noxious weeds, if such plants are likely to be materially damaging to neighboring lands.

Under the Colorado Department of Agriculture's rules pertaining to the administration and enforcement of the Colorado Noxious Weed Act, state-listed noxious weeds are placed into one of three categories:

- List A species are designated for eradication and require prevention of seed production or development of reproductive propagules. List A species are rare noxious weed species that can be prevented from establishing permanent populations in Colorado.
- List B species are managed by state noxious weed management plans with the goal of stopping the continued spread of these species.
- List C species are those for which the state, in consultation with other interested parties, will develop management plans with the goal of supporting jurisdictions that choose to require management of those species.

Each county and some cities in the Project vicinity also maintain lists of noxious weeds that are of local priority to manage.

Information on the distribution of noxious weeds was obtained from observations made during biological field work in 2005, 2006, and 2010. Several county-listed noxious weeds are present at Gross Reservoir but are relatively uncommon. They were observed mostly around the reservoir rim and in moist areas such as portions of Winiger Gulch.

Table 47 lists the noxious weeds observed in the Project area during field surveys, along with their state and county status.

Table 47:
Noxious Weeds Observed in the Project Study

Common Name	Scientific Name	State List Category	County Lists	
			Boulder	Jefferson
Canada thistle	*Cirsium arvense*	B	√	√
Cheatgrass (downy brome)	*Bromus tectorum*	C		
Common mullein	*Verbascum thapsus*	C		√
Dalmatian toadflax	*Linaria dalmatica*	B	√	
Houndstongue	*Cynoglossum officinale*	B		√
Musk thistle	*Carduus nutans*	B	√	√
Oxeye daisy	*Chrysanthemum leucanthemum*	B		√

Source: Colorado Department of Agriculture 2006; 2005, 2006, and 2010 Field Surveys for the Moffat Collection System Project Final EIS, see Final EIS for reference materials.
State List Categories:
B = species managed by state noxious weed management plans with the goal of stopping the continued spread of these species.
C = species for which the state, in conjunction with other interested parties, will develop management plans with the goal of supporting local governing bodies in implementing more effective integrated weed management.

PROJECT EFFECTS (TERRESTRIAL AND AQUATIC PLANT LIFE)

Primary issues related to direct and indirect impacts to vegetation as a result of implementing the Project that were identified during scoping for the Moffat Collection System Project EIS include:

- Impacts of water depletions on riparian vegetation, as well as any permanent changes to vegetation structure and composition
- Impact of reservoir inundation on rare plants or communities
- Impact of post-construction revegetation and/or restoration efforts
- Impact of proposed methods for timber removal in the inundation area of Gross Reservoir.

Other issues include the impacts of Project implementation on noxious weeds and the potential introduction of exotic species.

Vegetation would be directly and indirectly impacted by the Project. Direct impact mechanisms would include grubbing, clearing, soil removal, rock quarrying, soil compaction, paving, spills of fuel or other hazardous materials, or other construction-related activities that would result in the removal or modification of vegetation. Other direct impacts include inundation of shoreline areas as a result of raising Gross Dam. Indirect impacts to vegetation may include the introduction, establishment, or spread of noxious weeds, erosion, and hydrological modifications.

Both permanent and temporary impacts would occur. Permanent impacts include loss or permanent modification of vegetation communities due to their replacement by Project facilities or due to the creation of new unvegetated areas. Temporary impacts are associated with construction but could have long-term impacts on the viability or composition of a particular plant community, or such areas could be converted to other vegetation types during reclamation.

Gross Reservoir

The Project would directly impact approximately 508 acres of vegetation at Gross Reservoir, including approximately 456 acres of permanent vegetation loss and approximately 52 acres of temporary impact. An additional 98 acres of unvegetated areas (mostly standing water) would be affected. Most of the impacts would be permanent, and most would occur in the Ponderosa and Ponderosa Pine/Douglas Fir communities (Table 48). All of the direct impacts of the Project would occur at Gross Reservoir. Because the affected vegetation types are common in the region, losses of vegetation are considered to a moderate impact.

Table 48:
Vegetation Impacts of the Project at Gross Reservoir

Vegetation Area	Permanent Impacts (acres)[1]	Temporary Impacts (acres)[1]	Total Direct Impacts (acres)[1]
Vegetated Areas			
Grassland/forb mix	11.5	2.1	13.6
Disturbed rangeland	21.4	0.0	21.4
Ponderosa pine	169.9	7.4	177.3
Ponderosa pine/Douglas fir	253.0	42.5	295.5
Subtotal	455.8	52.0	507.8

Table 48:
Vegetation Impacts of the Project at Gross Reservoir

Vegetation Area	Permanent Impacts (acres)[1]	Temporary Impacts (acres)[1]	Total Direct Impacts (acres)[1]
Unvegetated Areas			
Disturbed soil	8.9	3.6	12.5
Standing water	0.0	33.7	33.7
Talus slope/rock outcrop	0.4	0.0	0.4
Subtotal	9.3	37.3	46.6
Total	465.1	89.3	554.4

1 Vegetation impacts calculated based on a reservoir elevation of 7,410 feet.

Most of the impacts to vegetation would occur in the new inundation area (between 7,282 and 7,406 feet) at Gross Reservoir and would occur as a result of site preparation. Various methods may be used to remove the trees. Trees and associated slash and debris would be removed for sale or disposal, and the area would be cleared prior to inundation. A portion of the cleared area would also be used for borrow material. Post-construction restoration of the cleared area above the inundation line would include its revegetation with a mix of native grasses, forbs, and shrub species. Denver Water would work closely with the USFS to ensure that forest clearing and revegetation would be consistent with USFS standards.

Pursuant to FERC's Order Article 423, within one year of the date of FERC's Order and after conferring with certain governmental stakeholders, including Boulder County, Denver Water must submit a Tree Removal Plan for FERC's review and approval. Denver Water will provide the draft Tree Removal Plan to Boulder County for review and comment in accordance with the terms of FERC's Order. The Project Tree Removal Plan will encompass approximately 486 acres, of which 145 acres is Denver Water property, , and 270 acres is National Forest. The land that will be cleared is between the elevations of 7,282 feet and 7,406 feet.

Clearing will remove approximately 140 to 1,170 trees/acre or an estimated 234,000 trees or 24,422 tons of woody biomass within the inundated area. Most are coniferous trees that range in size from 8 to 50 feet tall and vary in diameter at breast height (DBH) from 2 to 30 inches. Thirty-six unique stands of trees were identified for complete removal along the shoreline. Shoreline vegetation includes predominately ponderosa pine and Douglas-fir, with some Colorado blue spruce and Rocky Mountain juniper with inclusions of grass/shrub meadow complexes. The value of the sawtimber produced is below the cost of production, so the sawtimber is considered non-merchantable, i.e., biomass. Denver Water plans to remove biomass larger than 2-inches.

Mountain pine beetles disperse July through September, and cutting of trees during this period could attract mountain pine beetles. Most of the areas of tree removal are on NFS land, and Denver Water would consult with the USFS regarding appropriate removal methods and timing. Methods to avoid and minimize impacts may include surveys to identify beetle activity prior to timber clearing, scheduling of tree cutting to avoid beetle dispersal, and storing and processing forest residue in a manner that would limit dispersal of mountain pine beetles. Logs can be treated to prevent beetles developing in them by peeling away the bark, chipping, burning, or solar treatment. The proposed disposal methods, including use of an

air curtain burner, chipping, and commercial use of merchantable logs, are all appropriate means of disposal for beetle infested trees. With the implementation of these disposal methods, removal of trees at Gross Reservoir is not likely to lead to additional spread of mountain pine beetle (Colorado State Forest Service 2011a, see Final EIS for reference materials).

Construction activities at the site and vehicle movement along the access routes may cause a temporary increase in the potential for initiation of wild fires. With standard safety precautions and training of construction workers, fires are likely to be quickly contained or extinguished and are not expected to adversely affect forest and other vegetation.

During operation, formerly vegetated areas within the reservoir would be open water or barren areas along the shorelines where the water level fluctuates. The degree, duration, and time of year at which a reservoir is drawn down and refilled are the main factors determining the type and extent of vegetation along the shoreline. Other factors that would influence shoreline vegetation establishment include topography, soil substrate, aspect, and shading. Under the Project, the average water elevation would fluctuate about 57 feet per year, from 7,326 feet in April to 7,383 feet in July, based on reservoir modeling. Reservoir elevations would change over time as seasonal demand changes or as precipitation varies. Based on the large annual fluctuation in water level, the drawdown zone would likely be relatively barren but may contain some pioneering annual species, similar to the existing reservoir. Upland perennial species may become established if the water level remains below the maximum capacity for a prolonged period of time.

Small scattered patches of riparian or wetland vegetation may also become established in areas where appropriate hydrology remains consistent for a period of time, particularly at the mouths of perennial or intermittent drainages where there is supplemental water. Along the shore of the reservoir, the water levels would remain relatively constant from June to July but would drop about 8 feet by September. These communities are unlikely to become dominant because of the large water elevation fluctuations and relatively short periods of stable water elevations. Once the water is drawn down, hydrology suitable for riparian or wetland vegetation is expected to be short-lived because most of the terrain is relatively steep and/or has coarse-textured soils. These dry conditions tend to favor upland plant species, but the short growing season after drawdown would prevent much growth of vegetation at all. The existing Gross Reservoir has about 0.5 acre of wetland and 2 acres of riparian vegetation along its shoreline (excluding stream inlets), and a roughly similar extent of wetland and riparian vegetation can be expected to become established along the new shoreline.

Permanent impacts to vegetation would also occur from dam expansion, construction of new roads, quarrying, and construction of the saddle dam. Temporary impacts would occur where existing vegetation would be mostly or entirely removed during construction, but the areas would be revegetated after construction. Temporary impacts would occur from the dam expansion, construction of the saddle dam, operation of the quarry, and use of spoil and stockpile areas.

Specific restoration and revegetation plans have yet to be identified but would likely consist of seedings of native grasses, forbs, and shrub species that are appropriate for post-construction conditions. Revegetation of the cleared area above the inundation area would be done in the first appropriate season

following timber removal, while revegetation of other construction areas would mostly occur at the end of construction. Within the inundation area there could be a gap of several years between timber removal and inundation. Control of wind and water erosion would be addressed by the construction contractor in the stormwater management plan and fugitive dust control plan for the Project. Plant communities resulting from revegetation efforts would be relatively sparse initially, primarily consisting of grasses, forbs, and shrubs, similar to what is found in an early successional plant community. As the revegetated sites mature, they would begin to look more similar to adjacent plant communities. The Osprey Point Quarry would be primarily inundated with the new reservoir, while, if used, the Final EIS Quarry site would be difficult to revegetate because of exposed rock and lack of suitable soil for restoration efforts. Denver Water would coordinate with the USFS to ensure appropriate reclamation of this and any alternative quarry sites on NFS land.

The reservoir drawdown area and the temporarily disturbed areas would provide good habitat for noxious weeds and exotic species. County-listed species that would be most likely to invade the upper part of the drawdown area include Canada thistle and yellow toadflax. These species, along with cheatgrass, common mullein, houndstongue, diffuse knapweed (*Centraurea diffusa*), and musk thistle are already present at Gross Reservoir, and could be spread by construction activities. Additional noxious weed species may be introduced to the area with the importation of fill and other construction material as well as by the use of equipment and new roads. Noxious weed seeds may also be spread by moving water. Denver Water has a weed control program under its current FERC License and will continue to implement this program to prevent the establishment and spread of noxious weeds. With implementation of the weed control program, impacts from weeds are expected to be minor.

The increased inundation area would affect two globally rare plant communities that are tracked by the CNHP: river birch/mesic forb foothills riparian shrub and thinleaf alder/mesic forb riparian shrubland. Impacts to these communities were estimated based on the results of riparian and wetland surveys and are summarized in Table 49.

Although the wetland and riparian surveys used vegetation structure (e.g., tree, shrub, herbaceous) rather than composition, it is likely that all or most of these communities are wetlands identified as Palustrine Scrub-Shrub (PSS) and Palustrine Emergent Wetland (PEM)/PSS and riparian areas identified as Riparian Shrubland and Riparian Wood/Shrubland. Based on these results, a total of about 4.9 acres of these two communities would be affected in Winiger Gulch, Forsythe Gulch, and South Boulder Creek west of the reservoir and in the three tributaries on the south side of the reservoir. Only the occurrences along Winiger Gulch and South Boulder Creek have been identified by the CNHP. Direct effects from Gross Reservoir would reduce but would not eliminate these plant communities from these six drainages.

The River Birch/Mesic Forb Community has a CNHP conservation rating of G4/S2; the S2 rating means that this community is known typically from 6 to 20 locations in Colorado and/or has few remaining acres. In addition to Gross Reservoir, the River Birch/Mesic Forb Community occurs in the Boulder Foothills and Fairview Peak PCAs in Boulder County and has also been reported in Nevada and Utah in addition to other areas in Colorado (CNHP 2009, see Final EIS for reference materials). The Thinleaf Alder/Mesic Forb Community has a rating of G3/S3, where the S3 rating means that it is known typically from 21 to 100 locations in Colorado. The Thinleaf Alder/Mesic Forb Community is not listed for other CNHP PCAs

in Boulder County (CNHP 2009, see Final EIS for reference materials) but is also known from Idaho, Nevada, Utah, and Wyoming, in addition to other areas in Colorado.

Table 49:
Impacts of the Project on Sensitive Plant Communities in the Project Area

River Birch/Mesic Forb and Thinleaf Alder/Mesic Forb	Impacts (acres)[1]
Wetland Type	
PSS	1.0
PEM/PSS	0.5
Riparian	
Wood/shrubland	1.1
Shrubland	2.3
Total Birch and Alder	4.9
Existing Old Growth	1.2

1 Impacts calculated based on a reservoir elevation of 7,410 feet.

Impacts to these two communities are considered moderate because they would cause a local loss of biodiversity but would not substantially affect their overall distribution or abundance.

The Project would also affect about 1 acre of old growth ponderosa pine. According to the USFS, there are approximately 1,300 acres of old growth ponderosa pine in the ARNF (USFS 1997b, see Final EIS for reference materials). Impacts of Gross Reservoir expansion would cause a loss of about 0.1 percent of old growth ponderosa pine on the ARNF, which is considered to be a negligible impact.

South Boulder Creek

Other than at the mouths of perennial or intermittent drainages into Gross Reservoir, the Project would have no effects to upland vegetation along South Boulder Creek.

Conclusions related to vegetation supported by the FERC in its review of the Project (FERC SEA, Section 5.1.5) impacts were as follows.

> *The 2014 Final EIS reviewed and evaluated effects on terrestrial resources with Denver Water's proposal to raise Gross Dam and enlarge Gross Reservoir. The Final EIS found that moderate direct temporary and permanent loss or conversion of vegetation communities would occur as a result of construction and restoration work, and reservoir inundation. The Final EIS also found a minor increase in the potential for spread or introduction of invasive plant species in the drawdown area and temporary disturbance areas. However, the Final EIS found that Denver Water's proposal is not likely to increase spread of mountain pine beetle or increase risk of forest wildfire in the project area.*
>
> *Denver Water would address and mitigate effects on special status plants through its proposed BMPs, and pre-construction surveys, identification of buffers, and relocation of plants through its proposed Special Status Plants Relocation Plan that it would develop to supplement its approved Article 410 Rare and Sensitive Plant Species Protection Plan. The measures to protect special*

status plants would be developed in consultation with, and approval of, the Forest Service to comply with Forest Service 4(e) conditions 18 (Special Status Species and Sensitive Areas) and 22 (Special Status Plants Relocation Plan). The off-license conveyance of the 539-acre Toll Property to the Forest Service, to be administered and protected as part of the Roosevelt National Forest, would provide further mitigation for effects to special status plants. Denver Water would file the final plan for Commission approval, including evidence of consultation and rationale for why any agency recommendations were not included in the final plan, and copies of agency approvals where necessary. With compliance with these plans and measures, effects to sensitive plants in the Gross Reservoir Project area would not exceed the minor, short-term effects identified in the Final EIS.

MITIGATION (TERRESTRIAL AND AQUATIC PLANT LIFE)

Denver Water's License Amendment Application to the FERC evaluated all mitigation measures for vegetation (Exhibit E, Table 5.1) as provided below.

Per the Denver Water/USFS Settlement Agreement, Denver Water will convey the 539-acre Toll Property to the USFS to be administered and protected as part of the Roosevelt National Forest as mitigation for resource values that will be lost on Denver Water and NFS lands due to inundation and construction-related ground disturbance. The 539 acres of private, forested lands will be protected and accessible to the public through its addition to the National Forest. The Toll Property parcels are surrounded by the Roosevelt National Forest and contain diverse vegetation types (forest, grassland, fens, wet meadows, pond, stream, and riparian habitat). The property will protect two PCAs: Mammoth Gulch PCA with Very High Biodiversity Significance due to the occurrence of a unique iron fen plus imperiled woodland species and the Middle and South Boulder Creek PCA with High Biodiversity Significance due to the occurrence of a globally vulnerable forested fen and shrubland community. The Toll Property also preserves valuable wildlife habitat including elk and mule deer summer range and migration corridors, potential habitat for lynx (federally threatened and state endangered species), habitat for boreal toad (state endangered and USFS sensitive species), and a wide range of habitats for small mammals and birds.

Per the USFS Section 4(e) Condition 19 (Erosion Control and Reclamation) from the Denver Water/USFS Settlement Agreement, the USFS Section 4(e) Condition 10 (Use of Roads on National Forest System Lands) from the Denver Water/USFS Settlement Agreement, and the USFS Section 4(e) Condition 28 (Reclamation and Revegetation Seed Mixes and Mulch Materials) from the Denver Water/USFS Settlement Agreement: Denver Water will minimize impacts to vegetation on NFS lands through implementation of a new Erosion Control and Reclamation Plan and a new Road Management Plan. Denver Water will revegetate and reclaim NFS lands with seed mixtures and mulch materials approved by the USFS according to a new Reclamation and Revegetation Seed Mixes and Mulch Materials plan.

Per USFS Section 4(e) Condition 17 (Invasive Species Management) from the Denver Water/USFS Settlement Agreement and USFS Section 4(e) Condition 30 (Cost Collection and Participating Agreement regarding weed control) from the Denver Water/USFS Settlement Agreement: Denver Water will develop an Invasive Plant and Noxious Weed Species Management Plan for NFS lands in consultation with the USFS.

Per USFS Section 4(e) Condition 20 (Fire Management and Response Plan), Denver Water will develop a new Fire Management and Response Plan to reduce the risk of wildfires at and near Gross Reservoir.

Conclusions supported by the FERC in its review of the Project impacts related to vegetation its review of Project impacts (Final SEA, Section 5.1.5.2) were as follows.

> *To reduce and mitigate effects on these resources as much as possible, Denver Water would need to finalize details of tree cutting and disposal and related work in a series of plans required by the Forest Service, Federal Power Act Section 4(e). These plans including a Tree Removal Plan (condition 27), a Pit Development and Reclamation Plan (condition 26) if it is necessary to utilize a quarry is developed on Forest Service land, an Erosion Control and Reclamation Plan (condition 19), consultation on Reclamation and Revegetation Seed Mixes and Mulch Materials (condition 28), an Invasive Plant and Noxious Weed Species Management Plan (condition 17), Vegetation resources would also be protected through a Fire Management and Response Plan (condition 20). Denver Water would develop and finalize these plans in consultation with the Forest Service and other specified entities. Denver Water would file the final plans with the Commission, for approval, including evidence of consultation and rationale for why any agency recommendations were not included in the final plans, and copies of all agency consultation.*
>
> *Also, we [FERC] note that loss of forest and habitat would also be mitigated, in part, through Denver Water's off-license conveyance of the 539-acre Toll Property to the Forest Service, to be administered and protected as part of the Roosevelt National Forest, and would be accessible to the public. The parcels in the Toll Property are surrounded by the Roosevelt National Forest and contain diverse vegetation types, including forest, grassland, wetland, fens, wet meadows, pond, stream, and riparian habitat.*

AFFECTED ENVIRONMENT (SPECIAL STATUS PLANT SPECIES)

Special status species include federal- and state- listed threatened, endangered, and candidate species; USFS Region 2 sensitive species; Bureau of Land Management (BLM) sensitive species; and Colorado Natural Heritage Program (CNHP)-listed species.

Federally listed species are protected under the Endangered Species Act (ESA), while state-listed species are protected under Colorado state law. Information about the potential occurrence of federal- and state-listed endangered and threatened plant species is presented below. A list of federal- and state-listed species that may occur in the Project area, along with their status and habitat affiliation are provided in Table 50, and more detailed information for those species with potential to occur in the Project area is presented below.

Table 50:
Federal- and State-Listed Endangered or Threatened Species—Plant Species

Name	Status*	Habitat	Potential for Occurrence in the Study Area**		
			Gross Reservoir	South Boulder Creek above Gross Reservoir	South Boulder Creek below Gross Reservoir
Ute ladies'-tresses orchid *Spiranthes diluvialis*	FT	Sub-irrigated alluvial soils along streams; open meadows on floodplains	1	1	5
Colorado butterfly plant *Gaura neomexicana* ssp. *coloradensis*	FT	Sub-irrigated alluvial soils of drainage bottoms within mixed grass prairie	1	1	1
Western prairie fringed orchid *Platanthera praeclara*	FT	Marshes and wet meadow communities in tallgrass prairie. Known population adjacent to Platte River in Nebraska		1	1

Sources: Federal Species—USFWS (2012); State Species—CDOW (2011c) , see Final EIS for reference materials

* Status: FT = Federally Threatened, FE = Federally Endangered, FP = Proposed for Listing, FC = Candidate for Federal Listing, ST = State of Colorado Threatened, SE = State of Colorado Endangered, USFS = U.S. Forest Service Region 2 sensitive, BLM = Bureau of Land Management sensitive

** Codes to Occurrence in Study Area:

1 = Not present—Habitat is unsuitable or outside current known range.

2 = Unlikely—Based on marginal habitat, rarity of occurrence and/or range. Also includes areas where habitat is suitable, but not found during presence/absence surveys or considered unlikely to occur by detailed habitat evaluation.

3 = Potentially present—Habitat suitable or marginal. Wide-ranging species may occur occasionally during foraging or migration but Study Area do not have important habitat. No documentation of presence for sedentary species.

4 = Known or likely to occur: 4A—Habitat suitable, (animals) may occur regularly during foraging or migration; 4B—(animals) may breed in Study Area.

5 = Known or likely to occur, key habitat features present.

Other Special Status Species, as described below, include USFS Region 2 sensitive species (USFS 2011, see Final EIS for reference materials); ARNF plant species of local concern (USFS 2010, see Final EIS for reference materials); and CNHP-listed species (CNHP 2013, see Final EIS for reference materials). Table 51 presents these species, their status, habitat, and potential to occur in the Project area. For South Boulder Creek, only those species inhabiting aquatic or riparian environments associated with the stream are given.

Information on special status species was obtained from field visits, CNHP element occurrence data, the Natural Diversity Information Source (NDIS) website of species' ranges, USFS data, previous studies and reports, and literature searches. Habitats that support special status species were further identified using Geographic Information System (GIS) to overlay aerial photographs on Project area boundaries.

Table 51:
Other Special Status Species—Plant Species

Name	Status*	Habitat	Potential for Occurrence in the Project Area**		
			Gross Reservoir	South Boulder Creek above Gross Reservoir	South Boulder Creek below Gross Reservoir
Larimer aletes *humilis*	ARNF, G2G3/S2S3	Cracks and crevices of granite outcrops and on decomposed granite soils.	2		
Dwarf wild indigo *Amorpha nana*	G5/S2S3	Prairies and grasslands.	1		
Wild sarsaparilla *Aralia nudicaluis*	ARNF	Cool ravines, foothills and montane. Moist to dry wooded areas.	5		
Forktip three-awn *Aristida basiramea*	G5/S1	Dry, open, sandy soils in grassland and sandstone outcrops.	1		
Sea pink (Siberian sea thrift) *Armeria maritima* ssp. *sibirica* (*Armeria scabra* spp. *sibirica*)	USFS, G5T5/S1	Alpine; tundra, grassy slopes; 11,900-13,000 feet. Nearest location is Hoosier Ridge in Park County.	1		
Dwarf milkweed *Asclepias uncialis* ssp. *uncialis*	BLM, USFS, G3G4T2T3/S2	Shortgrass prairie, on sandstone-derived soils and gravelly or rocky slopes. Elevation 4,000 to 6,500 feet.	1		
Park milkvetch *Astragalus leptaleus*	USFS, G4/S2	Montane sedge meadows, grassy stream banks, 7,500 to 10,000 feet.	2	1	1
Paper birch *Betula papyrifera*	ARNF, G5/S1	Cool, north-facing ravines in foothills.	2		
Upswept moonwort *Botrychium ascendens*	USFS	Mesic montane coniferous forest.	2		
Prairie moonwort *Botrychium campestre*	USFS, G3G4/S1	Well-drained dry to mesic soils in sunny, non-forested habitats at low elevation.	1		
Reflected moonwort *Botrychium echo*	G3/S3	Gravelly soils near roads and trails, rocky hillsides, grassy slopes, and meadows at 8,200 to 12,140 feet.	1		
Forktip moonwort *Botrycium furcatum*	USFS, G1G2/S1S2	Subalpine.	1		
Triangle-leaved moonwort, green-stemmed phase *Botrychium lanceolatum* ssp. *viride*	ARNF	Mesic deciduous woodlands under closed canopy and mesic coniferous forests.	2		
Slender moonwort *Botrychium lineare*	USFS, G2?/S1	Grassy slopes, in tall grasses, stream edges in forests at 7,900 to 9,500 feet. Only 3 populations in Colorado (Elevation Paso and Lake counties).	2		
Leather leaf grapefern *Botrychium multifidum*	ARNF, G5/S1	Wet meadows, forest edges, lake shores or margins. Typically, at elevations between 6,750 to 11,500 feet.	2		
Paradox moonwort *Botrychium paradoxum*	USFS	Montane to subalpine grasslands or forb-dominated meadows.	1		

Table 51:
Other Special Status Species—Plant Species

Name	Status*	Habitat	Potential for Occurrence in the Project Area**		
			Gross Reservoir	South Boulder Creek above Gross Reservoir	South Boulder Creek below Gross Reservoir
Northwestern moonwort *Botrychium pinnatum*	ARNF, G4?/S1	Moist grassy sites in open forests, meadows, near streams, and other sites where soil moisture is constant.	2		
"Redbank" moonwort *Botrychium "redbank"*	ARNF	Subalpine open upland areas in Colorado.	1		
Least moonwort *Botrychium simplex*	ARNF, G5/S2	Subacid or acid soils high in organic matter, 8,500 to 12,700 feet.	1	1	1
Rattlesnake fern *Botrychium virginianum* (*Botrypus virginianus*)	ARNF, G5/S1	Cool, moist ravines and canyons in the foothills.	2		
Dewey sedge *Carex deweyana*	ARNF	Moist foothill and montane ravines.	5		
Lesser panicled sedge *Carex diandra*	USFS, G5/S1	Montane and subalpine fens; over 6,000 feet.	1	1	1
Woolyfruit sedge *Carex lasiocarpa*	ARNF, G5/S1	Subalpine fens.	1		
Mud sedge *Carex limosa*	ARNF, G5/S2	Fens; montane or subalpine peatlands; often as part of a floating mat community adjacent to an open water system.	1	1	1
Livid sedge *Carex livida*	USFS, G5/S1	Montane and subalpine fens over 6,400 feet.	1	1	1
Peck's sedge *Carex peckii*	ARNF, G4G5/S1	Cool shaded gulches, Front Range foothills.	2		
Sprengel's sedge *Carex sprengelii*	ARNF, G5?/S2S3	Moist soil in cool ravines in the foothills.	5		
Torrey sedge *Carex torreyi*	G4/S1	Gulches in outer foothills near Boulder.	2		
Sandhill goosefoot *Chenopodium cycloides*	USFS, G3G4/S1	Sandy soils, often around the edges of blowouts in sand dunes, 3,800-5,700 feet elevation in Colorado.	1		
Enchantress's nightshade *Circaea alpina*	ARNF	Moist to wet woods and cool ravines.	5		
Purple cinquefoil *Comarum palustre*	ARNF	Grows in bogs, marshes, wet meadows, creek banks, and lake margins.	2		
Yellow coralroot *Corallorhiza trifida*	ARNF	Montane and subalpine forests; cool, moist habitats.	2		
Spring coralroot *Corallorhiza wisteriana*	ARNF	Semi-shade in montane aspen and pine.	2		
Bunchberry *Cornus canadensis*	ARNF	Subalpine forests.	1		
Hazelnut *Corylus cornuta*	ARNF	Cool ravines in the foothills.	2		

Table 51:
Other Special Status Species—Plant Species

Name	Status*	Habitat	Potential for Occurrence in the Project Area**		
			Gross Reservoir	South Boulder Creek above Gross Reservoir	South Boulder Creek below Gross Reservoir
Yellow hawthorn *Crataegus chrysocarpa*	G5/S1	Thickets and rocky ground along streams.	1		
Willow hawthorn *Crataegus saligna*	G3G4/S3	Canyons and riparian corridors from 5,345 to 8,600 feet in western Colorado.		1	1
Yellow lady's slipper *Cypripedium parviflorum*	USFS, G5/S2	Montane and subalpine, moist forest and aspen groves, 7,400 to 8,500 feet.	3	1	1
Clawless draba *Draba exunguiculata*	USFS, G2/S2	Alpine; talus slopes, fell fields; 11,500-14,000 feet.	1		
Gray's peak whitlow-grass *Draba grayana*	USFS, G2/S2	Alpine, subalpine; tundra, gravelly slopes; 11,000-14,000 feet.	1		
Roundleaf sundew *Drosera rotundifolia*	USFS, G5/S2	Subalpine; peatmats, fens; 9,100-9,800 feet.	1		
Stream orchid *Epipactus gigantea*	USFS, G4/S1S2	Mineral-rich environments with a constant supply of moisture, and it occurs at springs, seeps, and along creeks.	2		
Dropleaf buckwheat *Eriogonum exilifolium*	USFS, G3/S2	Flat to moderately sloping barren areas in shrub-steppe and open woodland, 6,090 to 8,800 feet.	1		
Slender cottongrass *Eriophorum gracile*	USFS, G5/S1S2	Montane, subalpine; fens, wet meadows; 8,100-12,000 feet.	1		
Hall's fescue *Festuca hallii*	USFS, G4/S1	Alpine, subalpine; tundra, dry grasslands; 11,000-12,000 feet.	1		
Rattlesnake-plantain *Goodyera repens*	ARNF, G5/S3S4	Shade-loving species found in cool, coniferous forests, usually with a mossy understory. Elevation 8,000-9,500 feet.	2		
Scarlet gilia *Ipomopsis aggregata* ssp. *weberi*	USFS, G5T2/S2	Open sites in sagebrush, snowberry, shrubby serviceberry, chokecherry.	1		
Simple kobresia *simpliciuscula*	USFS, G5/S2	Alpine; glacial outwash, fens, moist gravelly tundra; 9,600-12,800 feet.	1		
Tall blue lettuce *Lactuca biennis*	ARNF	Clearings in the foothill canyons.	5		
Gayfeather, Rocky Mountain blazing star *Liatris ligulistylis*	ARNF, G5/S2	Wet meadows and moist swales, lower elevations.	1		
Wood lily *Lilium philadelphicum*	ARNF, G5/S3S4	Moist woods, thickets, and wet meadows.	2		
Northern twayblade *Listera borealis*	ARNF, G4/S2	Moist shady spruce forests, elevations of 8,700 to 10,800 feet.	1		
Broad-leaved twayblade *Listera convallarioides*	ARNF, G5/S2	Moist, shady spruce forests, 8,700 to 10,800 feet.	1		

Table 51:
Other Special Status Species—Plant Species

Name	Status*	Habitat	Potential for Occurrence in the Project Area**		
			Gross Reservoir	South Boulder Creek above Gross Reservoir	South Boulder Creek below Gross Reservoir
Heartleaved twayblade *Listera cordata*	ARNF	Found in peat-moss hummocks in forests or boggy areas. Also in upland forest humus and or needle duff.	2		
Utah lupine *Lupinus lepidus* ssp. *utahensis*	ARNF	Gravelly to sandy soils, sagebrush.	1		
Stiff club-moss *Lycopodium annotinum*	ARNF	Subalpine spruce thickets and willows.	1		
Fringed loosestrife *Lysimachia ciliata*	ARNF	Wetlands in the Front Range, 5,100-8,000 feet elevation.	1		
Colorado tansy-aster *Machaeranthera coloradoensis*	USFS, G3/S3	Alpine, subalpine; park grasslands, scree slopes, dry tundra; 7,600-13,000 feet.	1		
White adder's-mouth orchid *Malaxis brachypoda* (*Malaxis monophyllos* ssp. *brachypoda*)	USFS, G4?/S1	Shaded streamsides, mossy wet areas. In Colorado, known from foothills near Boulder in Boulder and Jefferson counties.	2		
Leechleaf blazingstar *Mentzelia sinuata*	ARNF	Shale outcrops, Front Range foothills.	1		
Buckbean *Menyanthes trifoliata*	ARNF	Upper montane and subalpine ponds.	1	1	1
Budding monkeyflower *Mimulus gemmiparus*	USFS, G1/S1	Subalpine and montane; seepages and wet banks; 8,400-11,120 feet.	2		
Kotzebue's grass of Parnassus *Parnassia kotzebuei*	USFS, G5/S2	Alpine, subalpine; wet rocky areas, moss mats; 10,000-12,500 feet.	1		
Harrington's penstemon *Penstemon harringtonii*	BLM, USFS, G3/S3	Open sagebrush shrublands on gentle slopes, 6,400 to 9,400 feet.	1		
Sweet coltsfoot *Petasites sagittatus*	ARNF	Marshy meadows in intermountain parks and meadows.	1		
Bell's twinpod *Physaria bellii*	G2G3/S2S3	Shale outcrops from Fort Collins and Denver in shrub communities dominated by *Rhus trilobata* and *Cercocarpus montanus*.	1		
Rock cinquefoil *Potentila rupicola*	USFS, G2/S2	Granite and schist outcrops and cliffs on coarse shallow soils, exposed sites, montane and subalpine zone.	3		
Greenland primrose *Primula egaliksensis*	USFS, G4/S2	Extreme rich fens 9,000-10,000 feet in Colorado.	1		
Slivery primrose *Primula incana*	ARNF	Alkaline clay soil in floodplains and moist open meadows.	1		

Table 51:
Other Special Status Species—Plant Species

Name	Status*	Habitat	Potential for Occurrence in the Project Area**		
			Gross Reservoir	South Boulder Creek above Gross Reservoir	South Boulder Creek below Gross Reservoir
Pictureleaf wintergreen *Pyrola picta*	ARNF, G4G5/S3S4	Cool, moist woods on north or northeast-facing slopes, 6,000-10,000 feet.	2		
Ice cold buttercup *Ranunculus karelinii* (*R. gelidus* ssp. *Grayi*)	USFS, G4G5/S1	Alpine; scree slopes, dry rocky areas; 12,000-14,100 feet.	1		
American currant *Ribes americanum*	G5/S2	Riparian areas, lower elevations.	1	1	1
Dwarf raspberry *Rubus arcticus* ssp. *acaulis* (*Cylactis arcticus* ssp. *acaulis*)	USFS, G5T5/S1	Montane and subalpine willows and wet meadows (fens), swampy conifer forest.	4	1	1
Silver willow *Salix candida*	USFS, G5/S2	Foothills, montane; rich fens, pond edges, permanently saturated peatlands; 8,800-10,600 feet.	1	1	1
Autumn willow *Salix serissima*	USFS, G4/S1	Peatlands with saturated soils (fens, willow carrs), stream banks.	1	2	2
Maryland sanicle *Sanicula marilandica*	ARNF	Along streams in cool canyons in foothills.	5		
False melic *Schizachne purpurascens*	ARNF	Deeply shaded forested slopes.	5		
Rocky Mountain bulrush *Schoenoplectus saximontanus*	G5/S1	Damp soils, ponds, ditches, vernally moist areas, drying mudflats.	1	1	1
Peatmoss *Sphagnum angustifolium*	USFS, G5/S2	Subalpine iron fens and fens, nine locations in Colorado.	1		
Baltic sphagnum *Sphagnum balticum*	USFS, G2G4/S1	Subalpine iron fens, two locations in Colorado.	1		
Sphagnum, all species not listed as USFS sensitive	ARNF	Fens, seeps.	1		
Lesser bladderwort *Utricularia minor*	USFS, G5/S2	Montane fens and seeps, freshwater marshes.	1	2	2
Prairie violet *Viola pedatifida*	G5/S2	Prairies, open woodlands, and forest openings.	1		
Selkirk's violet *Viola selkirkii*	USFS, G5?/S1	Cold, north-facing drainages in montane forests.	2		

Table 51:
Other Special Status Species—Plant Species

Name	Status*	Habitat	Potential for Occurrence in the Project Area**		
			Gross Reservoir	South Boulder Creek above Gross Reservoir	South Boulder Creek below Gross Reservoir

Source: Species lists and status from CDOW 2010, USFS 2010, USFS 2011, BLM 2009, CNHP 2013
*Status:
ARNF = Species of local concern for the Arapaho & Roosevelt National Forests and Pawnee National Grassland.
BLM = Listed as sensitive by Bureau of Land Management.
SC = Colorado Parks and Wildlife special concern.
USFS = U.S. Forest Service Region 2—Threatened, Endangered and Sensitive Plants and Animals. Sensitive species are those for which population viability is a concern as evidenced by: a) significant current or predicted downward trends in population numbers or density; or b) significant current or predicted downward trends in habitat capability that would reduce a species' existing distribution. USFS Management Indicator Species (MIS) are discussed in Sections 3.9, 4.6.9, and 5.9 except where they are also special status species (e.g., boreal toad).
CNHP Rank Definition:
G1 = Critically Imperiled—At very high risk of extinction due to extreme rarity (often 5 or fewer populations), very steep declines, or other factors.
G2 = Imperiled—At high risk of extinction due to very restricted range, very few populations (often 20 or fewer), steep declines, or other factors.
G3 = Vulnerable—At moderate risk of extinction due to a restricted range, relatively few populations (often 80 or fewer), recent and widespread declines, or other factors.
G4 = Apparently Secure—Uncommon but not rare; some cause for long-term concern due to declines or other factors.
G5 = Secure—Common; widespread and abundant.
S1 = Critically Imperiled—Critically imperiled in the nation or State/province because of extreme rarity (often 5 or fewer occurrences) or because of some factor(s) such as very steep declines making it especially vulnerable to extirpation from the State/province.
S2 = Imperiled—Imperiled in the nation or State/province because of rarity due to very restricted range, very few populations (often 20 or fewer), steep declines, or other factors making it very vulnerable to extirpation from the nation or State/province.
S3 = Vulnerable—Vulnerable in the nation or State/province due to a restricted range, relatively few populations (often 80 or fewer), recent and widespread declines, or other factors making it vulnerable to extirpation.
S4 = Apparently Secure—Uncommon but not rare; some cause for long-term concern due to declines or other factors.
S5 = Secure—Common, widespread, and abundant in the nation or State/province.
T = Status of intraspecific taxa (subspecies or varieties) are indicated by a "T-rank" following the species' global rank.
**Codes to Occurrence in Study Area:
1 = Not present—Habitat is unsuitable or outside current known range.
2 = Unlikely—Based on marginal habitat, rarity of occurrence and/or range. Also includes areas habitat is suitable, but not found during presence/absence surveys or considered unlikely to occur by detailed habitat evaluation.
3 = Potentially present—Habitat suitable or marginal. Wide-ranging species may occur occasionally during foraging or migration but Study Area do not have important habitat. No documentation of presence for sedentary species.
4 = Known or likely to occur.
5 = Known or likely to occur, key habitat features present.
? = Uncertainty about the rank, could be higher or lower.
N/A = not applicable

Gross Reservoir

Federal- and State-Listed Species

Only one Ute Ladies'-tresses orchid was found in the Project area. No other federal- or state-listed plant species are known to occur around Gross Reservoir.

Other Special Status Species

A number of Other Special Status Species, including USFS Region 2 sensitive species and the USFS Arapaho & Roosevelt National Forests (ARNF) plant species of local concern, are known or likely to occur around Gross Reservoir.

The CNHP has identified two globally rare plant communities in the Project area for the FERC License (CNHP 2009); these are also listed as plant communities of local concern by the USFS ARNF. The River Birch/Mesic Forb (*Betula occidentalis*/*Maianthemum stellatum*) Foothills Riparian Shrub Community is reported to occur along South Boulder Creek above Gross Reservoir and the Thinleaf Alder/Mesic Forb (*Alnus incana*/mesic forb) Riparian Shrubland Community is reported to occur on Winiger Gulch upstream of the reservoir (CNHP 2009, see Final EIS for reference materials). Both of these areas are part of the Winiger Gulch Potential Conservation Area (PCA).

PCAs located in the Project area are shown in Figure 11, Exhibit 1. Shapins Associates reported that the Foothills Riparian Shrub Community also occurs along much of Forsythe Canyon upstream of Gross Reservoir (Shapins Associates 2002, see Final EIS for reference materials), and a mix of these communities was also observed along two of the drainages along the south side of the reservoir during surveys by the Corps in 2010 (Corps 2014). The Foothills Riparian Shrub Community has a CNHP conservation rating of G4/S2, and The Thinleaf Alder/Mesic Forb Community has a rating of G3/S3.

The Winiger Gulch PCA also supports an excellent occurrence of Sprengle's sedge (*Carex sprengelii*), a CNHP and USFS sensitive species.

According to data provided by the USFS, about 13.8 acres of old growth ponderosa pine forest is present in the western portion of the Project area. The USFS also identified Blue Spruce as a plant community of local concern that may occur in the Project area. Blue spruce trees are present in Forsythe Canyon, but specific Blue Spruce Community types have not been identified.

Wild sarsaparilla (*Aralia nudicaulis*)**.** This species was reported to be present at several locations in 2001 (Shapins Associates 2002), with more than 3,200 plants observed. During surveys conducted in 2010, wild sarsaparilla was found to be a regular component of riparian habitat and shaded mesic areas in the Project area. More than 5,000 individuals were observed in 2010 in five populations located in Winiger Gulch, Forsythe Canyon, along two unnamed drainages on the south side of the reservoir, and along the downstream the South Platte River.

Dewey sedge (*Carex deweyana*)**.** Surveys in 2001 (Shapins Associates 2002, see Final EIS for reference materials) found about 50 individuals of Dewey sedge in Forsythe Canyon and a few plants in one of the drainages on the south side of Gross Reservoir. Surveys in 2010 confirmed the presence of

this species at those and additional locations and about 260 individuals in four populations in Forsythe Canyon, Winiger Gulch, and two drainages on the south side of Gross Reservoir.

Sprengel's sedge. The CNHP found Sprengel's sedge near the junction of Winiger Gulch and its south fork during surveys in 2007. This population was found again along with additional occurrences in other portions of Winiger Gulch and in Forsythe Canyon. An estimated 650 individuals of this species were observed. Sprengel's sedge was most common in open areas in the valley bottom. The largest numbers were found at the site where they were originally reported by the CNHP.

Enchantress's nightshade (*Circaea alpina*)**.** More than 900 individuals of this species were observed in Winiger Gulch and along one of the tributaries on the south side of the reservoir. This is likely an underestimate because of the diminutive size of the plant. At Gross Reservoir, enchantress's nightshade occurs on unvegetated, heavily shaded stream banks, growing to the water's edge. Due to the dense shade it prefers, the species was always observed with little or no other associated herbaceous vegetation.

Tall blue lettuce (*Lactuca biennis*)**.** One individual of this species was found in Forsythe Canyon in 2001 (Shapins Associates 2002). About 150 plants of this species were found at several locations along both Forsythe Canyon and Winiger Gulch. It is a tall herbaceous plant that grows in areas of dense herbaceous vegetation in relatively unshaded areas on mesic terraces.

Wood lily (*Lilium philadelphicum*)**.** This species was mentioned as being present but not affected by activities at Gross Reservoir (FERC and USDA 1999, see Final EIS for reference materials). The location of the population is not known and is likely not to be within the Project area. Wood lily was not observed during the 2010 survey.

Dwarf raspberry. About 10 individuals of this species were found in Forsythe Canyon in 2001 (Shapins Associates 2002, see Final EIS for reference materials). This population was not found again in 2010; however, the location that was searched was based on a GPS point, and the survey was conducted later in the season when the species may have been dormant. The area was a mesic riparian area with mineral soils and is not typical of the habitats in which this species generally occurs.

Maryland sanicle (*Sanicula marilandica*)**.** Several plants of this species were found in one of the drainages on the south side of Gross Reservoir in 2001 (Shapins Associates 2002, see Final EIS for reference materials). About 32 individuals of this species were found in the same drainage again in 2011. They occurred in areas of moderate shade along the edges of the creek. It appears that none of this population is located on NFS land.

False melic (*Schizachne purpurascens*)**.** About 20 to 30 individuals of false melic were found at a location in lower Forsythe Canyon during surveys of the Gross Reservoir area in 2001 (Shapins Associates 2002, see Final EIS for reference materials). The species was found in three additional locations in 2010, but the number of individuals observed at those locations was not recorded. This species appears to be a regular though uncommon constituent of riparian areas, and it was also observed in aspen communities on the north side of Gross Reservoir.

Ferns. All species except brittle bladderfern (*Cystopteris fragilis*) are considered to be plant species of local concern for the ARNF. Six species of ferns were found during surveys at Gross Reservoir in 2010, including forked spleenwort (*Asplenium septentrionale*), brittle bladderfern, male fern (*Dryopteris felix–mas*), Rocky Mountain polypody (*Polypodium saximontanum*), western brackenfern (*Pteridium aquilinum*), and Oregon cliff fern (*Woodsia oregana* ssp. *cathcartiana*). The numbers of individuals were not recorded.

South Boulder Creek

Characterization of special status species focused on the river segment of South Boulder Creek that extends from the outlet of Moffat Tunnel to Eldorado Springs near Denver Water's South Boulder Diversion Canal. The vegetation along this segment of South Boulder Creek is predominantly riparian herbaceous and shrub but also supports riparian deciduous (mostly upstream of the Town of Rollinsville) and evergreen communities. Ute ladies'-tresses orchid and Colorado butterfly plant have ranges that include or potential habitat in this river segment.

Federal- and State-Listed Species

Ute Ladies'-tresses orchid and **Colorado butterfly plant.** Ute ladies'-tresses orchid and Colorado butterfly plant occur in the same types of habitats. The east portion of South Boulder Creek below Gross Reservoir is within the elevational range of Ute-ladies'-tresses orchid. However, habitat evaluations conducted in 1998 concluded that no potential habitat was present. As of 2004, 29 known sites were located on South Boulder Creek within City of Boulder Open Space and Mountain Parks property or private property downstream of the potentially affected segment of South Boulder Creek (Fertig et al. 2005, see Final EIS for reference materials). Ute ladies'-tresses orchid does not emerge in all these sites every year, so assessing population status can be difficult. The Colorado butterfly plant is not known to occur anywhere along South Boulder Creek although suitable habitat occurs at many of the same locations occupied by Ute ladies'-tresses orchid.

PROJECT EFFECTS (SPECIAL STATUS PLANT SPECIES)

Gross Reservoir

The calculation of acres of impact in this section assumes disturbance between the current reservoir pool elevation (7,282 feet) and elevation 7,410 feet. This includes disturbance associated with the expanded reservoir for the Environmental Pool for mitigation (elevation 7,406 feet).

Federal- and State-Listed Species

Only one Ute Ladies'-tresses orchid was found in the Project area. No other federal- or state-listed plant species are known to occur around Gross Reservoir, therefore the Project would have no or negligible adverse effect to federal- and state-listed species.

Other Special Status Species

Impacts to Other Special Status Species listed in Table 52 from expansion of Gross Reservoir would include direct and indirect, permanent and temporary impacts. The primary direct impact would be loss of habitat from reservoir expansion and from placement of associated facilities.

Impacts to Other Special Status plants are summarized in Table 52. The Project would not affect any USFS Region 2 sensitive species, but would affect several species of local concern in the ARNF. For several species, inundation would destroy a large portion of the known populations in the Gross Reservoir area. USFS policy, as stated in USFS Manual 2600, is to maintain viable populations of all native and desired non-native wildlife, fish, and plant species in habitats distributed throughout their geographic range on NFS lands. Because of the size of the populations and the relatively high proportion of plants affected, Project impacts may affect the long-term viability of populations of several species within the ARNF.

Table 52 provides the estimated number of plants of each species that are present within the area of inundation and tree-clearing at Gross Reservoir. Plants within the inundation area would be destroyed by flooding. Plants within area of tree-clearing around the reservoir perimeter could be destroyed or injured by movement of equipment and construction activity, but impacts are avoidable. Most of these species occur in open areas where tree clearing would not be necessary or would be limited. Impacts to plants in the tree-clearing area are avoidable if populations are located and marked in advance of clearing and vehicles and mechanical equipment are not allowed to operate within the sensitive area.

Wild sarsaparilla. Implementation of the Project would inundate about 80 percent of the wild sarsaparilla plants that were found in and near Gross Reservoir. The Project would affect all or nearly all of the wild sarsaparilla plants found along South Boulder Creek above the reservoir and along the two tributaries on the south side of the reservoir. About 440 plants in Forsythe Canyon and 500 in Winiger Gulch would not be affected by the Project. There are five to ten other locations of this species in the ARNF with less than a thousand individuals (Popovich 2011, see Final EIS for reference materials). The proportion of loss of this species from construction and inundation may affect viability of the local populations, but is not likely to result in a loss of viability forestwide. This species is not tracked by the CNHP, and impacts at Gross Reservoir are not likely to affect overall occurrence in Colorado.

Dewey sedge. Inundation associated with the Project would affect nearly half of the Dewey sedge observed at Gross Reservoir. Additional plants could be damaged by tree clearing. About 140 Dewey sedge plants that would not be affected by the Project were observed in Forsythe Canyon (75 plants), Winiger Gulch (65 plants), and one of the southern tributaries. The populations in the Gross Reservoir area are the only confirmed location within the ARNF (Popovich 2011, see Final EIS for reference materials) although herbarium species have been collected at several additional sites. The Project may affect viability of this species forest-wide. This species is not tracked by the CNHP, and impacts at Gross Reservoir are not likely to affect overall occurrence in Colorado.

Sprengel's sedge. Inundation associated with the Project would destroy about 90 percent of the observed population of Sprengel's sedge at Gross Reservoir. Additional plants could be damaged by tree clearing. All of the 37 plants observed along Forsythe Canyon and 70 to 92 percent of the plants in Winiger Gulch would be affected under the Project. The only unaffected subpopulations would be about 50 plants in Winiger Gulch and 10 plants on the south fork of Winiger Gulch. According to Popovich (2011, see Final EIS for reference materials), the populations in the Gross Reservoir area are the only confirmed location in the ARNF although herbarium specimens have been collected from several additional locations. The Project may affect viability of this species forestwide. This species is tracked by

the CNHP, and the state rating of S2S3 means it is intermediate between S2 (typically 6 to 20 known occurrences) and S3 (typically 21 to 100 known occurrences).

Enchantress's nightshade. Inundation associated with the Project would destroy about 77 percent of the plants of this species at Gross Reservoir. The Project would affect one large group of about 500 plants in lower Winiger Gulch and about 200 plants in one of the tributaries on the south side of Gross Reservoir. About 201 plants in the south fork of Winiger Gulch would not be affected. There are other known populations in the ARNF, and, although inundation associated with the Project may affect the viability of the local population, it is not likely to affect forest-wide viability. This species is not tracked by the CNHP, and impacts at Gross Reservoir are not likely to affect overall occurrence in Colorado.

Tall blue lettuce. One large group of 115 tall blue lettuce plants representing about 77 percent of the individuals found at Gross Reservoir would be affected by the Project. Plants in Forsythe Canyon and further upstream along Winiger Gulch and the south fork of Winiger Gulch would not be affected. According to Popovich (2011, see Final EIS for reference materials), this is the only known confirmed location in the ARNF although herbarium specimens have been collected from several other locations. The high proportion of plants that would be lost may affect viability of this population locally and forestwide. This species is not tracked by the CNHP, and impacts at Gross Reservoir are not likely to affect overall occurrence in Colorado.

Dwarf raspberry. The Project would affect the reported location of this species, which is about 600 feet upstream of the Gross Reservoir area of impact.

Maryland sanicle. About half of the observed population of Maryland sanicle at Gross Reservoir would be affected under the Project. None of the Maryland sanicle plants at Gross Reservoir are on NFS land. The Project may affect the viability of the local population. This species is not tracked by the CNHP, and effects to the local population are not likely to affect overall occurrence in Colorado. The population of Maryland sanicle along the drainage south of the reservoir extends outside of the Project area onto private land, and there is a good possibility that additional plants occur upstream.

False melic. Three of the locations where this species was recorded at Gross Reservoir would be affected by the Project. The location reported by Shapins Associates (2002, see Final EIS for reference materials) would not be affected. The occurrences in the Gross Reservoir area are the only confirmed locations in the ARNF (Popovich 2011, see Final EIS for reference materials) although herbarium specimens have been collected at several other locations. The Project may affect the viability of this species locally and forest-wide. This species is not tracked by the CNHP, and impacts at Gross Reservoir are not likely to affect overall occurrence in Colorado.

Ferns. The Project will affect populations of five fern species considered to be of local concern in the ARNF. These species range from uncommon to common in Colorado. One of them, Rocky Mountain polypody, is tracked by the CNHP with a rating of G3/S3 and another, forked spleenwort, is watch-listed. Although populations within the inundation area would be destroyed, the Project is not likely to affect the viability of these species in the ARNF or its overall occurrence in Colorado.

Table 52:
Impacts to Special Status Plants in the Project Area

Plant	Total Observed Population in 2010	Type of Impact	Estimated Number of Plants Affected
Normal Water Elevation (feet)		Inundation	7,406[1]
Maximum Elevation of Construction Disturbance (Tree-Clearing along Shoreline, feet)		Tree-clearing[2]	7,410
Wild sarsaparilla *Aralia nudicaulis*	5,082	Inundation	4,122
		Tree-clearing	20
Dewey sedge *Carex deweyana*	342	Inundation	156
		Tree-clearing	30
Sprengel's sedge *Carex sprengelii*	653	Inundation	593
		Tree-clearing	31
Enchantress's nightshade *Circaea alpina*	907	Inundation	706
		Tree-clearing	0
Tall blue lettuce *Lactuca biennis*	149	Inundation	115
		Tree-clearing	0
Dwarf raspberry *Rubus arcticus* ssp. *acaulis* (*Cylactis arcticus* ssp. *acaulis*)	8	Inundation and Tree-clearing	0
Maryland sanicle *Sanicula marilandica*	32	Inundation	17
		Tree-clearing	0
False melic *Schizachne purpurascens*	N/A (4 sites)	Inundation and Tree-clearing	3 sites
Ferns: Brackenfern *Pteridium aquilinum*, Forked spleenwort *Asplenium septentrionale*, Male fern *Dryopteris filix-mas*, Rocky Mountain polypody *Polypodium saximontanum*, Oregon cliff fern *Woodsia oregana* spp. *cathcartiana*	N/A	Inundation and Tree clearing	N/A

Notes:

1 The elevation of 7,406 feet includes the Environmental Pool storage.

2 The calculation of the noted acres assumes disturbance between the current reservoir pool elevation (7,282 feet) and elevation 7,410 feet. This includes disturbance associated with the expanded reservoir of the Environmental Pool for mitigation (elevation 7,406 feet).

N/A = not available

South Boulder Creek

Federal- and State-Listed Species

Ute Ladies'-tresses Orchid. Ute ladies'-tresses orchid occurs downstream from Gross Reservoir along South Boulder Creek. As discussed for Preble's, flow diversions at the South Boulder Diversion Canal would generally decrease flow to South Boulder Creek, which would be "not likely" to adversely affect populations of Ute ladies'-tresses orchid occurring downstream. The USFWS concurred with this determination in its December 2013 BO. Average year flow would decrease by 1,000 AF (2 percent), wet year flow would decrease by 3,000 AF (5 percent), and dry year flow would increase by 150 AF (<1 percent).

Other Special Status Species

Stream flow changes resulting from operation of the Project are expected to have no or negligible adverse effect to Other Special Status Species.

Summary of Project Effects (Special Status Plant Species)

Construction of the Project facilities at Gross Reservoir would not have adverse effects to federal- or state-listed plant species. Construction activities at Gross Reservoir would destroy a large portion of the known populations of several listed ARNF plant species of local concern at Gross Reservoir. The Project may affect the long-term viability for Dewey sedge, Sprengle's sedge, tall blue lettuce, and false melic on ARNF. However, none of these species are tracked by the CNHP, and Project impacts are not likely to affect overall occurrence in Colorado. Denver Water would comply with the Special Status Plant Relocation Plan required under the USFS 4e conditions. The Plan requires collecting and/or transplanting some sensitive plants.

Ute ladies'-Tresses. Ute ladies'-tresses orchid occurs downstream from Gross Reservoir along South Boulder Creek. Flow diversions at the South Boulder Diversion Canal would decrease flow to South Boulder Creek downstream from the diversion point, but changes would be small (average annual flow reduction of 3 percent) and would be unlikely to adversely affect habitat or populations of Ute ladies'-tresses.

Conclusions supported by the FERC in its review of the Project impacts combined with mitigation (Final SEA, Section 5.1.4) were as follows.

> ***Special Status Plants***
>
> *Enlargement of Gross Reservoir would affect several plant species of local concern in the Arapaho and Roosevelt National Forests. These include wild sarsaparilla (Aralia nudicaulis), Dewey sedge (Carex deweyana), Sprengel's sedge (Carex sprengelii), enchantress's nightshade (Circaea alpine), tall blue lettuce (Lactuca biennis), Maryland sanicle (Sanicula marilandica), and false melic (Schizachne purpurascens). Five fern species that could be affected are brackenfern (Pteridium aquilinum), forked spleenwort (Asplenium septentrionale), male fern (Dryopteris filix-mas), Rocky*
>
> *Mountain polypody (Polypodium saximontanum), and Oregon cliff fern (Woodsia oregana spp. cathcartiana). Effects would occur primarily during tree clearing, and during inundation associated with reservoir enlargement. Although the new quarry site at Osprey Point was not analyzed in the Final EIS, no additional effects on special status plants would occur because the quarry would be located entirely within the reservoir inundation zone.*
>
> *Denver Water would address and mitigate effects on special status plants through its proposed BMPs, and pre-construction surveys, identification of buffers, and relocation of plants through its proposed Special Status Plants Relocation Plan that it would develop to supplement its approved Article 410 Rare and Sensitive Plant Species Protection Plan. The measures to protect special status plants would be developed in consultation with, and approval of, the Forest Service to comply with Forest Service 4(e) conditions 18 (Special Status Species and Sensitive Areas) and*

22 (Special Status Plants Relocation Plan). The off-license conveyance of the 539-acre Toll Property to the Forest Service, to be administered and protected as part of the Roosevelt National Forest, would provide further mitigation for effects to special status plants. Denver Water would file the final plan for Commission approval, including evidence of consultation and rationale for why any agency recommendations were not included in the final plan, and copies of agency approvals where necessary. With compliance with these plans and measures, effects to sensitive plants in the Gross Reservoir Project area would not exceed the minor, short-term effects identified in the Final EIS.

As indicated above, effects to wildlife and wildlife habitat in the Gross Reservoir Project area, including special-status species, would be reduced and mitigated through development of the plans and measures required by the Forest Service, and the off-license conveyance of the 539-acre Toll Property to the Forest Service.

Overall, we [FERC] find that approval of Denver Water's license amendment would not cause effects to terrestrial resources in the Gross Reservoir Project area to exceed those determined in the Final EIS, and effects would in fact be minimized through Denver Water's compliance with the plans and measures referenced above.

Denver Water's License Amendment Application to the FERC evaluated all mitigation measures for sensitive species (Exhibit E, Table 5.1) as provided below.

Denver Water will mitigate permanent impacts to sensitive species through the preservation (through USFS protection and administration of NFS lands) of 539 acres of diverse wildlife habitat types as described above.

Denver Water will develop a Special Status Plants Relocation Plan to address impacts to special status plants on NFS lands.

8-507.D.7.b.v, Air Quality

Air quality modeling was conducted for the Project and is included in Exhibit 14.

8-507.D.7.b.v.A, Daily Trips

Information regarding daily trips is addressed in Section 8-507.D.7.b.viii, Transportation Impacts of this 1041 permit application. Additional detailed traffic estimates and evaluation are included in the Traffic Impact Analysis provided in Exhibit 4.

The air quality impacts associated with Project construction are anticipated to be short-term and minor, primarily resulting from use of heavy-duty diesel construction equipment and fugitive dust emissions associated with equipment and vehicle travel on unpaved roads, material handling, excavation activities, and wind erosion. To minimize the adverse impacts associated with fugitive dust, including visibility issues, Denver Water will prepare a Fugitive Dust Control Plan that will detail specific BMPs to be implemented to minimize the generation of fugitive dust by Project construction activities.

8-507.D.7.b.v.B, Impacts to Air Quality

The following air quality information and analysis were gathered for preparation of Denver Water's License Amendment Application to the FERC (Section 3.3.13).

AFFECTED ENVIRONMENT (AIR QUALITY)

Air quality is primarily controlled by the magnitude and distribution of pollutant emissions (fugitive and point source) within any given region and the regional climate. The transport of pollutants from specific source areas is strongly affected by local topography, which is described below under Section 8-507.D.7.b.v.D.

Air Quality Standards

National Ambient Air Quality Standards

"Air Pollution" is a general term that refers to one or more substances that degrade the quality of the atmosphere. Individual air pollutants degrade air quality by impairing human or animal health, reducing visibility, damaging property, and/or reducing the productivity or vigor of crops and natural vegetation. Regulations for air pollutant emissions exist to protect human health and welfare and the environment.

Major sources of air pollution include combustion of fossil fuels for industrial uses such as electricity generation and heating combustion of fossil fuels for residential heating (e.g., furnaces and water heaters) combustion of fuels, such as residential wood burning, incineration, and gas and forest fires emissions from industrial/commercial processes (e.g., refineries and manufacturing) evaporative emissions and solvent usage (refueling of automobiles and other common household solvents such as paint thinner) on-road vehicles, such as cars, trucks, buses, and motorcycles fugitive dust from unpaved roads off-road vehicles, such as aircraft, boats, locomotives, farm equipment, construction machinery, and lawn mowers natural sources including windblown dust and soot from wildfires.

The EPA is responsible for developing and enforcing regulations that govern air quality. The 1970 Federal Clean Air Act (CAA) established National Ambient Air Quality Standards (NAAQS) designed to protect public health. Seven air pollutants (criteria pollutants) have been identified by the EPA as being of concern nationwide: carbon monoxide (CO), sulfur oxides (SO_x), nitrogen dioxide (NO_2), ozone (O_3), particulate matter less than 10 and 2.5 microns in diameter (PM_{10} and $PM_{2.5}$), and lead (Pb). Although SO_x is listed as the criteria pollutant, ambient concentrations are actually measured as sulfur dioxide (SO_2). The sources of these pollutants, their effects on human health, and their concentrations in the atmosphere vary considerably. NAAQS standards for each of the criteria pollutants are shown in Table 53.

Table 53:
National Ambient Air Quality Standards

Pollutant	Primary Standards	Averaging Time	Secondary Standards
Carbon monoxide (CO)	9 ppm (10 mg/m^3)	8-hour[1]	None
	35 ppm (40 mg/m^3)	1-hour[1]	None
Lead (Pb)	1.5 µg/m^3	Quarterly average	Same as primary
	0.15 µg/m^3	Rolling 3-Month Average[2]	Same as primary
Nitrogen dioxide (NO_2)	0.053 ppm (100 µg/m^3)	Annual (arithmetic mean)	Same as primary
	0.1 ppm	1-hour[3]	None

Table 53:
National Ambient Air Quality Standards

Pollutant	Primary Standards	Averaging Time	Secondary Standards
Particulate matter (PM_{10})	N/A[4]	N/A[4]	—
	150 µg/m[5]	24-hour[5]	Same as primary
Particulate matter ($PM_{2.5}$)	12.0 µg/m[5]	Annual[6] (arithmetic mean)	15.0 µg/m[5] (Annual)
	35 µg/m[5]	24-hour[7]	Same as primary
Ozone (O3)	0.08 ppm/ 0.075 ppm[8]	8-hour[9]	Same as primary
Sulfur oxides (measured as SO2)	75 ppb	1-hour[10]	0.5 ppm (3-hour)

Source: EPA 2010c, see Final EIS for reference materials.
Averaging times are based on the following:
1 Not to be exceeded more than once per year.
2 Final rule signed October 15, 2008.
3 To attain this standard, the 3-year average of the 98th percentile of the daily maximum 1-hour average at each monitor within an area must not exceed 0.100 ppm (effective January 22, 2010).
4 Due to a lack of evidence linking health problems to long-term exposure to coarse particle pollution, the agency revoked the annual PM10 standard in 2006 (effective December 17, 2006).
5 Annual Mean—not to be exceeded more than once per year on average over 3 years.
6 To attain this standard, the 3-year average of the weighted annual mean PM2.5 concentrations from single or multiple community-oriented monitors must not exceed 15.0 µg/m3.
7 To attain this standard, the 3-year average of the 98th percentile of 24-hour concentrations at each population-oriented monitor within an area must not exceed 35 µg/m3 (effective December 17, 2006).
8 The 1997 standard of 0.08 ppm—and the implementation rules for that standard—will remain in place for implementation purposes as EPA undertakes rulemaking to address the transition from the 1997 ozone standard to the 2008 ozone standard.
9 To attain the 0.08 ppm standard, the 3-year average of the fourth-highest daily maximum 8-hour average ozone concentrations measured at each monitor over each year must not exceed 0.084 ppm. To attain the revised 0.075 ppm standard, the 3-year average of the fourth-highest daily maximum 8-hour average ozone concentrations measured at each monitor over each year must not exceed 0.075 ppm.
10 Final rule signed June 2, 2010. To attain this standard, the 3-year average of the 99th percentile of the daily maximum 1-hour average at each monitor within an area must not exceed 75 ppb.
— = indicates that the sampling site does not collect data for that pollutant
$\mu g/m^3$ = micrograms per cubic meter
mg/m^3 = milligrams per cubic meter
N/A = not applicable
ppb = parts per billion
ppm = parts per million

A statewide monitoring network measures ambient concentrations of criteria pollutants. If ambient criteria pollutant concentrations do not exceed the NAAQS, an area is designated as an attainment area. In contrast, an area with pollutant concentrations that exceed the NAAQS for one or more pollutants is designated as a non-attainment area for these pollutants. Colorado is designated as an attainment area for CO, NO_2, O_3 (1-hour), SO_x, PM_{10}, and $PM_{2.5}$. The Denver Metropolitan Area is designated non-attainment for the 8-hour O_3 standard based on the 0.08 part per million (ppm) ozone NAAQS and is expected to be designated non-attainment based on the revised 0.075 ppm ozone NAAQS. The Denver Metropolitan Area consists of Adams, Arapahoe, Boulder, Broomfield, Denver, Douglas, Jefferson, and parts of Larimer and Weld counties. Table 54 shows the monitored values for the counties in the Project vicinity where land-disturbing activities would occur or that would contain haul routes.

The Denver Metropolitan Area volunteered to participate in the EPA Early Action Compact Protocol process for the purpose of deferring the effective date of a non-attainment designation while implementing emission control measures to reduce ambient ozone concentrations. However, the 3-year average of the fourth-highest daily maximum ozone concentrations exceeded the 0.08 ppm 8-hour standard for ozone during the summer of 2007. Ozone non-attainment provisions became effective on November 20, 2007.

Table 54:
National Ambient Air Quality Standard Monitoring Data

	Criteria Pollutants											
	CO (ppm)		NO_2 (ppm)	O_3 (ppm)		SO_2 (ppm)		$PM_{2.5}$ (µg/m³)		PM_{10} (µg/m³)		Pb (µg/m³)
County	2nd Max 1-hr	2nd Max 8-hr	Annual Mean	2nd Max 1-hr	4th Max 8-hr	2nd Max 24-hr	Annual Mean	98th Percentile	Annual Mean	2nd Max 24-hr	Annual Mean	Quarterly Mean
Boulder	3.3	2.4	—	0.089	0.076	—	—	23	7.73	35	21	—
Jefferson	—	—	—	0.93	0.074	—	—	—	—	—	—	—
Denver	4.5	1.9	0.025	0.09	0.072	0.008	0.002	19.4	7.9	56	30	0.01
Adams	3.1	1.7	0.016	0.095	0.076	0.008	0.002	20.3	8.62	107	32	—
Weld	3.2	2.2	—	0.092	0.073	—	—	21.8	8.12	60	22	—

Source: EPA 2010c

Notes: Cells with "—" indicate that the sampling site does not collect data for that pollutant.

CO = carbon monoxide

NO_2 = nitrogen dioxide

O_3 = ozone

SO_2 = sulfur dioxide

Pb = lead

PM_{10} = particulate matter less than 10 microns in diameter

µg/m³ = micrograms per cubic meter

hr = hour

ppm = parts per million

Max = maximum

$PM_{2.5}$ = particulate matter less than 2.5 microns in diameter

Regional Haze/Visibility/Extinction

Regional haze results in reduced visibility in many cities and scenic areas. Haze is caused when sunlight encounters tiny particles and moisture in the air. Some light is absorbed by particles while other light is scattered, which reduces the clarity and color of what we see. Some types of particles such as sulfates scatter more light, particularly during humid conditions.

Visibility is generally defined as the maximum distance a landscape can be viewed against the background of the sky. Visibility is commonly expressed in terms of visual range, which is defined as the distance at which a large black object just disappears from view.

Class I areas include each national park over 6,000 acres and each national wilderness area over 5,000 acres that existed as of the date of enactment of the CAA (August 7, 1977). There are 12 Class I areas in

Colorado (Table 55). The CAA requires states to treat Class I areas with the most stringent degree of protection from future degradation of air quality.

The closest Class I areas to the Project are Rocky Mountain National Park (managed by the National Park Service [NPS]) and Eagles Nest Wilderness Area (managed by the USFS). Visibility monitoring has been ongoing at 50 NPS locations, including Rocky Mountain National Park, as a part of the Interagency Monitoring of Protected Visual Environments (IMPROVE) program.

Table 55:
Colorado Class I Areas

Black Canyon of the Gunnison National Park	Mesa Verde National Park
Eagles Nest Wilderness Area	Mount Zirkel Wilderness Area
Flat Tops Wilderness Area	Rawah Wilderness Area
Great Sand Dunes National Monument	Rocky Mountain National Park
La Garita Wilderness Area	West Elk Wilderness Area
Maroon Bells-Snowmass Wilderness Area	Weminuche Wilderness Area

Source: NPS (2006) , see Final EIS for reference materials.

Extinction, expressed as inverse megameters (Mm^{-1}), is another common measure of air quality and is proportional to the amount of light lost as it travels over 1,000 kilometers (km). Extinction is most useful for relating visibility directly to particle species concentrations in the air. To understand the correspondence between visual range and extinction, a 10 Mm^{-1} extinction value shows the percentage of good, moderate, and poor days in the Denver and Front Range area from 1990 to 2005 (Table 56). Visibility in the Denver and Front Range area has been improving in recent years, with a higher proportion of good visibility days and fewer poor visibility days (Chart 11). Visibility is expected to continue to improve as stricter emissions standards for gasoline and diesel motor vehicles are put into place.

Table 56:
Mean Visibility Data

Condition	Extinction[1] b_{ext} (Mm^{-1})	Standard Visual Range (km)
Rocky Mountain National Park (ROMO1)		
Best 20% Visibility Days	11.8	308
Middle 20% Visibility Days	19.1	196
Worst 20% Visibility Days	37.4	109
White River National Forest (WHRI1)[2]		
Best 20% Visibility Days	10.1	324
Middle 20% Visibility Days	15.7	221
Worst 20% Visibility Days	26.9	142

Source: CSU 2010, see Final EIS for reference materials.

Table 56:
Mean Visibility Data

Condition	Extinction[1] b_{ext} (Mm^{-1})	Standard Visual Range (km)

Summary data are based on new IMPROVE algorithms.

1 Atmospheric light extinction is a fundamental metric used to characterize air pollution impacts on visibility. It is the fractional loss of intensity in a light beam per unit distance due to scattering and absorption by the gases and particles in the air. Light extinction (*bext*) can be expressed as the sum of light scattering by particles (*bs,p*), scattering by gases (*bs,g*), absorption by particles (*ba,p*) and absorption by gases (*ba,g*).

2 Representative monitoring for Maroon Bells, West Elk, Eagles Nest, and Flat Tops Class I areas.

% = percent

km = kilometer

Mm-1 = inverse megameters

Status of State Implementation Plans

Colorado is in attainment of all NAAQS except for the 8-hour ozone standard. The CDPHE Air Quality Control Commission (AQCC) adopted an Ozone Action Plan in 2004 and entered into the Early Action Compact in 2007. Table 57 shows the cities and counties that are in non-attainment or are maintenance areas for criteria pollutants.

Air Quality Conformity

The CAA's general conformity provisions require federal agencies to ensure that planned federal actions located in an area designated "non-attainment" or "maintenance" do not impair state and local efforts to improve or maintain air quality. General conformity provisions apply on a per-pollutant basis to areas that meet one of the following criteria:

- The area is designated as non-attainment for one or more pollutants or
- The area is designated as a maintenance area (an area that was previously designated non-attainment and is working to maintain acceptable air quality).

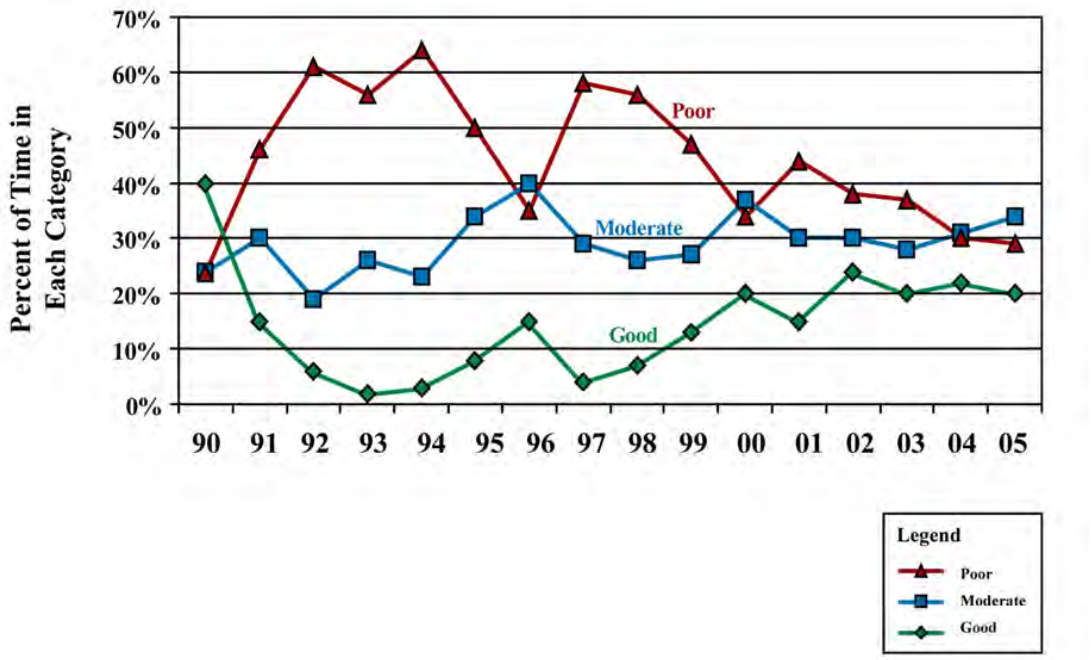

Chart 11: Visibility Trends in Denver and the Front Range (1990 through 2005)

Source: CDPHE (2006)
Note: These percentages do not total 100 because "extremely poor" visibility days are not shown.

Table 57:
NAAQS Non-attainment and Maintenance Areas in the Denver Area

Pollutant	City	County
Non-Attainment		
Ozone (8-hour)	Denver	Adams, Arapahoe, Boulder, Broomfield, Denver, Douglas, Jefferson, Larimer, and Weld
Maintenance		
CO, PM10	Denver	Adams, Arapahoe, Boulder, Broomfield, Denver, Douglas, and Jefferson

Source: EPA (2010d)
CO = carbon monoxide
PM = particulate matter

The CDPHE AQCC incorporated by reference EPA's provisions of Title 40, Part 51, Subpart W and Title 40, Section 6.303 in Air Quality Regulation 10.

The federal agency responsible for approving an action is required to determine if the action conforms to the applicable non-attainment or maintenance area State Implementation Plan (SIP). Colorado's SIPs establish conformity criteria and procedures that are consistent with federal conformity provisions.

The general conformity process is broken down into two steps that must be completed prior to commencement of a federal action:

1. A conformity analysis to determine if *de minimis* or regional significance thresholds are exceeded (Table 58). The conformity analysis has two steps:
   a) An applicability analysis to determine whether the action meets a regulatory exemption (listed in 40 Code of Federal Regulations [CFR] 93.153c) and
   b) If the action is not exempt, emission calculations to determine if a *de minimis* threshold is exceeded.
2. If the action is not exempt and *de minimis* or regional significance thresholds are exceeded, a Conformity Determination must be performed.

The general conformity threshold for volatile organic compounds (VOCs) is 100 tons per year assuming that the Denver 8-hour ozone non-attainment area classification is considered maintenance. Based on the information provided in the SIP, activities conducted inside the Denver Metropolitan Area would need to be evaluated for conformity.

Table 58:
Conformity *de Minimis* Threshold Levels

Pollutants/Maintenance Areas	Tons per Year
Ozone (NO_X, SO_2 or NO_2)	
Marginal or moderate ozone non-attainment area	100
Ozone (VOCs)	
Maintenance areas inside an ozone transport region	50
Maintenance areas outside an ozone transport region	100
CO	
All Maintenance Areas	100
PM_{10}	
All Maintenance Areas	100
Pb	
All Maintenance Areas	25

Source: 40 CFR Part 93.153
Notes:
Denver is located outside of an ozone transport region.
NO_x = oxides of nitrogen
NO_2 = nitrogen dioxide
SO_2 = sulfur oxide
VOCs = volatile organic compounds
CO = carbon monoxide
PM_{10} = particulate matter less than 10 microns in diameter
Pb = lead

PROJECT EFFECTS (AIR QUALITY)

Short-term direct air quality impacts resulting from the Project would be related primarily to 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.

Gross Reservoir

Total emissions from the Project were calculated based on equipment proposed to be used over the construction schedule. Average annual emissions in a 12--month period were calculated.

This procedure allows the comparison of annual emissions with the conformity *de minimis* levels to determine if the Project needs to undergo conformity analysis. At Boulder County's request, Denver Water updated the air quality modeling in 2019, and those results are presented in Exhibit 14.

Table 59 summarizes estimated emissions from Project construction. Most construction equipment exhaust emission factors are conservatively based on Tier 1 emission factors from Median Life, Annual Activity, and Load Factor Values for Nonroad Engine Emissions Modeling (EPA 2004). On-road exhaust emissions from delivery vehicles and from workers commuting to the construction site are estimated using emission factors provided by the CDPHE APCD (CDPHE 2006).

For the dam and reservoir expansion, average annual emissions of CO and oxides of nitrogen (NO_x) are greater than the conformity *de minimis* levels of 100 tons per year (tpy) for each. Therefore, the Project would undergo a general conformity analysis, if necessary, to ensure that the region remains in compliance with the NAAQS.

Additional impacts would occur from tree removal. Clearing will remove approximately 140 to 1,170 trees/acre or an estimated 234,000 trees or 24,422 tons of woody biomass within the inundated area. Removal systems will be based largely on helicopter logging with cable ground support and, where accessible, conventional ground-based logging to bring biomass material to selected landings. Woody biomass material will be chipped, ground, or converted to biochar and delivered to feasible markets in Colorado. Air curtain burners would minimize releases to the air resulting from burning woody material as nearly complete combustion is achieved with minimal escape of particulates virtually eliminating smoke. The air quality modeling study (Exhibit 14) includes tree removal activities in the impacts analysis.

Table 59:
Construction Emissions for the Project

Source	Total Emissions (tons)							
	Criteria Pollutants						HAPs	GHGs
	CO	NO_x	PM_{10}	$PM_{2.5}$	SO_2	VOCs	Total	CO_2
Construction Equipment Exhaust	392.47	318.58	18.47	17.91	6.00	46.17	0.48	24,041.66
Portable Diesel Engine Exhaust	15.49	71.89	5.10	5.10	4.75	5.73	0.06	2,511.62
On-road Exhaust								
Worker Commuting	59.22	4.38	0.11	—	0.04	4.53	0.22	42.60
Delivery Vehicles	27.18	28.59	0.87	0.36	1.25	3.63	0.28	10.44
Fugitive Dust								
Wind Erosion	—	—	3.22	0.48	—	—	—	—
Material Handling	—	—	—	—	—	—	—	—

Table 59:
Construction Emissions for the Project

Source	Total Emissions (tons)							
	Criteria Pollutants						HAPs	GHGs
	CO	NO_x	PM_{10}	$PM_{2.5}$	SO_2	VOCs	Total	CO_2
Paved Roads	—	—	156.36	22.58	—	—	—	—
Unpaved Roads	—	—	105.98	10.59	—	—	—	—
Rock Crushing/Screening	—	—	3.33	—	—	—	—	—
Concrete Batching	—	—	22.35	22.35	—	—	—	—
Total Emissions (tons)	494.36	423.44	315.79	79.37	12.04	60.06	1.04	26,606.32
Project years:	4.1	4.1	4.1	4.1	4.1	4.1	4.1	4.1
Average Annual Emissions (tons per year)	120.58	103.28	77.02	19.36	2.94	14.65	0.25	6,489.35

CO = carbon monoxide
GHG = greenhouse gases
HAP = hazardous air pollutants
NO_x = oxides of nitrogen
$PM_{2.5}$ = particulate matter less than 2.5 microns in diameter
PM_{10} = particulate matter less than 10 microns in diameter
SO_2 = sulfur dioxide
VOCs = volatile organic compounds

The EPA's "major source" emissions thresholds for hazardous air pollutants (HAPs) are 10 tpy for a single HAP or 25 tpy for any combination of HAPs. The EPA Greenhouse Gases (GHG) Final Rule states that new facilities with GHG emissions of at least 100,000 tpy carbon dioxide equivalent (CO_2e) and existing facilities with at least 100,000 tpy CO_2e that make changes that would increase GHG emissions by at least 75,000 tpy CO_2e are required to obtain Prevention of Significant Deterioration (PSD [Major Source]) permits. As shown in the Table 59, the HAPs and GHGs total emissions for this Project are well below the major source status thresholds for PSD permitting requirements.

During the construction phase of the Project, air quality impacts would be minor. Negligible air quality impacts are expected during operation.

Summary of Project Effects to Air Quality

Short-term air quality impacts for the Project are related primarily to on-site construction activities. Temporary off-site air quality impacts would include exhaust emissions from heavy-duty construction equipment, exhaust emissions from construction workers' vehicles and delivery vehicles, and fugitive dust emissions. If the Project is permitted, a general conformity analysis would be conducted prior to construction to ensure compliance with the NAAQS.

Conclusions supported by the FERC in its review of the Project impacts relating to air quality (Final SEA, Section 5.1.11.2) were as follows.

> *The Final EIS found that the effects of construction on air quality would be short-term (4.1 years), direct, and adverse, and hazardous air pollutants and greenhouse gas total emissions would be well below the major source status thresholds for permitting requirements. Air quality effects*

during project operations would be comparable to current conditions. The Final EIS presented an evaluation of the effects of project construction and operation of the enlarged reservoir. Short-term, direct air quality effects for the project would be related primarily to 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.

Total emissions from the expansion of the dam and 77,000 acre-foot expansion of the reservoir were calculated based on proposed equipment used over the 49-month (4.1- year) construction schedule and presented in the Final EIS.

Denver Water now proposes to use a different quarry area on its own land within the current reservoir area. The discussion of the effects on air quality in the license amendment application did not specifically discuss this change. However, Denver Water's Final Quarry Location Report notes that the ability to obtain all of the aggregate material from an on-site quarry (regardless of the quarry site selected) would significantly reduce the number of vehicle trips to transport materials from off-site from 22 vehicle trips per day for aggregate, flyash, and cement to 6 vehicle trips per day for only flyash and cement, therefore reducing air quality effects during construction. While both the particulate matter measuring less than 10 microns in diameter (PM10) and 2.5 microns in diameter (PM2.5) are anticipated to increase from the Corps FEIS Quarry site to the Osprey Point quarry site due to increased volume of rock crushed, the net total PM10 emissions are estimated to significantly decrease because the decreased truck trips would more than compensate for the increased emissions from rock crushing. However, the net total PM2.5 emissions are estimated to increase slightly because the mission increases from rock crushing would be larger than the emission decreases from truck trips. However, both the total and average annual emissions for all criteria and hazardous pollutants, overall, would be reduced.

Prior to construction, Denver Water would obtain and comply with the necessary air quality permits and would also develop and implement a Fugitive Dust Control Plan that would include specific measures to minimize the generation of fugitive dust during construction. Therefore, based on the results of May 15, 2017 air quality study cited above, and considering the use of the currently-proposed Osprey Point quarry and implementation of the Fugitive Dust Control Plan, approval of the FERC hydropower license amendment application would represent an overall reduction in effects to air quality from those identified in the Final EIS.

Impacts to air quality were addressed in the Corps ROD (Section 6.6, page 19).

The Preferred Alternative [the Project] maximum annual emissions are less than 10% of the 2011 and 2017 nonattainment area emissions for carbon monoxide (CO), oxides of nitrogen (NOx), particulate matter of 10 microns in diameter (PM10), and volatile organic compounds (VOCs). Since the Project emissions with the use of the Osprey Point quarry site are both below the de-minimis levels and below 10% of the area's emissions inventory for the conformity review, a conformity determination is not required and the Project has been found to conform.

MITIGATION (AIR QUALITY)

To minimize the adverse impacts associated with fugitive dust, including visibility issues, Denver Water would implement BMPs and prepare a Fugitive Dust Control Plan that would detail specific measures to be implemented to minimize the generation of fugitive dust by Project construction activities. This plan would include control measures such as watering unpaved roads or applying chemical stabilizers, as necessary to reduce dust. Denver Water would also post and enforce speed limits to limit dust production.

In addition, certain construction activities, including operation of the concrete batch plant and aggregate production associated with the on-site quarry, as well as some of the possible tree removal options, such as utilization of an air curtain destructor, would require air quality permits from the CDPHE, if emissions exceed certain permitting thresholds. Denver Water would obtain all required permits prior to beginning construction. Prior to construction, Denver Water would obtain and comply with the necessary air quality permits for the concrete batch plants and the portable crushing operation.

The FERC analysis evaluated the effects of all mitigation measures (Final SEA, 5.1.11.2) and concluded the following.

> *Prior to construction, Denver Water would obtain and comply with the necessary air quality permits and would also develop and implement a Fugitive Dust Control Plan that would include specific measures to minimize the generation of fugitive dust during construction. Denver Water states this plan would include control measures such as watering unpaved roads or applying chemical stabilizers, as necessary to reduce dust. Denver Water would also post and enforce speed limits to limit dust production. Therefore, considering the use of the currently proposed Osprey Point Quarry and implementation of the Fugitive Dust Control Plan, approval of Denver Water's application would represent an overall reduction in effects to air quality from those identified in the Final EIS.*
>
> *Based on our review of the analyses and summaries in the Final EIS and the Corps' ROD, the issues of greenhouse gas emissions and any contributions to climate change from the current proposal have been adequately addressed.*

8-507.D.7.b.v.C, Air Quality Standards for Proposed Transportation Facilities

The project will comply with required air quality permit requirements and is not a proposed transportation facility. Therefore, this section is not applicable.

8-507.D.7.b.v.D, Airsheds, Air Circulation, and Microclimates

The following airshed-related information and analysis were gathered for preparation of Denver Water's License Amendment Application to the FERC (Section 3.3.13).

Meteorology and Climate in the Project Vicinity

Both the geographical and meteorological characteristics of the Denver Metropolitan Area and the Rocky Mountains to the west are major factors affecting air quality conditions in the Project vicinity. Topography

is particularly important in channeling pollutants along valleys, creating upslope and downslope circulation that entrains airborne pollutants and blocking the flow of pollutants toward certain areas.

Gross Reservoir is located on the eastern slope of the Colorado Rocky Mountain Front Range in South Boulder Creek Canyon. Boulder Creek Canyon is rugged and contains narrow, V-shaped valleys with steep slopes (50 percent and greater in places) and small areas of relatively flat topography. Numerous near-vertical cliffs, up to a few hundred feet high, exist at the site. Ridges and higher areas have more gentle slopes and some relatively small flat areas. Elevations within the existing FERC Project Boundary range from about 8,000 feet down to 7,000 feet below Gross Dam.

The National Climatic Data Center maintains data from a national network of cooperative- and government-operated (i.e., military bases, airports, etc.) meteorological monitoring stations. Meteorological data for each county in the Project vicinity are provided in Table 60 and Table 61 (WRCC 2010). Wind data are not as available as the other meteorological data; wind data for the years 2004 through 2007 for two sites near the Project vicinity, Broomfield Jefferson County Airport (KBJC) and Mountain Research Station (Boulder 14W) are provided in Table 62 (CISL 2010, NOAA 1998).

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Table 60:
Average Maximum and Minimum Temperatures (°F)

County	Site ID	Jan		Feb		Mar		Apr		May		Jun		Jul		Aug		Sept		Oct		Nov		Dec		Annual	
		Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min
Boulder	50848	44.8	20.5	47.0	22.5	53.1	27.8	61.8	35.7	70.4	44.3	80.5	52.8	86.3	58.7	84.6	57.5	76.9	49.0	66.0	39.0	53.8	28.9	46.1	22.3	64.3	38.2
Jefferson	52790	44.3	10.0	45.5	12.2	49.8	18.3	56.6	25.5	65.2	33.9	75.3	41.1	81.6	46.8	79.3	45.3	72.1	37.1	62.3	26.8	51.0	18.2	44.8	10.8	60.7	27.2
Denver	52220	43.8	17.0	46.9	20.4	52.7	26.2	61.3	34.3	70.9	44.1	81.6	52.8	88.2	59.0	85.8	57.3	77.4	48.1	66.1	36.7	52.7	25.5	45.0	18.3	64.4	36.6
Adams	51179	42.3	13.1	46.3	17.1	53.2	23.4	62.5	31.9	72.1	41.7	83.4	50.5	90.3	56.6	87.8	55.0	79.3	46.0	67.6	34.5	52.8	22.6	44.2	15.1	65.2	34.0
Weld	53553	41.6	15.4	47.1	19.9	56.2	26.8	64.6	34.7	73.7	44.2	83.9	52.7	90.0	58.3	87.7	56.2	79.5	46.9	66.5	35.4	51.3	24.6	41.8	16.4	65.3	36.0

Source: WRCC (2010)
Notes:
° F = degrees Fahrenheit
ID = identification
Min = minimum
Max = maximum

Table 61:
Average Total Precipitation and Snowfall (inches)

County	Site ID	Jan		Feb		Mar		Apr		May		Jun		Jul		Aug		Sept		Oct		Nov		Dec		Annual	
		Precipitation	Snowfall	Precipitation	Snowfall	Precipitation	Snowfall	Precipitation	Snowfall	Precipitation	Snowfall	Precipitation	Snowfall	Precipitation	Snowfall	Precipitation	Snowfall	Precipitation	Snowfall	Precipitation	Snowfall	Precipitation	Snowfall	Precipitation	Snowfall	Precipitation	Snowfall
Boulder	50848	0.59	9.6	0.78	11.2	1.72	16.5	2.64	11.4	2.97	2.3	1.89	0	1.73	0	1.61	0	1.52	1.1	1.47	5.1	1.01	11.8	0.78	10.6	18.71	79.5
Jefferson	52790	0.55	8.6	0.69	9.7	1.67	18.7	2.21	14.0	2.57	3.4	2.14	0.1	2.23	0	2.31	0	1.47	1.5	1.27	7.4	0.93	12.0	0.75	10.0	18.79	85.3
Denver	52220	0.50	7.3	0.56	7.0	1.25	12.2	1.79	8.3	2.42	1.6	1.69	0	1.96	0	1.74	0	1.14	1.5	1.01	4.1	0.81	8.6	0.58	7.8	15.45	58.6
Adams	51179	0.42	6.3	0.40	5.3	0.96	8.9	1.66	6.0	2.49	0.6	1.85	0	2.13	0	1.83	0	1.21	1.0	0.83	2.8	0.63	5.9	0.42	5.9	14.83	42.7
Weld	53553	0.47	5.9	0.36	4.2	1.06	7.4	1.82	4.9	2.42	0.8	1.87	0	1.54	0	1.36	0	1.11	0.7	1.04	3.2	0.75	6.8	0.51	6.6	14.32	40.4

Source: WRCC 2010
mph = miles per hour

Table 62:
Wind Data

Station	Monitored Metric	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
KBJC[1]	Prevailing Wind Direction	W	N	W	N	N	N	N	N	N	N	W	W	N
	Mean Wind Speed (mph)	10	9	10	9	9	9	8	8	8	8	8	10	9
	Maximum Wind Speed (mph)	62	37	63	38	34	57	51	51	46	61	40	67	67
Boulder 14W[2]	Mean Wind Speed (mph)	9	8	7	5	5	5	4	4	5	6	7	9	6
	Maximum Wind Speed (mph)	29	26	29	25	21	25	13	13	20	26	27	28	29

1 Source: CISL 2010
2 Source: NOAA 1998
Notes:
N = north
mph = miles per hour
W = west

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8-507.D.7.b.v.E, Impact and Net Effect of Construction and Operation Impacts

Net effects to the air quality during construction and operation are described in Section 8-507.D.7.b.v.B. In addition, Exhibit 14 presents additional air quality modeling results associated with construction and operation of the Project. Principal construction emission source categories associated with the Project include exhaust emissions associated with construction equipment and on-road vehicle engines and fugitive dust associated with equipment and vehicle travel on unpaved roads, material handling, excavation activities, and wind erosion. The emission calculations in Exhibit 14 are based on the Project construction schedule, construction equipment anticipated to be utilized on-site, and the most recent estimated equipment. The annual maximum and annual average construction emissions presented in tons per year are presented in Tables 63 and 64, respectively. Additional information about methods and emission calculations is provided in Exhibit 14.

Table 63:
Total Maximum (Worst-Case) Construction Emissions

Emission Sources[1]	CO (tpy)	NO_X (tpy)	SO^2 (tpy)	PM_{10} (tpy)	$PM_{2.5}$ (tpy)
Construction Equipment	19.9 (2021)	103.5 (2023)	3.0 (2023)	3.9 (2023)	3.8 (2023)
On-Road Vehicles	4.36 (2023)	1.07 (2021)	0.01 (2021)	0.04 (2021)	0.03 (2021)
Fugitive Emissions	—	—	—	125.11 (2023)	16.55 (2023)
Crushing Operations	—	—	—	0.66 (2023)	0.09 (2023)
Concrete Batch Plants	—	—	—	4.75 (2023)	1.05 (2023)
Total	24.26	104.57	3.01	134.46	21.52

1 Worst-case year presented following tons per year value.
CO = carbon monoxide
NO_x = oxides of nitrogen
$PM_{2.5}$ = particulate matter less than 2.5 microns in diameter
PM_{10} = particulate matter less than 10 microns in diameter
SO_2 = sulfur oxide
tpy = tons per year

Table 64:
Total Annual Average Construction Emissions

Emission Sources	CO (tpy)	NO_X (tpy)	SO_2 (tpy)	PM_{10} (tpy)	$PM_{2.5}$ (tpy)
Construction Equipment	12.7	45.7	0.5	1.9	1.9
On-Road Vehicles	2.74	0.56	0.004	0.02	0.02
Fugitive Emissions	—	—	—	93.61	12.36
Crushing Operations	—	—	—	0.25	0.03

Table 64:
Total Annual Average Construction Emissions

Emission Sources	CO (tpy)	NO_X (tpy)	SO_2 (tpy)	PM_{10} (tpy)	$PM_{2.5}$ (tpy)
Concrete Batch Plants	—	—	—	1.26	0.28
Total	15.44	46.26	0.504	97.04	14.59

CO = carbon monoxide
NO_x = oxides of nitrogen
$PM_{2.5}$ = particulate matter less than 2.5 microns in diameter
PM_{10} = particulate matter less than 10 microns in diameter
SO_2 = sulfur oxide
tpy = tons per year

As indicated above in Section 8-507.D.7.b.v.C and supported by the analysis in Exhibit 14, the air quality impacts associated with Project construction are anticipated to be short-term and minor, primarily resulting from use of heavy-duty diesel construction equipment and fugitive dust emissions associated with equipment and vehicle travel on unpaved roads, material handling, excavation activities, and wind erosion. To minimize the adverse impacts associated with fugitive dust, including visibility issues, Denver Water will prepare a Fugitive Dust Control Plan that will detail specific BMPs to be implemented to minimize the generation of fugitive dust by Project construction activities. Emission sources during the operational phase of the Project would include exhaust emissions from on-road vehicles associated with operations and maintenance site personnel. The air quality impacts associated with Project operation are anticipated to be comparable to current conditions.

8-507.D.7.b.vi, Environmental Resources and Significant Environmentally Sensitive Factors

8-507.D.7.b.vi.A, Natural Hazards, Public Outdoor Recreation and Open Space, Areas of Geologic, Historic, and Archaeological Importance

8-507.D.7.b.vi.A.1, Potential Natural Hazards

Geologic hazards and mapping are addressed in Section 8-507.D.6.b of this 1041 permit application. Floodplains, flood hazards, and related surface water issues are addressed in Sections 8-507.D.6.a and 8-507.D.7.b.ii. Additional information on natural hazards is included in Exhibit 12. A brief summary is presented below.

The following information and analysis related to geologic hazards (required FERC safety inspections) was gathered for Denver Water's License Amendment Application to the FERC (Exhibit A).

Dam safety analyses are regularly conducted for the existing Gross Dam, as well as routine dam safety inspections coordinated with FERC. Similarly, dam safety inspections and final design analyses will be conducted for an enlarged Gross Reservoir. Where appropriate, general safety features were incorporated into the conceptual dam designs used for this analysis.

Denver Water would design the dam expansion in accordance with the FERC Engineering guidelines for the Evaluation of Hydropower Projects, and the *Colorado Rules and Regulations for Dam Safety and Dam Construction* and current engineering practices. The Project would be subject to a series of design

reviews by several organizations including: Denver Water, the SEO, the FERC Division of Dam Safety and Inspection (D2SI), and an independent Board of Consultants review panel made up of expert dam engineers approved by FERC. These reviews will ensure that the structure is designed and constructed to be safe and structurally sound.

FERC and the SEO conduct annual inspections of the existing Gross Dam and would continue to do so once the reservoir is enlarged. FERC also requires that an Independent Safety Inspection by an outside third-party consultant be conducted every 5 years. Daily inspections will also continue to be conducted at Gross Dam by Denver Water personnel as they are now. Denver Water's Dam Safety staff also conducts a formal inspection of Gross Dam every year, which would continue for the new structure. Denver Water's Manager of Dam Safety conducts periodic spot inspection of the existing facility, which would also continue. Additionally, Denver Water would update its current Emergency Action Plan (EAP), required by FERC and the SEO to minimize the risk of loss of life and property damage, if potential emergency conditions threaten the structural integrity of a dam. The EAP describes procedures to:

- Identify unusual and unlikely conditions that may endanger the dam
- Initiate remedial actions to prevent or minimize the downstream impacts of a dam failure
- Initiate emergency actions to warn downstream residents of impending or actual failure of the dam

The EAP provides a detailed description of the communications protocol such as who needs to be notified and what areas are likely to be flooded, among other details, in the highly unlikely event of a dam failure. Plan participants include the Boulder County Office of Emergency Management, Boulder County Sheriff, Boulder police and fire departments, Lafayette police department, Colorado State Police, State of Colorado Division of Emergency Management, National Weather Service, and many others. This plan is exercised yearly and a formal tabletop and functional exercise is conducted with downstream emergency personnel every 5 years.

8-507.D.7.b.vi.A.2, Public Outdoor Recreation and Open Space Areas

Figure 20 in Exhibit 1, Public Outdoor Recreation and Open Space Areas Map—Recreation Resources, includes a map of recreation areas and open space areas in Boulder County. Figure 13-2 in Exhibit 1, Recreation Areas at Gross Reservoir provides a map of recreation areas in the Project area. Pursuant to FERC Order Paragraph N and FERC Article 416, an updated Recreation Management Plan developed with consultation with certain governmental stakeholder (including Boulder County) will be filed with FERC within one year of FERC's Order.

The following recreation information and analysis were gathered for preparation of Denver Water's License Amendment Application to the FERC (Section 3.3.15).

AFFECTED ENVIRONMENT (RECREATION)

Gross Reservoir

Gross Reservoir is located in Boulder County north of the unincorporated communities of Wondervu and Miramonte. Lands within the Project area are owned by Denver Water and the USFS. The Roosevelt National Forest administrative boundary bisects Gross Reservoir north to south, and land management within the Project area is the responsibility of the USFS and Denver Water; however, recreational activities on NFS lands at Gross Reservoir are managed by Denver Water.

The Project area is bounded on the west by NFS lands and on the east by Boulder County Open Space's Walker Ranch Park. Private lands are located adjacent to the northeast and southern boundaries. The Boulder County Sheriffs' office provides law enforcement at the reservoir through a contract with Denver Water; CPW manages the fishery at the reservoir and on South Boulder Creek.

Currently, Gross Reservoir has a surface area of 418 acres and 11 miles of shoreline that offer numerous year-round outdoor recreational opportunities. Recreational opportunities at Gross Reservoir include: non-motorized boating, fishing, hiking, picnicking, bicycling, camping, ice fishing, horseback riding, off-highway vehicle (OHV) riding, 4-wheel driving, and sightseeing. In general, wildlife is an important aspect of the recreational experience at Gross Reservoir. For example, bird and wildlife viewing is a popular activity, as well as hunting for deer, elk and turkey on NFS lands west of Gross Reservoir. Because Gross Reservoir provides drinking water to the Denver Metropolitan Area, no body contact, such as wading or swimming, is allowed in the water.

Until recently, no boating of any kind was permitted on the reservoir. However, as a condition of FERC relicensing, beginning in 2005, non-motorized car-top boating is allowed from Memorial Day through September 30. Additionally, the Gross Reservoir *Recreation Management Plan* is being implemented throughout the existing FERC Project Boundary, and facility improvements to all recreational areas are ongoing.

Past Denver Water surveys indicate that Gross Reservoir's most desirable attributes are its feeling of remoteness, the lack of man-made structures and human intervention, and other scenery-related attributes and activities such as sightseeing and wildlife viewing.

There are nine designated recreation sites at Gross Reservoir: North Shore Recreation Area, Peninsula Recreation Area, Dam Recreation Area, South Boulder Creek Outlet, Haul Road/Osprey Recreation Area, South Boulder Creek Inlet, Winiger Gulch Inlet, Winiger Ridge Access and Recreation Area, and Rocky Point/Jumping Rock. The existing recreation sites are depicted in Exhibit 1, Figure 13-2, and existing facilities and recreational opportunities at these sites are indicated in Table 65.

Table 65:
Existing Recreation Facilities at Gross Reservoir

Site	Facility
North Shore Recreation Area	• 40 parking spaces (2 ADA-accessible) • 15 dispersed formal and informal picnic sites • Renovated picnic shelter • 2 permanent pit toilets • Trail from North Shore to Rocky Point • Gated emergency and service access road • Disabled access from parking lot to picnic shelter • Hiking access • Improved trail from parking area to peninsula area • Formalized overlooks
Peninsula Recreation Area	• Day use picnic sites (10 developed sites and 2 group sites) • Fishing access • Boating access • Hiking access • Trail connections • Restroom facilities • Revegetation
Dam Recreation Area	• 38-car parking lot (with parking drop off and turn around and ADA access) • Trail connections • Revegetation • 2 permanent pit toilets • Overlook • Interpretive signage • Renovated picnic shelter • Fishing and hiking access • Day use picnic sites (20 developed sites and 3 group sites) • Restroom facilities
South Boulder Creek Outlet	• 10 parking spaces/picnic tables • Trail access for kayak put-in and fishing
Haul Road/Osprey Recreation Area	• 20-car parking lot (with parking drop off and turn around and ADA access) • Day use picnic sites (10 developed sites and 2 group sites) • Fishing, boating, and hiking access • 2 permanent pit toilets • Trail connections • Revegetation • Signage
South Boulder Creek Inlet	• Trail access from Haul Road Recreation Area • Parking (at Haul Road)
Winiger Gulch Inlet	• 4-wheel driving, hiking, biking, fishing, and equestrian access • Trailhead and connection to Forsythe Creek • 10 camping sites • Boat access
Winiger Ridge Access and Recreation Area	• 4-wheel driving, hiking, biking, fishing, and equestrian access • Trailhead and connection to Forsythe Creek • 11 camping sites • Boat access • Roads closed to motorized use • 10 parking spaces, including 2 for horse trailers

Table 65:
Existing Recreation Facilities at Gross Reservoir

Site	Facility
Rocky Point	• Trail from North Shore to Rocky Point • Hiking and fishing access

Source: Denver Water (2004) , see Final EIS for reference materials.
Notes:
Existing conditions were verified during EDAW fieldwork on September 16 and September 28, 2005.
ADA = Americans with Disabilities Act
FERC = Federal Energy Regulatory Commission

NFS Lands and Roads

NFS lands in the Project area are managed under the “roaded natural” and “semi-primitive motorized” recreation opportunity spectrum classes. Human evidence in roaded natural classes are characterized by a natural setting that may have modifications that range from being easily noticed to strongly dominant to observers within the area. However, from sensitive travel routes and use areas these alterations would remain unnoticed or visually subordinate. There is strong evidence of designed roads and/or highways. However, structures, such as utility corridors, microwave installations, and similar facilities, are generally scattered, remaining visually subordinate or unnoticed to the sensitive travel route observer. Frequency of contact is moderate to high on roads and low to moderate on trails and away from roads. On-site regimentation management and controls are noticeable but harmonize with the natural environment. There are no criteria for remoteness or size in the roaded natural classification (Recreation Opportunity Spectrum 2007, see Final EIS for reference materials).

The semi-primitive motorized classes contain open primitive roads that are not maintained for the use of standard passenger-type vehicles but rather for OHVs and high-clearance vehicles. These open roads generally consist of tracks, ruts, or ungraded rocky-rough surfaces that are not drained. The semi-primitive motorized classes are typically 2,500 acres or more in size but may be smaller if the area contains private lands that make a logical unit. Human evidence in these classes is characterized by a natural setting that may have moderately dominant alterations but would not draw the attention of motorized observers on trails and primitive roads within the area. Any closed improved roads must be managed to revegetate and harmonize with the natural environment.

There is strong evidence of primitive roads and the motorized use of trails and primitive roads at Gross Reservoir. Structures are rare and isolated; there are typically no transmission lines present in the semi-primitive motorized classes. Visitor management tools and controls such as parking facilities, physical barriers, signage, and information kiosks are obvious: control facilities such as parking areas, barriers, and signs harmonize with the natural environment, and visitor information facilities are not elaborate or complex.

Users should encounter fewer than 20 other parties per day on trails and in dispersed areas during at least 80 percent of the primary use season. Users may meet numerous other parties on roads and at developed recreation sites; developed sites often are at full capacity but do not exceed 80 percent of the

design capacity over the season of operation (Recreation Opportunity Spectrum 2007, see Final EIS for reference materials).

Recreation at Gross Reservoir

Access to recreation areas on the north side of Gross Reservoir is provided primarily from Flagstaff Road, also known as CR 77. Access to recreation areas on the south side is provided primarily from Boulder by CR 77S, also known as Gross Dam Road.

Forest Road (FR) 359, a high-clearance vehicle roadway, runs from its intersection with Boulder CR 68 to the shoreline at Winiger Ridge. Access along this road is restricted from December through May to protect elk winter range. Winiger Gulch Inlet can be accessed through NFS lands via Boulder CR 97E; this road is closed to motorized vehicles at the USFS boundary but is open to foot, bicycle, and equestrian use. The Forsythe Canyon Trail begins approximately 0.5 mile down FR 359 and follows Forsythe Creek down wooded, rocky Forsythe Canyon to the reservoir shoreline. In the spring, the small creek forms a small, picturesque, cascading waterfall (Forsythe Falls) that is a popular hiking destination.

Walker Ranch Park

Walker Ranch Park consists of 3,778 acres open to the public and managed by the Boulder County Department of Parks and Open Space. Recreational opportunities include fishing on South Boulder Creek and more than 12 miles of multi-use trails for hiking, mountain biking, and equestrian use. Picnic facilities are available at both the Flagstaff Road and Pica Road trailheads (Boulder County 2005a, see Final EIS for reference materials). Visitation to Walker Ranch Park is counted at both the Walker Ranch Loop trailhead and the Meyers-Homestead Loop trailhead. In 2005, approximately 25,000 visitors were counted on the Walker Ranch Loop and 24,000 visitors were counted on the Meyers-Homestead Loop (Bauer 2006, see Final EIS for reference materials). No other visitation use data are available for this area.

South Boulder Creek

South Boulder Creek offers a variety of recreational opportunities, including fishing and kayaking from the East Portal of the Moffat Tunnel to Gross Reservoir and from Gross Reservoir to the South Boulder Diversion Canal. Fishing on both sections is good and is moderately popular with anglers but is not considered heavy. Use is heavier in the spring and summer than in fall and winter (Kohler 2006, see Final EIS for reference materials). A typical weekend day during the peak fishing season between spring runoff and fall may see between 12 and 24 anglers in both sections, while a typical weekday during the same period may see anywhere between 6 and 12 anglers on both sections (Rocky Mountain Anglers 2005, see Final EIS for reference materials).

Kayaking is a popular activity on South Boulder Creek due to its proximity to Boulder and other Front Range communities. Certain portions of the section above Gross Reservoir are technically challenging due to narrow stream channels and the Creek section above Gross Reservoir can be challenging during spring runoff due to high volumes of water. During the early season, a typical weekend day may see between 10 and 15 private boat paddlers on the Creek section below Gross Reservoir and slightly fewer on the Creek section above the reservoir. A typical weekday evening during the same period may see

approximately five private boat paddlers (American 2005, Boulder County 2005a, see Final EIS for reference materials).

PROJECT EFFECTS (RECREATION)

Pursuant to FERC's Order Paragraph N, within one year of the date of FERC's Order and after conferring with certain governmental stakeholders, including Boulder County, Denver Water must submit revised Recreation Management and Monitoring Plans for FERC's review and approval. Denver Water will provide the draft Plans to Boulder County for review and comment in accordance with the terms of FERC's Order.

This section evaluates the potential impacts of implementing the Project on recreational use that would occur under the Project. A number of analysis methods were used to assess how the Project would impact recreation, including field assessments and observations, in-person and telephone interviews with recreation users and agency personnel, research and review of optimal recreation use conditions, and literature reviews.

Because changes in stream flows in South Boulder Creek both above and below Gross Reservoir would occur as a result of the Project, boating and fishing in these stream reaches were evaluated.

Gross Reservoir

The Project would result in direct and indirect impacts on both current and future recreational opportunities at Gross Reservoir. The acreage estimates for Gross Reservoir assume disturbance between the current reservoir pool elevation (7,282 feet) and elevation 7,410 feet. This includes disturbance associated with the expanded reservoir including the Environmental Pool for mitigation . All impacts to recreational uses would be temporary but the Corps considered to be major and would last for the duration of the construction period, which is anticipated to be approximately 5.5 years including offsite and ancillary improvements to support the dam construction.

Of the nine designated recreation sites at Gross Reservoir (see Exhibit 1, Figure 13-2 and Table 65), three serve as the primary recreation areas and access points for on-water use, such as car-top boating, including:

- Dam Recreation Area and Haul Road—Site access in this area would be temporarily and directly impacted by dam construction activities. Denver Water would completely close the area during construction. The Corps considered this to be a temporary major impact.
- Haul Road/Osprey Recreation Area—Site access in this area would be temporarily and directly impacted by dam construction activities. Denver Water would completely close the area during construction. The Corps considered this to be a temporary major impact.
- Peninsula Recreation Area—The Peninsula Recreation Area would not be disturbed as a result of construction activities, but temporary recreation facilities would be installed. Denver Water anticipates keeping this area open until the final phases of construction when the area would be relocated. The Corps considered this to be a temporary major impact.

The following recreation areas would be affected by construction:

- Dam Recreation Area: The Dam Recreation Area would be closed to the public during construction. The Scenic Overlook at the left abutment is also included in this area and would be permanently closed during construction for safety purposes to prevent public access to the area above the left abutment during construction. Recreation at the right abutment will be restored following construction completion as shown in the Addendum to the Recreation Management Plan (RMP) included in Denver Water's License Amendment Application to the FERC.
- Haul Road/Osprey Recreation Area: The Haul Road Recreation Area would be closed to the public during construction including access to the Inlet Trail. Recreation in this area would be restored following construction completion as shown in the Addendum to the RMP. Based on the areas affected during construction, four recreation activities would be affected during Project construction activities: (1) paddling, and (2) fishing, (3) hiking, and (4) access to site picnic areas, restrooms, and shelters. Paddling would be affected as the current boat launch area would be inaccessible due to the development of the Osprey Point Quarry. As noted elsewhere in this document, boating access will be facilitated through the Peninsula Recreation area near the North Shore. Fishing would be affected for the same reason as some anglers access the water using watercraft. Shore fishing would still be available for most areas of the reservoir. Hiking at the South Boulder Creek Inlet Trail would also be inaccessible due to the development of the Osprey Point Quarry. Access to site picnic areas (mostly located near the dam) would be affected due to construction activities at the south shore of the dam. Fencing and signage would be provided to prevent public access to areas closed for construction. Fencing designs and locations would be provided in the Security Design. Once construction activities are complete, access to these recreation amenities will be restored.

Post-construction, seven of the nine recreation areas (see Exhibit 1, Figure 13-2 and Table 65), would be inundated under the Project, which would result in moderate temporary impact to recreation. These facilities include:

- Dam Recreation Area
- Haul Road/Osprey Recreation Area
- Peninsula Recreation Area/trails below North Shore picnic areas
- Rocky Point
- South Boulder Creek Inlet
- Winiger Gulch Inlet
- Winiger Ridge Access and Recreation Area

All inundated recreation facilities at these locations would be relocated to sites above the new normal water line (7,406 ft) to allow for the continuation of their current uses. Relocation would occur sometime during the construction period. It is not known at this time exactly when relocations would occur, but Denver Water expects that the relocations would be completed during the final clean-up and restoration phases of construction. While portions of Rocky Point, Winiger Gulch Inlet, Winiger Ridge, and South Boulder Creek Inlet recreation areas would also be inundated, relocation of facilities would be minor, consisting mainly of trail realignments.

Note that the Project would not result in permanent impacts to the recreation facilities and use areas at the South Boulder Creek Outlet, the upper portions of the Winiger Ridge Access and Recreation Area, and the majority of the North Shore Recreation Area.

Under the Project, approximately 280 acres of NFS land would be inundated, which would include inundation of Forsythe Falls, which is located at the terminus of Forsyth Canyon off the northern arm of Gross Reservoir. The trailhead and most of the trail would be unimpacted by the expansion. The Corps considered the inundation of Forsythe Falls to be a major long-term impact. Nonetheless, the trailhead, trail, and ability to access the reservoir would still be available post-project.

The FERC relicensing effort at Gross Reservoir in 1999 resulted in a new license issued in 2001, which mandated the development of a *Recreation Management Plan* (Article 416) and is the plan currently being implemented at Gross Reservoir. As part of this management plan, upgrades and improvements of various recreation sites have been ongoing. Prior to inundation, many of these facilities would need to be relocated and completed above the new normal water line. Denver Water will develop an addendum to the Recreation Management Plan per the FERC Order for the relocation of recreation facilities needed as a result of inundation. Each relocated recreation area would provide for the specific opportunities and facilities outlined in the *Recreation Management Plan* for the 2001 license.

Vehicle access to Gross Reservoir would remain open during the construction period; however, various road segments would be temporarily closed for safety reasons. Denver Water intends to keep recreational facilities open as much as possible during construction without compromising public safety or construction progress. Certain areas would be restricted or temporarily closed during construction activities and tree removal. The picnic areas at the Dam Recreation Area would be closed during most of the construction period due to their close proximity to the dam, and the Haul Road Recreation Area would be closed during construction due to its proximity to the quarry site and spoil areas. All recreation areas could be temporarily affected during tree removal activities.

The plan for removal, storage, and relocation is summarized for each recreation area below:

- North Shore Picnic Area: No changes.
- Peninsula Recreation Area: The recreation facilities would remain in place for use during construction. Improvements to the area would likely include 20 parking spaces near the existing restroom and a boat access trail to the west. Following completion of the dam raise, all facilities would be removed as they would be inundated by the new reservoir level. Vault toilets would be inundated by the raised reservoir and would need to be properly abandoned and demolished.
- Scenic Overlook Area: The recreation facilities at the Scenic Overlook would need to be removed and relocated during construction. Signage notifying the public of the closure of this facility would be provided. If the two picnic tables at the Scenic Overlook meet accessibility requirements, they can be relocated to the Northern Dam Viewpoint.
- Northern Dam Viewpoint: New facilities at the Northern Dam Viewpoint would be constructed as part of the construction activities. The Northern Dam Viewpoint would likely have 8 parking spaces, 4 individual picnic sites, and 2 group shelters. Picnic facilities from locations closed during construction may be moved to this viewpoint if they meet accessibility requirements. Currently, Denver Water

envisions fifty percent reuse/relocation of picnic facilities to this area and fifty percent new facilities. New lockable charcoal grills and bear proof trash receptacles would be purchased for each picnic location and vault toilets would need to be installed near the parking lot.

- Dam & Haul Road Recreation Area: These recreation facilities would be closed during construction. The picnic facilities would need to be removed and stored during construction. The vault toilets would be inundated by the raised reservoir and would need to be properly abandoned and demolished. New picnic facilities would be developed as part of permanent recreation facilities at the raised reservoir shoreline and may utilize the stored equipment.

Other potential impacts to recreation and access may occur along SH 72 in Coal Creek Canyon between SH 93 and the western portion of Gross Dam Road, which would be utilized as the cement and fly ash material haul route for dam construction material. As such, the presence of additional heavy truck traffic may present a temporary moderate adverse impact on the recreational experience and on the safety of road bicyclists who utilize this road.

Other impacts of an enlarged Gross Reservoir include indirect minor beneficial impacts resulting from the creation of additional recreational opportunities due to an enlarged reservoir surface and extended shoreline. At the anticipated normal water elevation of 7,406 feet, an enlarged Gross Reservoir is anticipated to have a surface area of approximately 842 acres. This represents an additional 424 acres, approximately doubling the existing surface area of the reservoir. Prior to 2005, no water boating was permitted at the reservoir, but, per the current Gross Reservoir *Recreation Management Plan*, car-top boating is allowed from Memorial Day through the end of September. Enlarging the surface area of the reservoir would provide a substantial amount of additional space on which people can recreate via car-top boating.

Reservoir expansion would also create additional shoreline. At the anticipated normal water elevation of 7,406 feet, the reservoir would gain an additional 2.8 miles of shoreline, for a total of 13.9 miles. The additional shoreline may provide more dispersed shoreline recreational opportunities, such as additional fishing access, and would be a beneficial minor long-term impact.

It is possible that the additional recreational opportunities created as a result of an enlarged reservoir may result in some increased use. A larger reservoir with increased boating opportunities and additional fishing access may broaden its appeal to recreationists in the area. However, continuing seasonal water level fluctuations and other operating conditions are expected to make the reservoir no more attractive for boating and other recreational uses than it currently is. As a result, the Project is not anticipated to result in a substantial increase in use, and negative impacts to the recreation experience that might result from any such increase in use should be offset by the larger area available for this type of dispersed recreation. Beyond the developed recreation areas defined in the current Gross Reservoir *Recreation Management Plan*, no additional developed recreation sites are proposed.

Overall, these operational modifications, including increased storage levels, are not expected to notably change the seasonal pattern of filling and drawdown that already occurs. Therefore, operations of Gross Reservoir are not anticipated to have an impact on recreational use at Gross Reservoir.

Temporary impacts to recreational activity due to construction at Gross Reservoir may conflict with the recreational guidelines, goals, or objectives identified in the ARNF LRMP (USFS 1997b, see Final EIS for reference materials). However, because recreational use at the enlarged Gross Reservoir would only minimally vary from current levels and types, no long-term conflicts with the recreational guidelines, goals, or objectives identified in the ARNF LRMP or with the Boulder County Comprehensive Plan are expected.

South Boulder Creek

Recreational opportunities on stream segments affected by the Project could result from changes in stream flow. These recreational opportunities include water-dependent activities such as boating and fishing.

Segments of South Boulder Creek above and below Gross Reservoir receive some use by expert kayakers able to handle the Class IV+ whitewater that occurs in these portions of the stream. Flows above Gross Reservoir would increase as a result of the Project with flow increases during higher flow months (May through July) ranging from 7 to 17 percent. Immediately below Gross Reservoir, flows would decrease by 11 to 27 percent during higher flow months (May through July). Farther downstream, the degree of flow change would diminish, dropping to 5 percent or less. Although these flow changes would have an impact to boating during the peak summer season, the impact would be negligible.

The upper section of South Boulder Creek (Pinecliffe to Gross Reservoir) would be affected by the Project through increased flows, primarily during the summer months, with the greatest change occurring in June when average monthly flows would increase by 16 percent. Although the number of days with very high flows would increase during June, possibly curtailing use on some days by all but the most expert of boaters, the overall impact would be to shift use to periods later in the season. Increased flows in July and later in the summer would extend the boating season on this segment and would, therefore, not result in a loss of boating opportunities. The overall impact on boating resulting from increased flows would be minor to moderate and beneficial. Additionally, it is important to note that the peak flow would not increase as a result of the Project, rather higher flows would be present for an extended period.

Although higher flows would be present for an extended period in the section of South Boulder Creek above Gross Reservoir, due to the Project expansion of Gross Reservoir, approximately 0.47 mile of South Boulder Creek upstream of Gross Reservoir would be inundated. This stretch of South Boulder Creek is the lower end of a popular recreational whitewater kayaking run known as the RIMBY (Right In My Backyard) rapid. This section is renowned on the Front Range as one of the few challenging runs for whitewater boaters and is especially attractive due to its proximity to the Front Range. While the Corps considered inundation of this stretch to be a major long-term impact, the ability to float this section of South Boulder Creek will still be available, and depending on the reservoir elevation, a portion of the RIMBY rapid may be available for use. Additionally, the ability to access the reservoir via South Boulder Creek would still be available post-project.

The lower section of South Boulder Creek (Gross Reservoir through Eldorado Canyon) is an expert kayak run that would be influenced by the Project. The impact of the modest decrease in flows between Gross Reservoir and the South Boulder Creek Diversion Canal during higher flow months (May through July) on boating is expected to be negligible. Overall, the Environmental Pool would have a minor adverse impact

to recreation, specifically kayaking on South Boulder Creek below Gross Reservoir, by contributing to reduced summer flows. No other recreational impacts, adverse or beneficial, are expected as a result of the additional Environmental Pool at Gross Reservoir.

Minor adverse effects on the quality of fishing along portions of upper South Boulder Creek from the Moffat Tunnel to Gross Reservoir are expected as a result of implementation of the Project. Reductions in habitat availability for adult brook trout and rainbow trout in this reach may adversely impact fish populations. A potential reduction in fish populations would have a minor negative impact on the quality of the fishing experience in this stream reach.

There may be a minor beneficial effect on the quality of fishing on South Boulder Creek below Gross Reservoir as a result of higher-density fish populations. Increases in habitat availability for rainbow trout due to reduced flows during runoff, particularly during the peak runoff month of June, and increased flows during winter months would tend to provide more favorable conditions for fish and, thus, larger fish populations. Thus, flow reductions during periods of high flow and increased flows during the winter may provide a minor beneficial impact on the fishing experience in this stream reach.

Summary

The upper section of South Boulder Creek (Pinecliffe to Gross Reservoir) would be affected by the Project through increased flows, primarily during the summer months, with the greatest change occurring in June when average monthly flows would increase by 20 percent. Although the number of days with very high flows would increase during June, possibly curtailing use on some days by all but the most expert of boaters, the overall impacts would be to shift use to periods later in the season. Increased flows in July and later in the summer would extend the boating season on this segment and would, therefore, not result in a loss of boating opportunities. Impacts on boating resulting from increased flows would be minor to moderate and would be beneficial.

The lower section of South Boulder Creek (Gross Reservoir to the South Boulder Creek Diversion Canal) would be affected by the Project through decreased flows, particularly during the peak summer season. Impacts of the modest decrease in flows during higher flow months (May through July) on boating would be negligible.

Minor adverse effects on the quality of fishing along South Boulder Creek above Gross Reservoir as a result of implementing the Project are expected. Reductions in habitat availability for adult brook trout and rainbow trout in this stream reach due to increased flows may adversely impact fish populations. A potential reduction in fish populations would create a negative impact on the quality of the fishing experience in this stream reach.

Minor beneficial effects on the quality of fishing in South Boulder Creek below Gross Reservoir due to the Project are expected. Decreases in flows during peak runoff and increases in flows during winter months provide more favorable conditions for fish and may positively impact fish populations. A potential increase in fish populations would create a minor beneficial impact on the quality of the fishing experience in this stream reach.

Conclusions supported by the FERC in its review of the Project impacts related to recreation and open space (Final SEA, Section 5.1.7) were as follows.

> *The 2014 Final EIS determined that there would be temporary effects on recreation associated with Denver Water's proposal to raise Gross Dam and enlarge Gross Reservoir primarily because of inundation at six of the nine recreation access sites required by the approved Article 416 RMP.*
>
> *In Appendix M-2, the Final EIS found that proposed operation of the Environmental Pool would have a minor adverse effect on recreation, specifically kayaking, on South Boulder Creek, through periods of reduced flows. Flows are projected to decrease by as much as 12 cfs at both the outflow from Gross Reservoir and at the Eldorado gage in May with operation of the Environmental Pool. May is a primary use period for kayaking along South Boulder Creek, and the optimum flow range for kayaking is 150 to 300 cfs. A reduction of 12 cfs would reduce flows from 148 cfs under the proposed action [the Project] without the Environmental Pool to 136 cfs with the Environmental Pool.*
>
> *The Final EIS evaluated the effects of inundation and relocation of six of the nine license-required recreation sites, and the expanded surface area and shorelines around the reservoir available for recreation. As Denver Water explains in its license amendment application, it would relocate all facilities within the Dam Recreation Area, Haul Road Recreation Area, and Peninsula Recreation Area. Denver Water would relocate some of the facilities at Winiger Gulch Inlet, Winiger Ridge Access and Recreation Area, and South Boulder Creek Inlet to higher elevations in close proximity to the existing locations because portions of the facilities would be inundated by enlargement of the reservoir.*
>
> *Denver Water would also construct two new areas: Scenic Ridge Trail and Upper Viewshed Trail. The existing North Shore Recreation Area and South Boulder Creek Recreation Access (Outlet) would not be affected.*

MITIGATION (RECREATION)

Mitigation measures related to recreation were addressed in Denver Water's License Amendment Application to the FERC (Table 5.1-1) in Exhibit 5.

Per the existing FERC License Article 416 and the Addendum to the Recreation Management Plan and USFS Section 4(e) Condition 24 (Recreation Management) from the Denver Water/USFS Settlement Agreement: Denver Water will relocate those recreation facilities above the new normal water line of Gross Reservoir. Any existing or planned trails that will be affected by construction activities will be replaced in-kind. Recreation opportunities will be unchanged under the RMP.

Per the mitigation required by the FERC in the amended License, Denver Water intends to keep recreation facilities open as much as possible during construction without compromising public safety or construction progress. Denver Water will post notices about temporary restrictions and closures. Emergency access to Gross Reservoir will be maintained at all times.

To enable the general public to continue to enjoy leisure activities at Gross Reservoir while construction is occurring Denver Water is planning additional locations where temporary recreation improvements will be provided. The Peninsula Recreation Area which will be modified with improvements that will include the addition of a boat ramp and associated parking to temporarily replace the Haul Road/Osprey facilities which will be closed for quarry development.

Two floating barriers are planned across the reservoir. The barriers will be used to restrict public access, while on the reservoir, to the upstream face of the dam and to deter people from getting close to the Osprey Point Quarry where blasting will be used regularly to mine the bedrock.

A conceptual signage plan has been developed to provide clear notice of the closure of existing facilities on the south shore during construction and guidance to the new facilities for recreation. The plan will be coordinated with Denver Water's Public Affairs Department.

The temporary recreation improvements at the Peninsula Recreation Area include additional parking and is currently envisioned to provide enough room for 20 parking spaces just north of the existing restroom facilities. Gravel surfacing will be provided after clearing, grubbing, and grading of the area.

Temporary access for watercraft will be located along the west shore at the Peninsula Recreation Area to encourage access to the reservoir away from construction activities, which include the potential for a spoils pile to the east. Some minor grading and surfacing material will be placed to provide a safe boat trail for foot access to the reservoir during construction of the dam raise for paddling and fishing activities. The boat access trail will be about 5 feet wide and will extend as close as practical to elevation 7,250 ft, depending on the reservoir elevation during site development construction activities. If water levels during construction are lower, modifications may be needed, however the basic path will provide flexibility for access with fluctuating reservoir levels.

The Northern Dam Viewpoint will be located above the left abutment. The improvements will likely include an 8-space public parking lot with two ADA accessible spaces, a restroom, two group picnic sites, four individual picnic sites, a scenic overlook, and improved hiking trails to connect the site features.

The layout of the facilities will use site reconnaissance and aerial imagery to avoid large vegetation to reduce the disturbance of the natural environment. Additionally, the Forest Service Outdoor Recreation Accessibility Guidelines have been incorporated into the design of this area to the extent practicable for the layout of trails and picnic areas. Currently, the design meets the accessibility criteria for all areas except the southern-most trail loop and picnic area, which is situated in steeper terrain. It is not practical to regrade this portion of trail to meet accessibility criteria when considering the resulting impacts to the natural environment. Signage will be provided at the trail junctions to provide warning of steeper grades.

The FERC analysis evaluated the effects of all mitigation measures (Final SEA, page A-19) and concluded the following.

> *Condition No. 24-Recreation Management (REPLACES CONDITION 106; Complements existing Article 416)*

Licensee [Denver Water] shall implement the Addendum to the existing Recreation Management Plan under Article 416, submitted with the Final License Amendment Application. The Licensee [Denver Water] shall also implement the following recreation management measures:

Human/Bear Interaction Management-Beginning on the effective date of the amended license, Licensee [Denver Water] shall manage activities to minimize the potential for bear/human interactions as needed within the FERC Project Boundary on NFS land. If unwanted bear/human interactions are reported, Licensee [Denver Water] shall consult with the Forest Service and Colorado Parks and Wildlife and implement appropriate mitigation measures. These measures are subject to Forest Service approval. Potential measures could include, but are not limited to, activities such as trash management, signing to inform workers and visitors on bear activity, and proper behavior to reduce potential for attracting bears.

Recreation Use Monitoring—For the first three years after the expanded Gross Reservoir is full, Licensee [Denver Water] shall annually submit recreation use monitoring data spreadsheets to the Forest Service by February 28. At the end of the first three years, the Licensee [Denver Water] shall submit a recreation use monitoring report to the Forest Service using the data from the previous three years. Thereafter, the Licensee [Denver Water] shall provide the recreation use monitoring report to the Forest Service every three years. On the sixth year the report will include the Form 80 report, which is also submitted to FERC. The recreation use monitoring report shall provide a summary of annual monitoring conducted by year, a summary of the annual data collected, and a tabulation and summary of the data and monitoring practices required in the approved Recreation Monitoring Plan (FERC Order issued June 8, 2004).

In addition to the above, for NFS land in the Winiger Ridge area within the FERC Project Boundary, the recreation use monitoring report shall include those items specified or required by the Forest Service, which include but are not limited to, Frissell condition class of dispersed campsites, documentation of any reported social use conflicts, and any environmental damage caused by dispersed recreation. This information will be used to determine patterns in dispersed recreation use after reservoir inundation and to evaluate the need for additional recreation mitigation measures.

The Forest Service monitoring requirements described above can be changed upon mutual agreement of the Forest Service and Licensee [Denver Water]. If the Forest Service and Licensee [Denver Water] agree to change the monitoring requirements, the Licensee [Denver Water] shall submit an update to the requirements with the Commission.

Costs for recreation use monitoring conducted by the Forest Service in the Winiger Ridge area outside the FERC Project Boundary is included in the Collection Agreement under Condition 30.

Dispersed Recreation Management at Winiger Ridge- Beginning on the effective date of the amended license, Licensee [Denver Water] shall conduct a pre-construction inventory of all social trails and roads at Winiger Ridge within the FERC Project Boundary as specified or approved by the Forest Service. Within three years after the expanded Gross Reservoir is full, and, at

minimum, every three years thereafter, the Licensee [Denver Water] shall consult with the Forest Service and the Forest Service will determine if there is a need to implement additional recreation management measures to meet Forest Plan direction.

If the Forest Service determines there is a need for additional mitigation measures due to Project-related effects to meet Forest Plan direction, based on pre-construction inventory results, the new inundation level of the expanded Gross Reservoir, and the ongoing recreation monitoring, the Licensee [Denver Water] shall develop a Recreation Adaptive Management Plan for Winiger Ridge. The [Recreation Adaptive Management] Plan shall be developed in consultation with the Forest Service and is subject to prior Forest Service review and approval. The Licensee [Denver Water] shall file the Recreation Adaptive Management Plan with the Commission. Upon Commission approval, the Licensee [Denver Water] shall implement the [Recreation Adaptive Management] Plan.

The [Recreation Adaptive Management] Plan shall include, but not be limited to, unless otherwise agreed to by the Forest Service:

- *Measures for addressing social, environmental, safety, and/or sanitation concerns that may arise from the proliferation and/or expansion of dispersed campsites at Winiger Ridge and surrounding area. These measures could include triggers for adding bathrooms, trash receptacles or other temporary or long-term mitigation measures as determined necessary by the Forest Service.*
- *Plans for converting obsolete roads to trails.*
- *Plans for formalizing social trails, including social trails for fishing.*
- *Measures for minimizing creation of new social trails.*
- *Fishing Line Recycling. Licensee [Denver Water] shall provide fishing line recycling receptacles at five relocated fishing access points, as described in the Recreation Plan Addendum, for collecting used line to keep it out of the environment. Receptacles shall include labels explaining their purpose to encourage use. Licensee [Denver Water] shall monitor and empty the receptacles as needed, and at a minimum on a monthly basis from May to November, and one time from December to April. Licensee [Denver Water] shall periodically send line for recycling to a fishing line recycling program.*

8-507.D.7.b.vi.A.3, Unique Areas of Geologic, Historic, and Archaeological Importance

Geologic Resources

Figure 24 in Exhibit 1, View Protection Corridors Map, maps Natural Landmarks and Natural Areas from the Boulder County Comprehensive Plan. Geologic features noted on this map in the area of Gross Reservoir include Winiger Ridge (#26 on map).

Cultural Resources

The Project is not located in Historical and Archeological Resource Areas of Statewide Importance or an Archaeologically Sensitive Area as identified in the Boulder County Comprehensive Plan (see Figure 8 in Exhibit 1).

Denver Water has conducted cultural resources surveys for the Area of Potential Effects (APE) of the Project. A Programmatic Agreement (PA) for cultural resources has been developed that stipulates how significant cultural resources are to be treated, including avoidance or protection measures and data recovery, and the actions that would need to be taken by Denver Water in the event that inadvertent discoveries of cultural resources or human remains are made during construction or operation. Denver Water has entered into a Memorandum of Agreement (MOA) with the FERC and the SHPO that will require Denver Water to develop and implement a Historic Properties Management Plan (HPMP) that manages and protects cultural resources identified in the PA for the term of the hydropower license. The PAs are included in this 1041 permit application as Exhibit 7.

The following information and analysis were gathered for Denver Water's License Amendment Application to the FERC (Section 1.3.5):

> *For the Moffat Collection System Project [the Project], the Corps prepared a Programmatic Agreement (PA) for cultural resources that stipulates how significant cultural resources are to be treated, including site avoidance or protection measures and data recovery. The PA also identifies the actions that would need to be taken by Denver Water in the event that inadvertent discoveries of cultural resources or human remains are made during construction or operation of the Moffat Collection System Project. The PA was prepared with participation or review by Denver Water, the Colorado State Historic Preservation Officer (SHPO), the Advisory Council on Historic Properties, the USFS, the Boulder County Historic Preservation Advisory Board, and various American Indian Tribes.*
>
> *For the Proposed Project, Denver Water will also enter into a Memorandum of Agreement (MOA) with the FERC and the SHPO that will require Denver Water to develop and implement a Historic Properties Management Plan (HPMP) that manages and protects cultural resources identified in the PA for the term of the hydropower license. The HPMP will include requirements for: 1) notifying the FERC in the case of unanticipated discoveries, 2) procedures to be followed in the event of an emergency at the Project, and 3) reporting requirements for informing the FERC of the execution of the treatment plan developed in accordance with the PA for the Proposed Project's adverse effects to the two historic properties identified in Section 3.3.18. The executed MOA will be incorporated in the order approving the Proposed Project, and the HPMP will be approved by the Commission before initiation of construction.*

Conclusions supported by the FERC in its review of the Project impacts related to cultural resources (Final SEA, Section 5.1.12) were as follows.

> *The description of cultural resources provided in the Final EIS remains unchanged. The APE for the action consists of the area to be affected by construction activities and highest proposed pool levels, plus a 100-foot buffer zone. The APE was intensively surveyed in 1997 for Denver Water's application for a new license, and a second survey was conducted in 2005 of areas that could be affected by reservoir enlargement that are outside of the relicensing APE (URS 2006). By letter dated January 12, 2007, the Colorado SHPO concurred that only three cultural resources within the APE are eligible for listing in the National Register:*

- *5BL455.2 Denver & Rio Grande Western Railroad Tunnel;*
- *5BL7019.1 Resumption Flume; and*
- *5BL10210 Gross Dam, Reservoir, Construction Features, Access Roads.*

One additional site requires additional field data to determine its eligibility and remains potentially eligible: 5BL4796, Community of Miramonte.

The description of paleontological resources provided in the Final EIS remains unchanged. The paleontological potential of the project area is rated as Class III and is unlikely to contain fossil materials. For this reason, paleontological surveys were not required.

The Final EIS evaluated potential effects of modification of Gross Dam and the enlargement of Gross Reservoir on cultural resources and found that the dam and reservoir itself (5BL10210) and a portion of the Resumption Flume (5BL7019.1) would be adversely affected. To ensure the Commission remains in compliance with Section 106 of the NHPA for the proposed action [the Project], the Commission, in conjunction with Denver Water and Colorado SHPO, developed and executed a PA to take into account the effects of the proposed action [the Project] on these two historic properties and memorialize agreed-upon mitigation for the effects. The Colorado SHPO and Commission are signatories to the PA, and Denver Water, the Corps, and the Forest Service are concurring parties. The executed PA, and its terms, would be incorporated into the project license by the Commission's amendment order. The PA calls for Denver Water to complete HAER documentation of Gross Dam and reservoir and the Resumption Flume before modification.

The Final EIS also found that no other cultural resources would be affected by modification of the dam and enlargement of the reservoir; however, the Final EIS did not assess the effects of other project-related activities on cultural resources, such as ongoing operation and maintenance of the project, public access, and recreation. To that end, in addition to HAER documentation of the dam, reservoir, and Resumption Flume, the PA requires Denver Water to prepare an HPMP for the Gross Hydroelectric Project before beginning any construction activities that would affect the character-defining features that make these properties eligible for listing on the National Register. The HPMP would contain measures for "considering and managing effects on historic properties of activities associated with constructing, operating, and maintaining the project for the remaining term of the license." The HPMP would be prepared in consultation with the Colorado SHPO, Forest Service, and the Corps and would consider the Commission and Advisory Council's joint document Guidelines for the Development of Historic Properties Management Plans for FERC Hydroelectric Projects (2002). In its amendment application, Denver Water explains that the HPMP would also include specific requirements for: (1) notifying the Commission in the case of unanticipated discoveries; (2) procedures to be followed in the event of an emergency at the project; and (3) reporting requirements for informing the Commission of the execution of the treatment plan developed in accordance with the PA for the proposed project's adverse effects on the two historic properties. In accordance with the terms of the PA, no construction activities would take place until after the HAER report is accepted by the Colorado SHPO and National

Park Service and after the Commission has issued an order approving and implementing the HPMP.

Additionally, Article 415 of the project license requires Denver Water to consult with the Colorado SHPO, the Forest Service, and U.S. Bureau of Land Management about any discovered sites; prepare a plan to evaluate the significance of the sites; and develop measures to avoid or mitigate any impacts on resources determined to be eligible for inclusion in the National Register. That article would be updated and modified to accommodate the PA and HPMP, which would now guide the management and protection of cultural resources and historic properties for the remainder of the project license. And although the Commission is not a party to the agreement, additional protection measures are found within a separate PA that was fully executed on October 26, 2015, between Denver Water, the Corps, the Colorado SHPO, and the Forest Service and filed on July 24, 2017. The Northern Cheyenne Tribe, Northern Arapaho Tribe, Cheyenne-Arapaho Tribes of Oklahoma, Ute Mountain Tribe, and Boulder County Historic Preservation Advisory Board were invited to sign the PA as concurring parties.

In comments filed on the February 6, 2018 Supplemental EA, a commenter raised concerns about potential effects on the Walker Ranch Historical site. The Walker Ranch Historic District (District) was listed on the National Register on June 14, 1984, and its boundaries were expanded on June 29, 1988. The District is located approximately one-eighth mile east of the Gross Reservoir Dam and outside of the current project boundary. However, a very small portion of the expanded project boundary as proposed would pass within the boundary of the District as shown on a map provided in the National Register Nomination Form (Bell and Weisberger, 1984). Although this area is contained within the District, according to the nomination form, no individual cultural resources that contribute to the District's National Register eligibility are located here. Although noise and dust could reach the District during construction activities, in those sections, we [FERC] conclude that such effects would be similar to those identified in the Corps' Final EIS. For these reasons, we [FERC] find that through execution of the PA and preparation of an HPMP that addresses all eligible or potentially eligible resources identified within the project APE, which would include the portion of the Walker Ranch Historic District located within the proposed project boundary, approving Denver Water's amendment application would not result in any new permanent or temporary impacts on cultural resources from those identified in the Final EIS.

The MOAs were signed subsequent to the issuance of the Final Corps Final EIS. The Programmatic Agreement for the Final EIS (Corps 2015) and the Programmatic Agreement for the Final SEA (FERC 2019) are reproduced in this 1041 permit application as Exhibit 7.

MITIGATION (UNIQUE AREAS OF GEOLOGIC, HISTORIC, AND ARCHAEOLOGICAL IMPORTANCE)

The FERC analysis evaluated the effects of all mitigation measures for cultural resources (Final SEA, Section 5.1.12) and concluded the following.

The Final EIS evaluated potential effects of modification of Gross Dam and the enlargement of Gross Reservoir on cultural resources and found that the dam and reservoir itself (5BL10210)

and a portion of the Resumption Flume (5BL7019.1) would be adversely affected. To ensure the Commission remains in compliance with Section 106 of the NHPA for the proposed action [the Project], the Commission, in conjunction with Denver Water and Colorado SHPO, developed and executed a PA to take into account the effects of the proposed action [the Project] on these two historic properties and memorialize agreed-upon mitigation for the effects. The Colorado SHPO and Commission are signatories to the PA, and Denver Water, the Corps, and the Forest Service are concurring parties. The executed PA, and its terms, would be incorporated into the project license by the Commission's amendment order. The PA calls for Denver Water to complete HAER documentation of Gross Dam and reservoir and the Resumption Flume before modification.

The Final EIS also found that no other cultural resources would be affected by modification of the dam and enlargement of the reservoir; however, the Final EIS did not assess the effects of other project-related activities on cultural resources, such as ongoing operation and maintenance of the project, public access, and recreation. To that end, in addition to HAER documentation of the dam, reservoir, and Resumption Flume, the PA requires Denver Water to prepare an HPMP for the Gross Hydroelectric Project before beginning any construction activities that would affect the character-defining features that make these properties eligible for listing on the National Register. The HPMP would contain measures for "considering and managing effects on historic properties of activities associated with constructing, operating, and maintaining the project for the remaining term of the license." The HPMP would be prepared in consultation with the Colorado SHPO, Forest Service, and the Corps and would consider the Commission and Advisory Council's joint document Guidelines for the Development of Historic Properties Management Plans for FERC Hydroelectric Projects (2002). In its amendment application, Denver Water explains that the HPMP would also include specific requirements for: (1) notifying the Commission in the case of unanticipated discoveries; (2) procedures to be followed in the event of an emergency at the project; and (3) reporting requirements for informing the Commission of the execution of the treatment plan developed in accordance with the PA for the proposed project's adverse effects on the two historic properties. In accordance with the terms of the PA, no construction activities would take place until after the HAER report is accepted by the Colorado SHPO and National Park Service and after the Commission has issued an order approving and implementing the HPMP.

Additionally, Article 415 of the project license requires Denver Water to consult with the Colorado SHPO, the Forest Service, and U.S. Bureau of Land Management about any discovered sites; prepare a plan to evaluate the significance of the sites; and develop measures to avoid or mitigate any impacts on resources determined to be eligible for inclusion in the National Register. That article would be updated and modified to accommodate the PA and HPMP, which would now guide the management and protection of cultural resources and historic properties for the remainder of the project license. And although the Commission is not a party to the agreement, additional protection measures are found within a separate PA that was fully executed on October 26, 2015, between Denver Water, the Corps, the Colorado SHPO, and the Forest Service and filed on July 24, 2017. The Northern Cheyenne Tribe, Northern Arapaho Tribe, Cheyenne-

Arapaho Tribes of Oklahoma, Ute Mountain Tribe, and Boulder County Historic Preservation Advisory Board were invited to sign the PA as concurring parties.

In comments filed on the February 6, 2018 Supplemental EA, a commenter raised concerns about potential effects on the Walker Ranch Historical site. The Walker Ranch Historic District (District) was listed on the National Register on June 14, 1984, and its boundaries were expanded on June 29, 1988. The District is located approximately one-eighth mile east of the Gross Reservoir Dam and outside of the current project boundary. However, a very small portion of the expanded project boundary as proposed would pass within the boundary of the District as shown on a map provided in the National Register Nomination Form. Although this area is contained within the District, according to the nomination form, no individual cultural resources that contribute to the District's National Register eligibility are located here. Although noise and dust could reach the District during construction activities, in those sections, we [FERC] conclude that such effects would be similar to those identified in the Corps' Final EIS. For these reasons, we [FERC] find that through execution of the PA and preparation of an HPMP that addresses all eligible or potentially eligible resources identified within the project APE, which would include the portion of the Walker Ranch Historic District located within the proposed project boundary, approving Denver Water's amendment application would not result in any new permanent or temporary impacts on cultural resources from those identified in the Final EIS.

8-507.D.7.b.vi.A.4, Environmental Resources

Other sections of this 1041 permit application present environmental impact analyses related to air (Section 8-507.D.7.b.v and Exhibit 14), water (Sections 8-507.D.7.b.ii.B through D), native plant and animal populations and their associated habitat (Sections 8-507.D.7.b.iii through iv), and the unique, distinctive, or significant natural features of the County's landscapes and related ecosystems, as mapped in Boulder County's Comprehensive Plan (Exhibit 1 and 8-511.B.14).

The following soils information and analysis was gathered for Denver Water's License Amendment Application to the FERC (Exhibit E, Section 3.3.6):

Affected Environment (Soils)

Information on soils in the Project area was gathered from literature review, electronic data sources, and agency coordination. Soil descriptions were obtained from published soil surveys for Boulder County. GIS spatial and attribute data were acquired from the Natural Resources Conservation Service (NRCS) and the USFS.

Upland areas at Gross Reservoir consist of shallow gravelly, stony, and cobbly sandy loam soils. Stream terraces, drainageways, alluvial fans, and floodplains consist of gravelly loam, sandy clay loam, and silt loam soils (Escobedo 2005, NRCS 1975, NRCS 2005, see Final EIS for reference materials).

Gross Reservoir and the surrounding areas have a thin cover of soils that grade into highly weathered or decomposed granitic bedrock. Rock outcrops and the presence of large boulders on the surface are also prevalent at Gross Reservoir. Rock outcrops are created when surface soils erode. The underlying

subsoils are too fine grained to “cement” larger particles together; thus, the subsoils erode away leaving behind exposed areas of bedrock (Denver Water 2002, see Final EIS for reference materials).

Steep slopes combined with the volatile weather patterns at Gross Reservoir create highly erosive soils that are prone to landslides. Localized areas of heavy recreational use also greatly contribute to soil loss. The Gross Reservoir *Erosion Control and Rehabilitation and Restoration Plan* (Denver Water 2002) states that recreational activities on trails and roads have eroded tons of soil materials into the reservoir, especially in areas where vehicles drive off designated roads, climb up steep slopes, and form deep ruts and depressions from their tires. Other potential soil limitations at Gross Reservoir include shallow depth to bedrock, areas of low strength, and areas of occasional flooding (Denver Water 1998b, NRCS 1975, NRCS 2005, USFS 2005a, see Final EIS for reference materials).

A field visit conducted on behalf of Denver Water in September 2005 to assess slope stability and erosion problems around Gross Reservoir indicated that, in general, the reservoir shoreline was stable with evidence of slight erosion, as indicated by exposed roots, bank sloughing, and exposed bedrock. Moderate to severe erosion, however, has occurred in areas where recreational activities have been concentrated, such as off-roading in the Winiger Ridge area. While the soils appeared to be relatively stable at the time of the field visit, removal of their protective vegetative cover would make them highly susceptible to erosion.

Project Effects (Soils)

Potential soils issues documented during the agency and public scoping process for the Moffat Collection System Project EIS included the impacts of water level changes in Gross Reservoir on shoreline inundation and erosion. Other soils issues include slope instability, landslides and slippage, expansive soils, flooding, erosion, sedimentation, and reclamation potential.

Permanent Impacts to Soils

Expansion of the dam, the reservoir, and related facilities would permanently affect approximately 465 acres of soils. The calculation of acres assumes disturbance between the current reservoir pool elevation (7,282 feet) and elevation 7,410 feet. This includes disturbance associated with the Environmental Pool (elevation 7,406 feet). A description of soils that may be impacted in the Gross Reservoir area is provided in Table 66.

Table 66:
Gross Reservoir Soils

Map Unit	Series	Description	Potential Limitations	Prime Farmland or Soils of Statewide Importance
FcF	Fern Cliff-Allens Park-Rock outcrop complex, 15 to 60 percent slopes	Stony to gravelly sandy loam and rock outcrops on mountain slopes, ridges, saddles, and cliffs	Severe water erosion hazard and steep slopes	No
JrF	Juget-Rock outcrop complex, 9 to 55 percent slopes	Very gravelly sandy loam and rock outcrops on mountain slopes and ridges	Severe water erosion hazard, steep slopes, and shallow depth to bedrock	No

Table 66:
Gross Reservoir Soils

Map Unit	Series	Description	Potential Limitations	Prime Farmland or Soils of Statewide Importance
Ro	Rock Outcrop	Barren areas located on steep slopes and cliffs comprised of exposed bedrock, such as granite, sandstone, shale, and limestone	Steep slopes and shallow depth to or exposed bedrock	No
2703B	Galuche-Ratake families complex, 5 to 40 percent slopes, very stony	Very gravelly coarse sandy loam on mountain slopes	Moderate to severe water erosion hazard, shallow depth to bedrock in some areas, and potential landslide activity	No
2704D	Haplustolls-Cathedral family-Rock outcrop complex, 40 to 150 percent slopes, rubbly	Very gravelly to very stony sandy loam and rock outcrops on mountain slopes and summits	Severe water erosion hazard, steep slopes, shallow depth to bedrock, potential landslide activity, and low strength	No
2705D	Ratake-Cathedral families-Rock outcrop complex, 40 to 150 percent slopes, rubbly	Very gravelly sandy loam to very stony sandy loam and rock outcrops on mountain slopes and summits	Severe water erosion hazard, shallow depth to bedrock in some areas, and potential landslide activity	No
2717B	Galuche-Wetmore-Ratake families complex, 5 to 40 percent slopes, stony	Gravelly to very gravelly coarse sandy loam on mountain slopes	Moderate to severe water erosion hazard, steep slope, shallow depth to bedrock, potential landslide activity, and areas of low strength	No
4703D	Bullwark-Catamount families-Rock outcrop complex, 40 to 150 percent slopes, rubbly	Gravelly to very cobbly sandy loam and rock outcrops on mountain slopes and summits	Severe erosion water hazard, steep slope, potential landslide activity, and areas of low strength	No
4704B	Bullwark-Catamount families-Rubble land complex, 5 to 40 percent slopes, rubbly	Gravelly to cobbly sandy loam on mountain slopes and fans	Moderate erosion water hazard, steep slope, potential landslide activity, and areas of low strength	No
5101A	Pachic Argiustolls-Aquolls complex, 0 to 15 percent slopes	Gravelly loam to gravelly sandy clay loam on stream terraces, alluvial flats, and drainageways	Slight to moderate water erosion hazard, occasional flooding, poorly drained, and areas of low strength	No
6102A	Gateview family-Cryaquolls, 0 to 15 percent slopes	Gravelly sandy loam to silt loam on alluvial fans, stream terraces, and floodplains	Moderate to severe water erosion hazard, flooding, and areas of low strength	No

Sources: NRCS (1975), NRCS and FS March (2005) , see Final EIS for reference materials.

Soils covered by facilities would be permanently lost unless salvaged and used as embankment fill. Soils permanently inundated by the reservoir would become anaerobic and would have altered chemical and biological processes. Soils in the drawdown zone would experience alternating wet and dry cycles associated with fluctuations in water level during reservoir operations. This anaerobic/aerobic pattern may result in moderate chemical and physical changes in the soils.

Expansive soils alternately swell when wet and contract when dry, thereby potentially damaging structures. No expansive soils have been identified in the Project area, and, thus, no impacts to the raised dam or associated facilities are anticipated.

Erosion from Construction

Soil erosion can increase the sediment load in surface-receiving waters downstream of the construction site. Soil disturbing activities may result in compaction, which may lead to decreased infiltration rates and corresponding increased runoff and erosion rates. The magnitude, extent, and duration of construction-related impacts depend on the erodibility rates of the soil; the proximity of the construction activity to receiving waters; and the construction methodologies, duration, and season.

Construction activities would temporarily disturb approximately 89 acres of soils, primarily through earth-moving activities and construction equipment traffic. The soils identified in the construction areas are described in Table 71, above. Some erosion is likely to occur and may adversely affect adjoining areas or deliver sediment to South Boulder Creek.

Stockpile areas located on the eastern boundary of the reservoir (approximately 0.5 acre) would be necessary for temporary storage of soil during construction activities. Several potential spoil areas (approximately 5 acres total) would be located north and south of the dam. These stockpile and spoil areas would be stabilized during construction to minimize erosion and sedimentation; following construction, spoil areas located outside the new normal water level would be reclaimed.

Additional impacts would occur from tree removal around the rim of the reservoir. Trees would be cleared from the inundation area and shoreline up to elevation new high water level 7,406 feet. Moderate impacts on soils include erosion resulting from disturbance and compaction during harvest. Several methods of tree removal may be used depending on slope, access, and presence of rock outcrops, including ground-based harvest systems (hand felling/grapple skidder and feller/buncher), cable-based system, helicopter system, or hydro-ax. Tree harvesting and removal would use both existing and new access roads.

The amount of soil disturbance and compaction resulting from timber harvest varies depending on the method of harvest (EPA 2005), with ground-based systems causing the most disturbance (about 25 to 35 percent for clear cutting) and helicopter systems causing the least (1 to 5 percent). Disturbance of soil and litter would result in accelerated erosion, which would need to be controlled with erosion and timber harvest BMPs. Use of cable systems, helicopter, and hydro-ax on steeper slopes would also help control erosion. Stumps and roots would remain in place, providing some surface protection. Post-construction restoration of the cleared area not inundated would include establishing a mix of native grass, forb, and shrub species to further minimize erosion.

Shoreline Character

The annual pattern of fluctuation in water level and content in Gross Reservoir (from April through November) would be similar to existing conditions. Average monthly volume for the reservoir would be at its lowest at the end of April (water surface elevation 7,326 feet), and would reach its highest level in July (water surface elevation 7,383 feet), after which it would be drawn down throughout the fall and winter. Under the Project, the contents of Gross Reservoir would drop steadily by an average of approximately 4,000 AF per month during winter months because the Moffat WTP would be operating at a minimum of 30 million gallons per day.

Fluctuating water levels associated with operation of Gross Reservoir under the Project would create changes in the stresses in the slopes of the shoreline. The nature of the shoreline and exposed reservoir bottom would be determined by the substrate, its stability and texture, the slope of the shoreline, and the reservoir's water level. Steep slopes combined with volatile weather patterns cause most soils at Gross Reservoir to be potentially highly erosive or prone to landslides. Removal of the soils' protective vegetative cover during construction would likely make them highly susceptible to erosion unless otherwise stabilized.

Reclamation Potential

Soils would be temporarily disturbed by construction of the enlarged dam, reservoir, and associated facilities. In general, the limitations for soil reclamation in the Project area are steep slopes, shallow depth to bedrock, and erosion.

Summary

Expansion of the dam, the reservoir, and related facilities would permanently affect approximately 465 acres of soils. Impacts to soils under the Project would be minimized during construction by implementing BMPs and by complying with stormwater management and fugitive dust control plans. Erosion should be limited in these areas by State requirements for stormwater and air quality control plans. Based on this mitigation, the Project would not significantly degrade soils.

Conclusions supported by the FERC in its review of the Project impacts relating to geology and soils (Final SEA, Section 5.1.1) were as follows.

> *Overall, effects on geology and soils under an approval of Denver Water's license amendment would not be significant enough to cause effects determined in the Final EIS for the project area to be exceeded.*

Mitigation (Soils)

The FERC analysis evaluated the effects of all mitigation measures (Final SEA, Section 5.1.12) and concluded the following.

> *Denver Water's implementation of its Stormwater Management Plan, Erosion Control and Reclamation Plan, Quarry Operation Plan and Quarry Reclamation Plan, and its compliance with Forest Service 4(e) conditions 19 (Erosion Control and Reclamation), 26 (Pit Development and Reclamation Plan), and 28 (Reclamation and Revegetation Seed Mixes and Mulch Materials), would significantly reduce effects to geology and soils in the project area. Effects to geology and soils from tree removal, reservoir enlargement, and relocation of recreation facilities would also be reduced through Denver Water's implementation of a Tree Removal Plan. Denver Water would finalize the plan in consultation with agencies and compliance with the Forest Service 4(e) conditions. Denver Water would file the final plan with the Commission, including evidence of consultation and rationale for why any agency recommendations were not included in the final plan, and copies of agency approvals where necessary. Effects on local soils would also be reduced through the Erosion and Sediment and Control Plan Denver Water would have to file*

with the Commission's San Francisco Regional Office. Land- disturbing work associated with the amendment would not be allowed to begin until the plan is approved by the Regional Office.

Overall, effects on geology and soils under an approval of Denver Water's license amendment would not be significant enough to cause effects determined in the Final EIS for the project area to be exceeded.

8-507.D.7.b.vii, Visual Aesthetics and Nuisance Factors

8-507.D.7.b.vii.A, Viewsheds, Scenic Vistas, Unique Landscapes or Land Formations

Visual resources and viewsheds are shown on Figure 24 in Exhibit 1, View Protection Corridors Map.

The following information related to visual resources and nuisance factors was gathered for Denver Water's License Amendment Application to the FERC (Section 3.3.17).

AFFECTED ENVIRONMENT (VIEWSHEDS, SCENIC VISTAS, UNIQUE LANDSCAPES OR LAND FORMATIONS)

Scenic quality, as defined in the USFS SMS, is a harmonious relationship between physical, biological, and cultural attributes that, when viewed by people, elicits psychological and physiological benefits. Visual absorption capacity refers to the relative ability of a landscape to accept contrasting human modifications without a loss in character (USDA 1995, see Final EIS for reference materials). Existing landscape character refers to the unit's scenic attributes (landform, water, cultural elements, and vegetation) combined with the cultural values that people assign to landscapes. Landscape character descriptions define a unit's "sense of place," or scenic expression, and document baseline conditions from which to monitor changes in scenic resources in the future (USDA 1995, see Final EIS for reference materials). User sensitivity to change is determined by evaluating factors such as visibility of the site, proximity to sensitive land uses, the number and type of potential viewers, and the purpose of their visit to the area.

Gross Reservoir

The visual and cultural image of Gross Reservoir is characterized by clear reservoir water, rocky shorelines and steeply sloped forested hillsides set against high mountain peaks in the background (Denver Water 2004, see Final EIS for reference materials). The reservoir is located in the steep foothills of the Colorado Front Range in a landscape that has been sculpted by deep erosion, deposition of headwater stream material, and downward migration of unconsolidated rock. Elevations within the Project area range from 6,900 feet below the dam on South Boulder Creek to 7,800 feet on some of the small peaks and ridges. In most cases, the terrain slopes steeply towards the reservoir, with most slopes ranging from 20 to 60 percent. Warm, south-facing slopes are dominated by ponderosa pine stands with some small grassland openings from past fires or disturbance, while north-facing slopes are dominated by closed canopy mixed-conifer forests punctuated only by rock outcroppings and small aspen groves. Aspen stands and aspen/cottonwood communities in wet ravine areas, which create seasonal interest in color and texture, are slowly being replaced by conifer forest. Weather, season, or time of day create continued viewer interest by dramatically altering the color intensity, reflection, shadow, form, and texture, for example, snow cover and tree defoliation during the winter and leaf color in the fall.

As a man-made reservoir, the existing landscape character is largely a result of human activities that have resulted in many positive visual characteristics. Properly sited and maintained recreational trails and signage, for example, contribute to the recreational character of the area and are considered positive elements in the landscape. However, certain activities have negatively impacted the visual character. Deviations from the form, line, color, and texture of the natural landscape include the dam, overhead utilities, buildings, roads, signage, and impacts due to unmanaged recreational activities at designated recreation areas. At certain times of the year, the setting is also influenced by the drawdown zone that surrounds the reservoir, which can be a conspicuous element of the landscape when water levels are low and a large area of barren soil is exposed.

Some of the most visible lands on the North Shore/Peninsula, the Dam, and Winiger Ridge are also those that have been most impacted by human uses. The Dam Recreation Area was used as a staging area during the original dam construction in the early 1950s. Its highly modified contours (form), poorly vegetated surface (texture), overhead utilities (lines), and the barren slope of loose and light-colored material extending into the reservoir (color) make the Dam Recreation Area the most visible human impact in the Project area. At the same time, the dam's convex form and sheer vertical drop have placed the Gross Reservoir Dam in cultural memory as a visual landmark. As a result, the Dam Recreation Area overlook adjacent to the dam, which provides excellent, panoramic views of the area, is among the most popular destinations at the reservoir.

Off-road vehicle use, dispersed camping, and cross-country travel have damaged vegetation and accelerated the natural erosion process, resulting in localized visual change. Most of the soils present are highly susceptibility to erosion, which is exacerbated by the steep slopes that occur in the area. The lines and colors created by road and trail networks are highly visible on the Winiger Ridge and North Shore/Peninsula Recreation Areas and in grass/forb rangelands and ponderosa pine communities. Moderate recreational impacts in and around rock outcroppings and on north-facing slopes are typically absorbed by the form and texture of the natural features.

Existing land uses include recreational and maintenance facilities and a variety of recreation opportunities. A dozen homes in the Lakeshore Park subdivision east of the North Shore Recreation Area overlook the reservoir and are visible from several vantage points. No residential subdivisions or other uses are proposed near the Project area, although 35-acre and larger mountain home development is expected to continue in the future. Older recreational facilities on the North Shore/Peninsula have been sited in highly visible locations, resulting in a contrast to the visual character.

Certain areas around the reservoir display particularly distinctive visual qualities that create positive or negative responses in the viewer. Past surveys conducted by Denver Water indicate that the sites with the most human intervention and landscape disturbance were generally rated by users as having the lowest scenic quality in the Project area, while the sites that were more pristine were rated highest (Denver Water 2003c, see Final EIS for reference materials). Three areas in particular have very high scenic quality:

- Forsythe Canyon with its steeply sloping granite walls in the foreground and views to the snow-covered Indian Peaks. The Forsythe Canyon Trail begins approximately 0.5 mile down Forest Road

(FR) 359 and follows Forsythe Creek down into a wooded, rocky canyon to the reservoir shoreline in Forsythe Canyon. In the spring the small creek forms a small, picturesque cascading waterfall that is a popular hiking destination.
- South Boulder Creek Inlet with its rapids dissipating into the waters of Gross Reservoir.
- South Boulder Creek in the rocky V-shaped canyon below the dam, a popular destination for kayakers and hikers.

Overall, scenic quality at the reservoir is rated as high, while Winiger Ridge and North Shore/Peninsula are rated as moderate. The Dam Recreation Area is rated as low for the reasons described above. Both Winiger Ridge and North Shore/Peninsula have the potential to have high to very high scenic quality, but have been degraded by unmanaged recreational use, inappropriate facility siting, and increased erosion.

A desired landscape character for lands managed by Denver Water within the Project area or the appearance of the landscape to be retained or created over time has been established in Article 414: *Visual Resource Protection Plan*, of the Gross Reservoir FERC license (Denver Water 2003c, see Final EIS for reference materials). Article 414 states that:

> The overall landscape character around the reservoir should remain natural appearing with limited human intervention. Forested areas should display diversity of vegetation and successional stages of plant development. Meadows and forest openings should be natural appearing and managed in absence of natural fire cycles. The recreation facilities should be developed to meet the roaded natural classification in the Forest Service's recreation opportunity spectrum. Visitors to this area should be provided with facilities and site amenities that are convenient, yet appropriate for the setting. Within this area, opportunities to get away from others in more remote and natural settings should be made available (p. 41).

The ARNF LRMP designates NFS lands adjacent to Gross Reservoir with a scenic integrity objective of "High," requiring that "the valued landscape character 'appear' intact" (USFS 1997b, see Final EIS for reference materials). Deviations may be present but must repeat the form, line, color, texture, and pattern common to the landscape character so completely and at such a scale that they are not evident" (USDA 1995, see Final EIS for reference materials).

Both one-time and frequent visitors utilize Gross Reservoir in the summer months for fishing, sightseeing, picnicking, hiking, biking, horseback riding, camping, cliff-jumping, and four-wheeling. Past Denver Water visitor surveys indicate that Gross Reservoir's most desirable attributes are its feeling of remoteness, the lack of man-made structures and/or human intervention, other scenery-related attributes, and the opportunity for scenery-related activities such as sightseeing and wildlife viewing (Denver Water 2004, see Final EIS for reference materials). Due to the recreational nature of users and the scenic amenities valued by residents, user sensitivity to visual change is considered to be high.

Improvements to all existing recreation areas and construction of one new site are proposed in Article 416: *Recreation Management Plan* and Article 414: *Visual Resource Protection Plan* of the Gross Reservoir FERC License (Denver Water 2004, see Final EIS for reference materials). These plans delineate facility design standards (i.e., configurations, alignments, building materials and colors,

landscaping and screening, erosion control, and restoration techniques) and site-specific recommendations for future uses and improvements. Under these guidelines, the desired landscape character would continue to be achieved over time resulting in improvements to several degraded areas.

South Boulder Creek

South Boulder Creek occurs in a scenic and visually sensitive location. The setting in which the stream is viewed is equally important as the stream flow when determining visual preferences. The surrounding topography, vegetation, complementary or incompatible uses, time of day, and the respective activity of viewers all contribute to the visual experience. This may be especially true in areas that are heavily dependent on visitation, such as mountain communities. In these settings, the visual experience often contributes to a broader recreational experience, and to some extent, helps to characterize surrounding land uses. Mountain communities are popular destinations for recreation, tourism, and as retirement and vacation destinations, and the surrounding visual setting and passive beauty of rivers and streams helps to define the character of these areas.

River water levels fluctuate diurnally and seasonally as a result of natural hydrologic cycles, reservoir management, and diversions, and stream levels also play a role in determining visual preferences. The stage or flow level affects the visual appearance of rivers and streams in a number of ways, such as boulders and/or bedrock that are submerged or exposed at the water surface; the amount of the channel that is occupied by water; and the relative stillness, turbulence, velocity, and/or whitewater at varying flows. Even in a natural state, Colorado streams are characterized by substantial variations in flow, typically reaching the highest flow levels in May or June and then rapidly dropping off through the remainder of the year until they reach the low flows that predominate during the winter months. Throughout the year, flows can easily be 10 to 20 times greater during peak runoff than they are during winter. As a result, a stream is a dynamic system that rarely remains static, and the viewer has an expectation of observing change over the course of the seasons.

PROJECT EFFECTS (VIEWSHEDS, SCENIC VISTAS, UNIQUE LANDSCAPES OR LAND FORMATIONS)

Pursuant to FERC's Order 4e Condition No. 23, at least 90 days before ground-disturbing activities on NFS land, Denver Water must submit a revised Visual Resource Management and Monitoring Plans for FERC's review and approval.

Potential visual resource issues identified during scoping for the Moffat Collection System Project EIS included:

- How the expansion of Gross Reservoir would relate to current natural and man-made recreational features and the visual integrity of adjoining open space.
- Impacts on the "Front Range Backdrop."

Sightseeing, hiking, outdoor tourism, nature-viewing, and other scenery-dependent outdoor activities are highly valued by the public in many areas within the Project area. This section describes the potential short- and long-term visual impacts to the existing landscape character and how that character is perceived via natural and man-made viewpoints, viewsheds, and scenic features.

The extent to which the Project would affect visual resources depends on the amount of visual contrast created between the 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 or high-quality scenery or if the view from the setting of visually sensitive land uses were impacted. Types of visual contrast include modifications to the existing form, line, color, and texture of landforms, vegetation, and structures. Potential contrasts considered the setting's visual absorption capacity or the feasibility of restoring or maintaining acceptable degrees of scenic quality. Impacts were also determined based on whether the predicted visual contrast caused by the Project would be consistent with management guidelines for each affected area.

A photographic simulation was prepared for the Gross Reservoir site (Figure 23 in Exhibit 1). The simulation was based on preliminary engineering information and was prepared by collecting Global Positioning System (GPS) points at Key Observation Points (KOPs), rendering Project components in Visual Nature Studio and Adobe Photoshop, and adding the rendered items to photographs taken from each KOP. The photographic simulation was used to help evaluate the degree of change in landscape character.

The degree of visual contrast considered field evaluations, viewing distance, primary activity of viewers, viewpoint use frequency, duration of view, number of viewers, relationship to constituent values, visual absorption capacity, and existing scenic quality. Major, moderate, and minor impacts were identified where the Project components would create contrasts in the foreground (within 0.5 mile) of residences, designated recreational use areas, scenic viewpoints, or scenic travel ways. Readily apparent and substantial changes were judged to be major impacts, readily apparent and moderate contrasts as moderate impacts, and slight but detectible contrasts as minor impacts. Negligible impacts were identified where the Project components would create very little to no change in the landscape character viewed by the public due to either distance, topography, vegetation, high visual absorption capacity, or low scenic quality.

The degree of contrast resulting from the Project was also compared with relevant management guidelines to determine whether the degree of contrast is within or exceeds the allowable degree of visual contrast for the area. Major impacts would occur where Project actions substantially conflict with management guidelines or policy plans, such as where the Project would result in a long-term adverse effect on public land with high visual quality objectives. Moderate conflicts would occur where the Project would affect lands with moderate visual quality objectives. No impacts would occur where the Project would affect private lands that are not managed for scenic values or would affect lands already degraded by uses that are out of character with the surrounding environment uses.

Gross Reservoir

Denver Water visitor surveys indicate that Gross Reservoir's most desirable attributes are its feeling of remoteness, the general lack of man-made structures and/or human intervention, other scenery-related attributes, and the opportunity for scenery-related activities such as sightseeing and wildlife viewing. Surveys further indicate that sites with the most human intervention and landscape disturbance were generally rated by users as having the lowest scenic quality, while sites that were more pristine were

rated highest. Due to the recreational nature of use and the scenic amenities valued by residents, user sensitivity to visual change is considered to be high.

The primary components of the Project would permanently modify the existing visual condition in the following ways:

- Approximately 465 acres of forested shoreline and existing viewpoints and use areas would be directly affected by being permanently inundated by the enlarged reservoir.
- Trees would be removed up to the new normal pool elevation (7,406 feet).
- The existing reservoir elevation would be raised approximately 124 feet above the existing normal water level.
- Approximately 13.9 miles of shoreline would be created, which is approximately 2.8 miles more shoreline than currently exists.
- The concrete dam would be raised approximately 131 feet to an ultimate dam crest of approximately 471 feet high, approximately 1,840 feet long, and 25 feet wide. The enlarged dam would also have a wider foundation at the South Boulder Creek outlet than currently exists.
- A new saddle dam would be constructed south of the dam.
- A quarry with terraced horizontal benches and cut slopes would be developed with a majority of the quarry being inundated by the new reservoir after construction.
- Existing recreation and visitation facilities would be relocated.
- Existing dam and spillway access roads would be relocated.
- Construction staging areas would be disturbed and then restored.
- Borrow material areas would be disturbed and then restored.
- Stockpile and spoil areas and associated haul roads would be disturbed and then restored.
- Reservoir operating elevations (releases, storage, fill rates) would change.
- Reservoir operations (traffic, monitoring, minor repair and maintenance activities) would change.

Visual Contrast Impacts

The Corps considered temporary construction activities to be a major adverse temporary direct impacts to visual resources at Gross Reservoir. Activities include development of quarries and borrow areas, construction staging and parking areas, stockpile and spoil areas, and a temporary concrete production plant; construction of temporary and permanent roads and associated temporary haul roads; heavy machinery traffic; blasting; dam construction, and vegetation removal. All of these activities, which would expose dust and bare soils to viewers, would contrast with the surrounding landscape and the Corps considered a major short-term impact.

Long-term direct impacts to visual resources at Gross Reservoir would include changes in scale of the shoreline, reservoir elevation, and dam profile; the presence of a new saddle dam; permanent inundation of scenic areas; relocation of existing facilities and roads; and disturbed areas undergoing restoration.

Figure 23 in Exhibit 1 provides a photographic simulation of the expanded Gross Reservoir (additional 77,000 AF of storage). Primary differences between the existing landscape character and the simulated condition are the scale of the reservoir body, an elongated shoreline, a longer and higher dam crest, and new visual relationships of the reservoir to topographical features. The “bathtub ring” effect resulting from

changes in reservoir operating elevations (e.g., releases, storage, and fill rates) is not illustrated in the photographic simulation. The amount of bare earth exposed by the “bathtub ring” effect would vary depending on reservoir operations. The unattractive visual contrast created by reservoir fluctuations would be similar to current conditions.

The expansion considerably alters the frame of reference (or cognitive map) for viewers, as popular viewpoints from eight of the nine designated recreation areas would be inundated. Viewers would need to create a new cognitive map or mental structure to record and recall spatial knowledge about Gross Reservoir’s physical environment, based on the new viewpoints and viewsheds. Some existing scenic areas would be lost, and some new views with potentially high scenic quality could be created. Similarly, some lands with resource damage due to unmanaged use in the past would be hidden from view. For example, portions of Forsythe Canyon and South Boulder Creek Inlet, which have very high scenic quality, would be directly affected by inundation, as would the Peninsula Recreation Area, which has been moderately affected by human uses and erosion. More specifically, Forsythe Falls, which is located at the terminus of Forsythe Creek off the northern arm of Gross Reservoir, would be inundated. Forsythe Falls is a popular destination for many hikers at Gross Reservoir due to its scenic nature, and the Corps considered that its inundation would constitute a major long-term impact.

Lands above the new normal water level (7,406 ft) with high scenic quality would not be impacted although they would be perceived differently from new viewpoints and within a new context. Overall, the existing landscape character (e.g., clear water reservoir, rocky shorelines, and steeply sloped forested hillsides set against high mountain peaks) would be retained.

Most existing recreational use areas would be inundated under the Project, resulting in their relocation and reconstruction to some degree and the relocation of several major access roads. Abandoned road segments and temporary construction roads remaining above the new normal water level would be reclaimed. Roads, parking lots, and recreational use areas would be replaced in accordance with the to be developed Article 416 Addendum to the Gross Reservoir Recreation Management Under these guidelines, the desired landscape character of new recreational use areas would continue to be achieved over time, resulting in improvements to several existing degraded areas. However, due to steep slopes and rocky soils, the new, relocated north and south dam access road, including parking lots, may require moderately to highly visible cut-and-fill to accommodate road grades. Permanent road relocations would be considered a minor to moderate adverse impact.

Other lands disturbed during construction that would remain above the new normal water level include portions of the quarry site, saddle dam, staging areas, and stockpile areas. Approximately 30 acres of permanent disturbance would remain above the new normal water level.

The Osprey Point Quarry site is located at the Haul Road/Osprey boat launch west of the planned saddle dam. For reference, the previous Final EIS Quarry was located to the north of the Osprey Point Quarry within the extent shown in the Final EIS along a rock knob. The Osprey Point Quarry was designed so that the quarry pit would occur below the new high water line of Gross Reservoir once the reservoir is raised to the greatest extent possible. The Osprey Point Quarry configuration results in exposure of a much lower highwall than the previous Final EIS Quarry, which eliminates or greatly minimizes visual

impacts. The Osprey Point Quarry would be almost or entirely submerged below the new high water line once the reservoir is enlarged and visual impacts during operation of the Project would be minimal[3].

The saddle dam, which would be constructed of RCC, would be located in a natural topographic saddle through an open, ponderosa pine/grassland savannah currently containing one access road. The Corps considered that the saddle dam would create a major permanent impact due to the degree of change in landscape character.

The remaining lands disturbed during construction above the new normal water level are staging and stockpile areas in the vicinity of the Dam Recreation Area and South Boulder Creek. Along with the quarry, the dam staging and stockpile areas would be the most visible effect in the Project area, attracting attention in the foreground from North Shore/Peninsula, Forsythe Canyon, and Winiger Ridge and for over a mile east of Gross Reservoir on Gross Dam Road. The Dam Recreation Area's long-term appearance after reclamation, consisting of highly modified landforms, uneven vegetation, and barren slopes of loose and light-colored material extending into the reservoir, would be similar to Current Conditions, resulting in a minor adverse temporary impact. Below the dam, the South Boulder Creek construction staging areas after reclamation would be less visible and create minor adverse contrasts, as they occur in an area of restricted public access and existing powerplant and utility facilities.

Under the Project, the dam axis, arch radius, crest width, materials, and downstream slope would remain similar to existing visual conditions, but at a larger scale. The dam height would be increased by approximately 131 feet and the crest length would be lengthened by several hundred feet. As a result, the enlarged dam would become more visible from some roads and other viewpoints in the Project vicinity. While the Corps considered this a major change compared with current conditions, the Corps also considered that the dam has been in use for over 50 years and in that time has become an accepted architectural element of the landscape character; thus, the dam raise itself would result in a minor visual impact.

Management Guideline Impacts

Under the Project, no areas of the Winiger Ridge Natural Landmark or within a 250-foot buffer zone surrounding the landmark, as described in the Environmental Resources Element of Boulder County's Comprehensive Plan and shown on the Zoning District Maps of Boulder County, would be inundated.

Scenery guidelines in Article 414: *Visual Resource Protection Plan* of the Gross Reservoir FERC License and in the USFS ARNF LRMP require that "the overall landscape character around the reservoir should remain natural appearing with limited human intervention" (Denver Water 2004, see Final EIS for reference materials) and that the valued landscape character appear intact. The scenic integrity

[3] Pursuant to FERC Order Article 424, within one year of the date of FERC's Order and after conferring with certain governmental stakeholders, including Boulder County, Denver Water must submit Quarry Operation and Reclamation Plans for FERC's review and approval. Denver Water will provide the draft Quarry Operation and Reclamation Plans to Boulder County for review and comment in accordance with the terms of FERC's Order.

objectives for the NFS land that would be disturbed by the Final EIS Quarry state that "Deviations may be present but must repeat the form, line, color, texture, and pattern common to the landscape character so completely and at such a scale that they are not evident" (USDA 1995, see Final EIS for reference materials). The Corps considered it not possible to completely mitigate the major short-term direct construction impacts to meet these objectives.

Long-term impacts would only partially meet the desired future condition. The new shoreline and recreational use areas would retain the existing, valued landscape character. The new water elevation, reservoir size, and dam would not be "at such a scale that they are not evident" in the short term but would become less evident in the long term as viewers became accustomed to the new reservoir size. The quarry, if effectively reclaimed, would "repeat the form, line, color, texture, and pattern common to the landscape character … [in such a way] that they are not evident." However, the saddle dam would not be compliant with management guidelines and the Corps considered it a major, adverse long-term impact.

South Boulder Creek

There is a strong correlation between flow levels and how viewers rate the aesthetic appearance of a given stream. Low flows (primarily in winter and early spring months), when much of the channel is not occupied by water and the stream has a "dried up" appearance, are generally rated lower in aesthetic quality than higher flow conditions. Similarly, peak flow levels are also generally rated lower in aesthetic quality than normal flow levels. For example, a study on the Cache la Poudre River in Colorado showed that scenic quality ratings increased as flow increased, but only up to approximately 1,300 cfs, or 65 percent of the average flow in June, beyond which the scenic quality ratings decreased (Brown and Daniel 1991, see Final EIS for reference materials). Another example involved a study on the Virgin River in Zion National Park, which showed that during periods of low flow, small increases in flow resulted in a dramatic increase in aesthetic quality ratings, but there was little or no improvement in ratings at medium and high flows (Whittaker and Shelby 2002, see Final EIS for reference materials). The lower aesthetic quality ratings may be attributable to the fact that higher flows tend to drown out riffles, pools, and other features of interest within the stream channel (Litton 1984, see Final EIS for reference materials).

South Boulder Creek would serve as the conduit for increased West Slope diversions under the Project. Minor flow increases in South Boulder Creek above Gross Reservoir under the Project would be imperceptible to casual observers, with the exception of June, when flow increases would be 106 cfs (17 percent) in average years and 153 cfs (32 percent) in wet years. 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 in winter months (i.e., low-flow periods) under the Project. Average year flows are projected to increase from 3 cfs to 92 cfs (as much as 904 percent) below the dam in January. These additions, while high in the winter, a period of low flows when streams are most sensitive to visual change, are characteristic of early spring flows and, though perceptible, would not create an adverse effect.

Reduced flows are not anticipated to cause any landscape-scale changes in riparian vegetation communities. Therefore, the Project is not expected to adversely affect the visual quality of any stream corridors through the modification of existing vegetation.

Summary

Visual impacts at Gross Reservoir are generally related to the increase in scale of the reservoir and dam. With the exception of the exposed quarry site (above the future reservoir pool) and the saddle dam, the general character of the landscape would not change, but viewers would have a different perspective due to the larger scale of the water feature and dam in the viewshed. Overall, with time, the impacts are considered minor to moderate.

Construction or development adjacent to streams may obstruct or impair views of the stream or may impair the visual or scenic quality from a setting such as a park or community space near the stream. However, the Project would not directly impair South Boulder Creek's intrinsic scenic attributes such as the occurrence of whitewater, riffles, and still pools or color and clarity.

Immediately below Gross Reservoir, there would be major increases in flows from October to February as a result of additional West Slope diversions (stored in Gross Reservoir) being released into South Boulder Creek under the Project. Increases would be most dramatic in January and February, with flow increases of 904 percent and 874 percent, respectively. While high in the winter, a period of low flows that make streams most sensitive to visual change, such increases would result in flow levels more characteristic of early spring (March and April), and would likely be noticeable but not likely to be perceived as adverse or to create an adverse effect.

Conversely, during the higher-flow period (May to July), flows would be reduced downstream from Gross Reservoir, with decreases in flows of 24 percent in May, 10 percent in June, and 6 percent in July. These changes would not be apparent to most observers. Overall, there would be no impact to the visual or scenic attributes of South Boulder Creek.

Public Survey

A public survey was performed in early 2018. Denver Water hired an independent third-party public opinion research firm, Corona Insights, to survey the community near Gross Reservoir. The goal of this research was to gauge public sentiment about the Project. Sixty-nine percent of the survey respondents indicated a high level of concern about "increased noise pollution". Direct questions related to visual impacts were not included on the survey, but related impacts such as dust in the air and impacts to vegetation and land were also rated with a high level of concern by most of the survey respondents. Other concerns identified via community outreach activities include that the quarry might leave a scar in the landscape. As previously discussed, the quarry would be almost entirely inundated by the reservoir expansion during operation of the Project. Mitigation measures for noise are described below. A summary of Denver Water's responses to community concerns is provided in the Good Neighbor Handout provided in Exhibit 6.

Conclusions supported by the FERC in its review of the Project impacts relating to visual resources (Final SEA, Sections Section 5.1.10.2) were as follows.

> *Construction-related effects on visual resources would occur during the construction period only, approximately 4.1 years [5.5 years including offsite and ancillary improvements to support the dam construction], and the 2014 Final EIS found that these effects would constitute temporary,*

direct, major adverse effects on visual resources. The visual character after construction would be comparable to current conditions, but the enlarged reservoir would be more of a dominant topographic feature. Reservoir level fluctuations would be similar to current conditions.

Once construction is complete, and the reservoir is refilled to its new maximum water level, the [majority of] Osprey Point Quarry site would be submerged, with an estimated 0 to 55 vertical feet of highwall quarry remaining above water at that elevation. [In the event the Quarry is not inundated, Denver Water will develop a reclamation plan for the portion above the new high water line.] The extent of highwall quarry that would be visible would depend on water depths during annual cyclical water level fluctuations resulting storage and release of water from operation of the Moffat Collection System, and the effects of wet and dry water years.

According to Denver Water's Final Quarry Location Report (Denver Water 2016a), reclamation plans for quarry sites with remaining exposed walls would take into consideration a range of reclamation methods, such as benching, rock sculpting (shaping the exposed rock to mimic a natural rock face), and selective planting to break up the scale of the exposed area and soften the contrasts with adjacent areas. Rock staining would also be considered, provided that its application would not affect water quality. Use of the Osprey Point Quarry location would also eliminate effects on Roosevelt National Forest lands because the quarry would be entirely on Denver Water lands. As such, the new proposed quarry location would result in an improvement over the potential effects on aesthetics analyzed in the Final EIS.

Compliance with the project's approved Visual Resources Protection Plan and the addendum required by Forest Service 4(e) condition No. 23 would help address affects to visual resources during construction and throughout the term of the license. In addition, Denver Water would take steps to minimize upward diffusion of light at the construction site by ensuring that yard lights used for nighttime lighting of facilities are downcast. This would reduce night sky effects from stray lighting.

MITIGATION (VIEWSHEDS, SCENIC VISTAS, UNIQUE LANDSCAPES OR LAND FORMATIONS)

Denver Water's License Amendment Application to the FERC (Exhibit 5) evaluated all mitigation measures for visual resources (in Table 5.1-1) as provided below.

Per existing FERC License Article 414, USFS Section 4(e) Condition 23 (Visual Resource Protection Plan Addendum) from the Denver Water/USFS Settlement Agreement, 404 Permit condition to develop a Reclamation Plan for Denver Water lands if the Osprey Point Quarry is developed, and Mitigation required by the FERC in the amended License: For all visual resource impacts on NFS lands, Denver Water will continue to comply with existing FERC License Article 414 for visual resource protection; and Prior to ground-disturbing or construction activities on NFS lands, Denver Water will file with the FERC an addendum to its Article 414 Visual Resources Protection Plan (developed in consultation with the USFS and approved by the FERC on May 22, 2003). The Visual Resources Management Plan will address visual effects from developing an on-site quarry, including reclamation treatments and measures for re-shaping and revegetating disturbed areas to blend with surrounding visual characteristics of the

landscape; and For the Osprey Point Quarry, which is not on NFS lands, Denver Water will prepare a Reclamation Plan to address visual effects with measures similar to those described above.

Per mitigation required by the FERC in the amended License, On Denver Water lands, all staging areas and temporary disturbances will be restored to approximate pre-existing conditions following construction. The majority of the reclamation work will be completed during the last year of construction when quarry operations have finished.

Per mitigation required by the FERC in the amended License, Parking for construction workers will occur primarily on Denver Water land at appropriate locations (e.g., stockpile and staging areas); and Yard lights used for nighttime lighting of facilities will be downcast, thereby minimizing upward diffusion of light at the construction site.

The FERC analysis evaluated the effects of all mitigation measures (Final SEA, Section 5.1.10.2) and concluded the following.

> *Construction-related effects on visual resources would occur during the construction period only, approximately 4.1 years [5.5 including offsite and ancillary improvements to support the dam construction, and the 2014 Final EIS found that these effects would constitute temporary, direct, major adverse effects on visual resources. The visual character after construction would be comparable to current conditions, but the enlarged reservoir would be more of a dominant topographic feature. Reservoir level fluctuations would be similar to current conditions.*
>
> *According to Denver Water's Final Quarry Location Report (Denver Water 2016a), reclamation plans for quarry sites with remaining exposed walls would take into consideration a range of reclamation methods, such as benching, rock sculpting (shaping the exposed rock to mimic a natural rock face), and selective planting to break up the scale of the exposed area and soften the contrasts with adjacent areas. Rock staining would also be considered, provided that its application would not affect water quality. Use of the Osprey Point Quarry location would also eliminate effects on Roosevelt National Forest lands because the quarry would be entirely on Denver Water lands. As such, the new proposed quarry location would result in an improvement over the potential effects on aesthetics analyzed in the Final EIS.*
>
> *Overall, the effects to visual aesthetics discussed above are consistent with the effects identified in the Final EIS, and would not significantly change from those described in the Final EIS. However, the relocation of the quarry site would reduce impacts to visual resources because the quarry would be submerged during operation of the Project.*
>
> *In their comments on the February 6, 2018 Supplemental EA, several entities express concerns about the effects of night sky lighting on visual resources and wildlife, including effects associated with construction and the physical increase in the elevation of the top of the dam compared to current conditions. Such concerns would be addressed through compliance with the project's Visual Resources Protection Plan and the addendum required by the Forest Service, and measures proposed by Denver Water such as use of shielded, downcast, low-sodium lighting*

during construction. Upon completion of construction, the amount of artificial lighting in the area would be essentially the same as the current condition, but at a higher elevation. As such, the incremental adverse effect on night sky conditions would be minimal.

8-507.D.7.b.vii.B, Identify Any Significant Deterioration of Existing Natural Aesthetics, Creation of Visual Blight, Noise Pollution or Obnoxious Odors

Effects on existing natural aesthetics and creation of visual blight which may stem from the proposal have been addressed Section 8-507.D.7.b.vii.A (above) of this 1041 permit application.

The following information and analysis related to noise was gathered for Denver Water's License Amendment Application to the FERC (Section 3.3.14).

AFFECTED ENVIRONMENT (SIGNIFICANT DETERIORATION OF EXISTING NATURAL AESTHETICS, CREATION OF VISUAL BLIGHT, NOISE POLLUTION OR OBNOXIOUS ODORS)

Noise is defined as unwanted sound and is often considered detrimental to human health and the environment (EPA 1974, see Final EIS for reference materials). The types of noise associated with the Project include noise generated by additional vehicular traffic, short-term construction traffic and activities, and facility operating noise.

Measuring Noise

Sound levels vary over a very large range and are usually measured on a logarithmic scale expressed as decibels (dB) in relation to a reference level of zero, which is the threshold of human hearing. Perceived sound is dependent on the wave amplitude (loudness), frequency (pitch), and duration of exposure. As sound propagates logarithmically, sound levels are not additive when combined. For example, if two sounds each of 70 dB occur at the same time, the resultant measured sound is only a 3 dB increase to 73 dB. Additional sounds add proportionately less to the total dB level measured. Frequencies in the range of 1,000 to 6,000 Hertz are heard more easily by the human ear and are therefore weighted higher than those outside this range. "A-weighted" sound levels are those within the frequency range of human hearing (1,000 to 6,000 Hertz), and the measurement convention for this range is referred to as dBA (A-weighted decibel scale [human ear]).

The EPA has adopted the following four descriptors for sound, all normally measured as dBA, which take into account how sound is propagated and heard (EPA 1974, see Final EIS for reference materials):

- A-weighted Sound Level (L_A)—Corresponds to the way the human ear perceives the magnitude of sounds at different frequencies.
- A-weighted Sound Exposure Level (SEL)—This is the intensity of sound measured over a period for time, usually of one-second duration. The SEL allows direct comparison of sounds with different magnitudes and duration.
- Equivalent Sound Level (L_{eq})—A summation of the individual sound energies over a given period of time, usually one hour, expressed in dBA.
- Day-Night Average Sound Level (L_{dn})—This is the L_{eq} for a full 24-hour period, taking into account the increased perception of sound at night by adding 10 dBA to the period between 10 p.m. and 7 a.m.

An additional factor in assessing noise includes the "startle effect" of sudden temporary loud sounds. The startle effect primarily impacts wildlife and can result in breeding disruption (particularly in song birds) and hormonal changes in mammals due to increased release of "fight or flight" hormones (adrenaline and related compounds) (Gladwin et al. 1988, see Final EIS for reference materials). Because the frequency range of sound heard varies significantly among species and is often different from the human range, noise effects on wildlife are not always readily predictable. Typically, the larger the space between the ears, the lower the sound frequency range to which hearing is adjusted.

Noise levels above L_A 134 dBA may cause temporary human hearing impairment, and permanent damage is predicted from exposure to L_A 140 dBA or higher. The EPA has predicted that exposure to an L_{eq} of 70 dBA for 24 hours per day, 365 days per year over 40 years would result in a hearing loss of less than 5 dBA in 96 percent of the population. This degree of loss is generally acceptable for long-term human exposure (EPA 1974, see Final EIS for reference materials). The World Health Organization takes a more protective approach and recommends general human exposure of less than 50 dBA to protect from annoyance during daytime activities and less than 45 dBA at night (WHO 2000, see Final EIS for reference materials).

Noise Criteria

In the Federal-Aid Highway Act of 1970, Congress directed the Federal Highway Administration (FHWA) to develop standards for vehicular noise levels compatible with different land uses. These standards are found in Procedures for Abatement of Highway Traffic Noise and Construction Noise (23 Code of Federal Regulations [CFR] 772).

FHWA's noise policy is implemented through CDOT Noise Analysis and Abatement Guidelines (CDOT 2013, see Final EIS for reference materials). The guidelines state that noise mitigation must be considered for any receptor (i.e., residence or commercial development) where predicted noise levels, using design-year traffic volumes and roadway conditions, approach or exceed the CDOT Noise Abatement Criteria (NAC).

The CDOT NAC are expressed in dBA (Table 67). Also, since passing vehicles generate traffic noise and traffic volumes constantly fluctuate, the L_{eq} is used to characterize traffic noise impacts. The NAC that may apply to the Project are activity categories B, C, D, E, F, and G.

Table 67:
CDOT Noise Abatement Criteria[1]—A-Weighted Sound Level in Decibels (dBA)

Activity Category	$L_{eq}(h)$[2]	Description of Activity Category
A	56 (exterior)	Lands on which serenity and quiet are of extraordinary significance and serve an important public need and where the preservation of those qualities is essential if the area is to continue to serve its intended purpose.
B[3]	66 (exterior)	Residential.
C[3]	66 (exterior)	Active sport areas, amphitheaters, auditoriums, campgrounds, cemeteries, day care centers, hospitals, libraries, medical facilities, parks, picnic areas, places of worship, playgrounds, public meeting rooms, public or nonprofit institutional structures, radio studios, recording studios, recreational areas, Section 4(f) sites, schools, television studios, trails, and trail crossings.

Table 67:
CDOT Noise Abatement Criteria[1]—A-Weighted Sound Level in Decibels (dBA)

Activity Category	$L_{eq}(h)$[2]	Description of Activity Category
D	51 (interior)	Auditoriums, day care centers, hospitals, libraries, medical facilities, places of worship, public meeting rooms, public or nonprofit institutional structures, radio studios, recording studios, schools, and television studios.
E[3]	71 (exterior)	Hotels, motels, offices, restaurants/bars, and other developed lands, properties or activities not included in A-D or F.
G	N/A	Undeveloped lands that are not permitted for development.
F	N/A	Agriculture, airports, bus yards, emergency services, industrial, logging, maintenance facilities, manufacturing, mining, rail yards, retail facilities, ship yards, utilities (water resources, water treatment, electrical), and warehousing.

Source: CDOT (2013) , see Final EIS for reference materials
Notes:
1 CDOT noise impact criteria have been set 1 dBA lower (more stringent) than FHWA values in 23 CFR 772 in order to identify noise levels that "approach" the FHWA criteria.
2 Hourly A-weighted equivalent level for the noisiest hour of the day in the design year.
3 Includes undeveloped lands permitted for this activity category.
dBA = A-weighted decibel scale.
L_{eq} = equivalent sound level, time averaged over a period of emission.
N/A = not applicable (i.e., Noise Abatement Criteria [NAC] Activity Categories F and G receptors are not sensitive to traffic noise or are undeveloped land uses and are not subject to a NAC value).

The CDOT guidelines also state that noise abatement should be considered when the new noise levels resulting from a proposed action "substantially exceed the existing noise levels." This criterion is defined as an increase in the L_{eq} of 10 dBA or more above existing noise levels. In general terms, a doubling in the amount of vehicular traffic results in only a 3 dBA increase in L_{eq}. Therefore, a substantial increase in both vehicular volume and speed would be required to increase sound levels by 10 dBA.

The CDOT guidelines define "noise sensitive receivers," in general, as "any location where traffic noise may be detrimental to the enjoyment and functional use of the property…." Such areas include "areas of frequent human use such as schools, parks, hotels, and commercial centers." Primary consideration is given to outdoor areas of frequent human use that are adjacent to individual properties, such as front and back yards or porch areas of residences, school playgrounds, and areas such as recreational trails and parks.

Under the Noise Control Act of 1972, Congress directed the EPA to conduct research and implement controls of noise on a national level. In 1992, states and local agencies took over the regulation of community noise. Colorado Revised Statutes (CRS) Section-30-15-401(1)(m) authorizes counties to regulate noise on public and private property in Colorado. Maximum permissible noise levels in Colorado are stated in CRS 25-12-103 and are implemented on the county level (Tables 68 and 69). The counties in the Project vicinity—where land disturbing activities and increased vehicular traffic may occur are Boulder and Jefferson counties. Additionally, Gilpin County may see increased traffic related to tree removal activities.

Table 68:
Allowable Noise Levels (dBA) Boulder County

Land Use	7 a.m.–7 p.m. (7 p.m.–7 a.m.)
Residential, public facilities and lands	55 (50)
Construction	80 (75)

Source: Boulder County (1992), see Final EIS for reference materials.
Note:
dBA = A-weighted decibel scale

Table 69:
Allowable Noise Levels (dBA) Jefferson County

Land Use/Zone District	L(25)	L(0)	Periodic/Impulsive
	7 a.m.–7 p.m.	7 a.m.–7 p.m. (7 p.m.–7 a.m.)	7 a.m.–7 p.m. (7 p.m.–7 a.m.)
Residential, Park, School	55	65 (50)	50 (45)
Commercial	60	70 (55)	55 (50)
Light Industrial	70	80 (65)	65 (60)
Industrial	80	90 (75)	75 (70)

Source: Jefferson County 2006, Jefferson County 2011
Notes: L(25) and L(0) are noise frequencies. The (25) and (0) are the percentages of time during a study period that the sound pressure level is exceeded. The Periodic/Impulsive column refers to periodic or impulsive bursts of noise. The allowable noise levels for periodic or impulsive noise is usually 5 dBA below normal allowable noise levels. The allowable noise level in the L(25) column may be exceeded 25 percent of the time. The allowable noise level in the L(0) column may not be exceeded, i.e., this is the maximum allowable noise level.
dBA = A-weighted decibel scale

Gross Reservoir Baseline Noise Survey

A baseline noise survey was conducted at the Project area as part of the FERC relicensing in 1997. The predominant sources of background noise were the rustling of vegetation in the wind, vehicular traffic, and the water flowing from the valve house outlet at the base of the dam. Noise measurements were recorded at the base of Gross Dam where water was rapidly flowing out of the valve house, on the north side of the reservoir in a picnic area about 0.8 mile south of the Lakeshore subdivision, at the recreation area on the south side of Gross Dam (Dam Recreation Area), and at the South parking area.

Noise levels varied considerably between these locations. The noise produced by water flowing out of the valve house below Gross Dam was 80.7 dBA measured at a location 30 feet from the outflow. The average noise on the north side of the reservoir was 50.1 dBA, the average at the south Dam recreation area was 68.6 dBA, and the average at the south parking lot was 55.3 dBA, mainly influenced by human activity and vehicles arriving at and departing from the recreation area (Denver Water 1998b, see Final EIS for reference materials). The background noise levels in the more remote portions of the Project area are estimated to be in an L_{dn} range of 30 to 40 dBA.

A more recent ambient noise survey was conducted in 2017, Gross Dam Noise Impact Report, is provided in Exhibit 15. The study includes an ambient sound level survey that was performed at three receptor locations nearby the Gross Dam over a period of seven days from February 22 to March 1, 2017. The average ambient sound levels for three time periods (day, evening, and night) at the three locations range from 25.8 (receptor location 2 at night) to 54.8 (receptor location 3 at day) dBA.

PROJECT EFFECTS (SIGNIFICANT DETERIORATION OF EXISTING NATURAL AESTHETICS, CREATION OF VISUAL BLIGHT, NOISE POLLUTION OR OBNOXIOUS ODORS)

Comments received during scoping for the Moffat Collection System Project EIS identified construction equipment operational noise as a potential issue.

Noise levels are regulated by the State of Colorado and by Boulder County with the objective of protecting the public from injury and annoyance (Boulder County 1992, CRS Title 25-12-103, EPA 1974, see Final EIS for reference materials). As a general approach to evaluating noise, levels predicted to exceed background are evaluated to determine whether county or state standards or other relevant guidelines could be exceeded. Noise standards and guidelines are summarized in Table 70.

Table 70:
Noise Standards and Guidelines

Affected Resource	Noise Level (dBA)	Comments/Reference
Residential Areas, Outdoor Exposure	55 dBA L_{eq}, 7:00 a.m.–7:00 p.m. 50 dBA L_{eq}, 7:00 p.m.–7:00 a.m.	Protect from annoyance where quiet is a basis for use (EPA 1974, see Final EIS for reference materials). Applies at 25 feet from property line (CRS 25-12-103). See also Areas Affected by Construction, below.
Residential Areas, Indoor Exposure	45 dBA, L_{dn}	Protect from annoyance where quiet is a basis for use (EPA 1974, see Final EIS for reference materials).
Public Areas, Continuous "Background" Exposure	70 dBA, L_{eq}, 24-hour period	Protect from hearing damage (EPA 1974, see Final EIS for reference materials). Applies at 25 feet from property line.
Public Areas, Peak Exposure	120 dBA, L_{eq}, 24-hour period	Protect from hearing damage based on sudden short-term exposure (EPA 1974, see Final EIS for reference materials).
Areas Affected by Construction	80 dBA L_{eq}, in residential zones, 7:00 a.m.–7:00 p.m. 75 dBA L_{eq}, in residential zones, 7:00 p.m.–7:00 a.m.	Boulder County permitted construction noise (Boulder County 1992, CRS 25-12-103). Measured at residential property boundary. OSHA PEL is 90 dBA for workers.
Public Property, Off-road	78 dBA (all motor vehicles)	Measured at 50 feet from source (Boulder County 1992, see Final EIS for reference materials).
	86 dBA (vehicles $\leq$ 35 mph) 88 dBA (vehicles > 35 mph) 80 dBA (motorcycles $\leq$ 35 mph 84 dBA (motorcycles > 35 mph)	Measured at 50 feet from lane of travel (Boulder County 1992, CRS 25-12-103).

Table 70:
Noise Standards and Guidelines

Affected Resource	Noise Level (dBA)	Comments/Reference

Notes:

≤ = less than or equal to
> = greater than
mph = miles per hour
CRS = Colorado Revised Statutes
OSHA = Occupational Safety and Health Administration
dBA = A-weighted decibel scale
PEL = permissible exposure level
L_{eq} = equivalent sound level, time averaged over a period of emission
L_{dn} = day-night average sound level

Denver Water conducted two detailed noise and vibration studies: the *Moffat Collection System Project Noise and Vibration Impact Analysis Report—February 2014,* and the *Gross Dam Noise Impact Report*, which are provided in Exhibit 15. Implementation of the Project would result in temporary noise impacts associated with construction activities. As evaluated in the two detailed noise studies, planned construction activities would not exceed the noise standards.

The equipment used to construct the Project facilities (e.g., loaders, backhoes, scrapers, generators, etc.) generally operate at between 70 and 90 dBA. These noise levels are estimated at 50 feet from the sources and diminish rapidly at greater distances. As a general rule, when the radius or distance that a sound wave travels has doubled, the sound level is reduced by 6 dBA (Whitaker and Benson 2002, see Final EIS for reference materials). Less developed portions of the Project area that are now relatively quiet would generally be more affected by new sources of noise due to the characteristic of sound waves heard from multiple sources not being directly additive. Portions of the Project area currently experiencing more background noise (e.g., near the Dam) would experience minimal change from current levels.

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

GROSS RESERVOIR

Enlarging Gross Reservoir under the Project would require approximately 39 pieces of equipment operating over a 5.5-year construction period including offsite and ancillary improvements to support the dam construction, followed by operation of the dam and reservoir. Operational noise would be generated from sources such as the pump station, generators, and commuting traffic.

On-Site Construction-Related Noise

The numbers, types, and manner of use of equipment proposed to build the dam and reservoir and associated facilities are described in the Project Description section of this 1041 permit application. Assumptions for analysis of on-site construction noise are:

- Construction activity would occur year-round with the majority of the work being completed each year between April and October and would be completed within approximately 5.5 years including offsite and ancillary improvements to support the dam construction. Much of the construction would occur during the day; however, double or triple shifts up to 24 hours per day will occur during the concrete

placement for the dam raise. Work hours for all construction would be limited in conformance with applicable local ordinances.

- Construction equipment would travel little or no mileage off site on public roads.
- Access to the construction areas would be restricted so that the public cannot come into close proximity of loud operating equipment.
- Earth-moving equipment such as loaders, backhoes, scrapers, and heavy trucks would be used; this equipment generally operates within a sound range of 70 to 90 dBA.
- Other stationary and materials handling equipment such as generators, air compressors, rock crushers, and concrete mixers would be used; this equipment generally operates in the range of 70 to 90 dBA to the property line.
- No occupied residences are located within 2,000 feet of the dam construction area.
- Construction equipment used by contractors is assumed to function as designed and to conform to applicable noise emission standards.

The activities associated with the expansion of Gross Reservoir are not predicted to exceed relevant standards or guidelines. On-site construction noise may periodically exceed the EPA noise threshold of 70 dBA for public exposure, but the public would not be exposed to these levels on a continuous basis. The noise levels described are predicted at distances of less than 50 feet from the source and would be temporary and remote. Sound travels omni-directionally (i.e., it does not travel upward or downward), which means that it dissipates outward in all directions; sound levels are generally reduced by 6 dBA as the radius or distance that a sounds wave travels doubles. Thus, noise levels would diminish rapidly with distance. Noise impacts are anticipated to be temporary and moderate during on-site construction.

Tree Removal. Additional noise impacts would occur from tree removal at Gross Reservoir. To minimize problems with floating debris, decaying vegetation, and water quality, all trees greater than 2 inches in diameter would be removed within the area of inundation. It is assumed that trees would be removed between the normal pool elevation (7,282 feet) and 7,406 feet. This activity would take approximately 16 months to complete. On-site temporary noise impacts would occur from timber harvest, yarding, and use of temporary roads. Noise levels would be similar to other construction activities and are not expected to exceed relevant standards and guidelines. Impacts are anticipated to be temporary and moderate.

Blasting. Blasting would occur when on-site aggregate quarries are in operation (approximately the first year of aggregate processing) and in the early phases of construction related to excavation for the dam foundation. Blasting would occur every other day due to the time it takes to drill the blast holes. Blasting would occur only during daylight hours and only once on blasting days. Safety precautions would be taken to keep unauthorized personnel away from blast areas. Blasts would be designed such that holes are appropriately spaced, loaded, and stemmed to prevent air blast and excessive vibration and to limit any rock flying outside of the blast zone. The blasting agent used would likely be Ammonium Nitrate Fuel Oil (ANFO), which, when handled appropriately, is a relatively safe and stable product used in construction and quarrying operations throughout the United States. The blast would be designed to produce relatively low vibration (ground motions) and blasting adjacent to the dam would be controlled to prevent any damage to the dam or the existing foundation. Blasting would be designed specifically for Gross Dam and would only create ground vibrations and land motion appropriate for the dam structure to

sustain. A seismograph would be used to monitor ground motions and air pressure (noise) vibrations produced from the blasting operations to ensure that acceleration thresholds are not exceeded.

All blasting would be designed and overseen by a Colorado-licensed blasting engineer. Denver Water plans to implement confined charge blasting for dam construction to minimize noise, thereby creating only temporary moderate impacts.

Wildlife. Construction may have temporary, minor indirect impacts on wildlife due to noise and disturbance associated with earth-moving and construction activity. Potential impacts to wildlife, including displacement by noise and disturbance resulting from on-site construction, quarrying, and transportation of materials and people, are addressed in Section 8-507.D.7.B.iii of this 1041 permit application.

2017 Noise Study. The most recent noise impact study for the Project is provided in Exhibit 15. Noise model receptor locations were placed at the nearest residences adjacent to the ambient measurement locations. There were no residences identified to the west of the Project area within one mile. Receptor 1 is located at 370 Lakeshore Drive, Boulder approximately 0.65 miles from the dam construction area. Receptor 2 is located off Miramonte Trail approximately 0.4 miles from the Osprey aggregate processing area. Receptor 3 is located off Coal Creek Canyon Road (SH 72) approximately 1.18 miles from the Osprey aggregate processing area.

Model scenarios included Osprey Quarry daytime including haul trucks and Osprey Quarry daytime including conveyor; and Osprey Quarry daytime blasting. Evening and nighttime scenarios were also modeled for construction evening activities and shift work construction. More detailed descriptions of these scenarios are provided in Exhibit 15. Daytime noise levels ranged from 30.9 to 46.3 dBA (Receptor 1); 47.0 to 49.0 dBA (Receptor 2), and 34.1 to 36.9 dBA (Receptor 3). The blasting model results were 34.1, 64.4, and 49.4, respectively for Receptors 1, 2, and 3, respectively.

Noise levels within these ranges are generally representative of a quiet urban environment. It is expected that inside residences, noise levels will be significantly lower and are not likely to be intrusive. The noise modeling results show that the conveyor is louder than using haul trucks. Noise from the haul trucks has been calculated based on an hourly noise level. Realistically, there will be short periods during the hour where noise levels from the haul trucks are above or below the modeled noise level. This variation has been accounted for in the calculation of the hourly noise level. The conveyor noise, however, has been modeled as a constant noise source as little variation in noise levels are expected. To reduce noise from the conveyor, aluminum idler rollers are recommended in place of modeled steel idler rollers.

Off-Site Construction-Related Noise

Off-site construction-related noise is predicted from increased traffic using site access roads. Residential areas may be affected by construction traffic during day-time hours. Projections of estimated peak-hour construction trips based on the Moffat Collection System Project Noise and Vibration Impact Analysis Report—February 2014 (included in Exhibit 15) are summarized in Section 8-507.D.7.b.viii and Table 69 of this 1041 permit application.

Assumptions for the analysis of off-site construction noise are:

- Types of traffic making daily or regular trips to the site include construction workers' vehicles, concrete mixers, and haul trucks carrying borrow material, fly ash, and cement to the site.
- Access roads most frequently used would be SH 72, CR 77S (Gross Dam Road), SH 128, and US 287.

The noise impacts from construction traffic would contribute to the overall background noise levels in the Project area and are anticipated to be temporary and minor. The degree that background noise levels may increase would be related to variations in the construction schedule. Construction traffic is presented in Exhibit 4. Construction traffic noise is predicted to comply with county ordinance requirements.

Offsite impacts would also occur from trucks hauling the forest residue from tree removal at the reservoir (ash, chips, whole trees, logs, and/or firewood) to sites where they would be disposed of or sold. Roads used for access would include Gross Dam Road (CR 77S) from SH 72, CR 97, CR 68, SH 72, and SH 93.

Off-site noise impacts related to construction traffic and to the transportation of forest residue will be minor and temporary.

Post-Construction Activities

The post-construction operations and maintenance workforce for the enlarged Gross Reservoir would not change from current conditions as of 2006, and is not expected to create more noise.

The types of motorized vehicles permitted at Gross Reservoir for recreation are relevant to the analysis of potential noise impacts. Motorized water craft, such as speed boats or jet skis, are not permitted at Gross Reservoir except for emergency rescue purposes. Off-road vehicles, however, are allowed on the land surrounding the reservoir. Speed limits enforced within the Project area would ensure that loud motorized vehicles, such as motorcycles, do not exceed relevant noise criteria or constitute a public nuisance.

Based on the facts that the operations and maintenance workforce will not change as a result of the Project and that recreational use of Gross Reservoir is not predicted to increase, no long-term noise impacts are anticipated from operation of the dam, reservoir, and associated facilities or from continued recreational use of Gross Reservoir.

Summary of Project Effects

Short-term increases in ambient noise levels from construction activities are anticipated from the Project. These impacts would be temporary, localized, and typically limited to daylight hours. Construction activities associated with the expansion of Gross Reservoir are not predicted to exceed relevant standards or guidelines. On-site construction noise may periodically exceed the EPA noise threshold of 70 dBA for public exposure (EPA 1974), but the public would not be exposed to these levels on a continuous basis. In addition, these levels are not predicted at any of the nearest residential locations. On-site noise impacts, including tree removal and localized blasting, are expected to be temporary and moderate during construction.

Off-site construction-related noise is predicted from increased traffic using site access roads. The noise impacts from construction-related traffic would contribute to the overall background noise levels at Gross Reservoir but are expected to be temporary and minor.

Since noise generated by Project construction activities and by construction and commuting traffic is not expected to exceed applicable standards or guidelines on a continuous basis, the temporary noise impacts would contribute to minor to moderate impacts. Post-construction activities associated with operation and maintenance of the facilities at Gross Reservoir and continuing recreation activities would contribute a negligible amount of noise to existing ambient conditions.

Conclusions supported by the FERC in its review of the Project impacts relating to noise pollution or obnoxious odors (FERC Final SEA, Sections 4.1.3 and 5.1.10) were as follows.

> *The proposed use of a quarry on Denver Water's land would significantly reduce the number of vehicle trips to transport materials from off-site from 22 vehicle trips per day to 6 vehicle trips per day, therefore reducing construction-related noise effects.*
>
> *The effects of construction on noise would be short-term, direct, moderate adverse effects. According to the final memorandum evaluating Denver Water's Final Quarry Location Report, the change in location to the Osprey Point quarry would result in similar, moderate, temporary noise impacts on and near the project site since the activities that would be used to produce sand and gravel aggregate on-site are similar to what was assumed for the impact analysis in the Final EIS. Similarly, the blasting frequency would [occur every other day with up to one] blast per day, but the timeframe (approximately the first year of aggregate processing and in the early phases of construction related to the dam foundation excavation) for blasting would be similar to that described in the Final EIS. Off-site noise impacts associated with haul trucks would be significantly reduced compared to what was presented in the Final EIS. Noise effects during project operations would be comparable to current conditions.*
>
> *Denver Water recognizes that any increase in noise levels above ambient will be a different environment than normal in this mountain community. Denver Water intends on using these noise studies as a tool to work with the local community, including Miramonte, to develop measures that aim to monitor, minimize, and mitigate noise disturbance during construction, to the extent reasonable and possible. For example, Denver Water is considering the use of project noise goals and potential forms of restitution when construction activities exceed those goals at determined monitoring locations. Denver Water also proposed in their application to use engineering and administrative controls, which may include modifying the equipment or the work area to make it quieter, substituting existing equipment with quieter equipment, retro-fitting existing equipment with mufflers, modifying backup alarm systems, and/or shutting down noisy equipment when not needed. In addition, Denver Water proposed to implement confined charge blasting for dam construction to minimize noise. Blasting would occur only during daylight hours, and a seismograph would be used to monitor ground motions and air pressure (noise) vibrations produced from the blasting operations to ensure that acceleration thresholds are not exceeded. These measures would help to reduce noise effects due to construction activities.*

Therefore, we [FERC] find that based on noise impact information provided by Denver Water in their application, the use of the new Osprey Point quarry, the results of the February 2017 noise study provided by Denver Water in their May 16, 2017 filing, and the noise impact minimization measures Denver Water proposes, approval of Denver Water's license amendment would have similar noise effects to those identified in the Final EIS.

Denver Water reviewed that its draft Traffic Control Plan (Denver Water 2015) is an example of the traffic control plan it would finalize with Colorado DOT, Boulder County, and affected community members, and then file for Commission approval to address traffic concerns. Denver Water indicated that a jointly-developed plan would include commitments for travel times, roads used or restricted from use, road maintenance, road improvements and other measures to minimize associated impacts from trucks, such as noise, odors, dust, as well as safety measures that could include a shuttle for workers. It also noted that some aspects of trucking specific to tree removal would be addressed in a jointly-developed finalized tree removal plan.

MITIGATION (SIGNIFICANT DETERIORATION OF EXISTING NATURAL AESTHETICS, CREATION OF VISUAL BLIGHT, NOISE POLLUTION OR OBNOXIOUS ODORS)

Denver Water's License Amendment Application to the FERC evaluated all mitigation measures for noise (Exhibit E, Table 5.1) as provided below.

- Denver Water will comply with applicable noise ordinances.
- Denver Water will use engineering and administrative controls, which may include modifying the equipment or the work area to make it quieter, substituting existing equipment with quieter equipment, retro-fitting existing equipment with mufflers, modifying back-up alarm systems, and/or shutting down noisy equipment when not needed.
- Denver Water will implement confined charge blasting for dam construction to minimize noise. Blasting will occur only during daylight hours, and a seismograph will be used to monitor ground motions and air pressure (noise) vibrations produced from the blasting operations to ensure that acceleration thresholds are not exceeded.

The FERC analysis evaluated the effects of all mitigation measures (Final SEA, Section 5.1.10) and concluded the following.

In the Final EIS, the Corps evaluated the effects of the Project on noise. As noted, the proposed use of a quarry on Denver Water's land would significantly reduce the number of vehicle trips to transport materials from off-site from 22 vehicle trips per day to 6 vehicle trips per day [averaged for Project duration], therefore reducing construction-related noise effects.

The Final EIS found that the effects of construction on noise would last approximately 4.1 years [5.5 with offsite and ancillary improvements to support the dam construction], constituting temporary, direct, moderate adverse effects. According to the final memorandum evaluating Denver Water's Final Quarry Location Report), the change in location to the Osprey Point Quarry would result in similar, moderate, temporary noise impacts on and near the project site since the activities that would be used to produce sand and gravel aggregate on-site are similar to what

was assumed for the impact analysis in the Final EIS. Blasting frequency would [occur every other day with to up to one] blast per day, but the timeframe (approximately the first year of aggregate processing and in the early phases of construction related to the dam foundation excavation) for blasting would be similar to that described in the Final EIS. Offsite noise impacts associated with haul trucks would be significantly reduced compared to what was presented in the Final EIS. Noise effects during project operations would be comparable to current conditions.

As described in Denver Water's application, the noise impacts are anticipated to be temporary and moderate during onsite construction. The Osprey Point Quarry is approximately 1,000 feet further from the closest (lakeshore) residential community as compared to the noise analysis performed for the impacts of the Final EIS Quarry. The Osprey Point Quarry would be approximately 1,000 feet closer to the seasonal private property owner (Miramonte) south of Gross Reservoir. Given the location of the Osprey Point Quarry site, noise impacts from quarrying are anticipated to be similar to those impacts identified in the Final EIS.

Denver Water commissioned its Gross Dam Noise Impact Report based on comments from Miramonte, Boulder County and others to better understand what the anticipated noise levels would be to neighbors from the proposed quarry operations at Osprey Point and the dam construction activities. Like the previous noise studies conducted by Denver Water, this study verified the conclusions of the Final EIS and established that noise levels at the Final EIS quarry and at the Osprey Point Quarry would be below local noise ordinances. Nonetheless, Denver Water recognizes that any increase in noise levels above ambient would be a different environment than normal in this mountain community. Denver Water intends on using these noise studies as a tool to work with the local community, including Miramonte, to develop measures that aim to monitor, minimize, and mitigate noise disturbance during construction, to the extent reasonable and possible. For example, Denver Water is considering the use of project noise goals and potential forms of restitution when construction activities exceed those goals at determined monitoring locations. Denver Water also proposed in its application to use engineering and administrative controls, which may include modifying the equipment or the work area to make it quieter, substituting existing equipment with quieter equipment, retro-fitting existing equipment with mufflers, modifying backup alarm systems, and/or shutting down noisy equipment when not needed. In addition, Denver Water proposed to implement confined charge blasting for dam construction to minimize noise. Blasting would occur only during daylight hours, and a seismograph would be used to monitor ground motions and air pressure (noise) vibrations produced from the blasting operations to ensure that acceleration thresholds are not exceeded. These measures would help to reduce noise effects due to construction activities.

Therefore, we [FERC] find that, based on noise impact information provided by Denver Water in its application, the use of the new Osprey Point Quarry, the results of the 2017 noise study, and the noise impact minimization measures Denver Water proposes, approval of Denver Water's license amendment would have similar noise effects to those identified in the Final EIS.

Some commenters state that the study was flawed because it did not evaluate noise effects associated with use of helicopters during construction, with one comment that tree removal would

involve thousands of helicopter flights lasting for years. [Denver Water notes that the draft Tree Removal Plan provided an estimate of 152 days of helicopter operation for tree logging. This is based on the recommended tree removal option and includes approximately 300 acres of trees to be removed with helicopters on the areas with slopes of 40 percent or higher. Note that an additional approximately 185 acres of trees would be removed via feller-buncher and cable techniques. The entire tree removal process is expected to take 7 to 8 months and may be extended over two years due to limitations in the operating or tree felling season.]

The use of helicopters eliminates the need for new logging roads on difficult terrain that would result in additional short-term damage to wildlife and botanical habitat that would require restoration. The Forest Service Environmental Assessment for the Vail Intermountain Fuels Project (Forest Service, 2016) estimated the helicopter noise level at 82 decibels, compared to a log skidder at 20 feet (82-88 dBA), loader at 20 feet (82-90 dBA), woodchipper (120 dBA), chainsaw at 10 feet (100-106 dBA), and heavy trucks (90 dBA). Therefore, the helicopter noise would be on the low end of the noise level compared to other activities required for the tree removal.

Section 8-507.D.7.b.v, Air Quality, addresses impacts to and mitigation measures for air quality.

8-507.D.7.b.vii.C, Identify Visible Structures

Visible structures have been addressed in Section 8-507.D.b.vii.B of this 1041 permit application. Permanent structures that will be visible as a result of the Project include recreation facilities, the dam, the dam control building on the dam, and the existing outlet works and hydropower facility buildings.

Temporary construction buildings will be visible only during construction. Six temporary facility areas will be required for construction of the project. A temporary office complex will include 19 trailers for approximately 50 personnel in an existing cleared area along an access road approximately 0.75 mile south of the main parking lot. A receiving office trailer would provide offices for two personnel at the existing entry area to the reservoir along Gross Dam Road. A 30-foot by 110-foot materials testing lab building would require 6 personnel to be located southeast of the dam along Gross Dam Road. A contractor staging area, shop, and storage area would include 6 trailers for 8 personnel along an existing access road south of the main reservoir parking area. The batch plant offices area would be located nearest the dam and include 3 trailers for 6 personnel adjacent to the existing main parking area. The crusher office would include 1 trailer for two personnel along an existing access road in the vicinity of the southern parking area.

More detailed information on the layout of temporary buildings is included in Figure 27, Exhibit 1.

8-507.D.7.b.viii, Transportation Impacts

Maps and figures showing transportation impacts in the Project area are provided Exhibit 4, Traffic Impact Analysis. Road improvements are shown in Figure 1-1 of Exhibit 1, Site Plan. Exhibit 4 also includes Level of Service (LOS) information and benefit/costs analysis of the proposed transportation improvements.

The following transportation information and analysis was addressed in Denver Water's License Amendment Application to the FERC (Exhibit E, Section 3.3.12).

AFFECTED ENVIRONMENT (TRANSPORTATION)

The Project is located north and west of the Denver Metropolitan Area. The surface transportation network in this area includes both roadways and railroads. The primary entity responsible for transportation planning is the region's Metropolitan Planning Organization, the Denver Regional Council of Governments (DRCOG). Three counties located in the Project vicinity (Boulder, Denver, and Jefferson) participate in the DRCOG, and the proposed Gross Reservoir haul routes also pass through Broomfield and Weld counties. In preparing the regional transportation plan, the DRCOG coordinates with various local, state, and federal agencies, including the Colorado Department of Transportation (CDOT), the Regional Transportation District (RTD), the Regional Air Quality Council (RAQC), Colorado Department of Public Health and Environment (CDPHE), the Federal Highway Administration (FHWA), and the Federal Transit Administration (FTA).

A regional transportation plan (Metro Vision 2030 Plan) was adopted in January 2005 to address the future growth of the Denver Metropolitan Area (DRCOG 2005, see Final EIS for reference materials). The plan was updated by the DRCOG in 2011 to evaluate a new planning horizon of 2035 (DRCOG 2011, see Final EIS for reference materials). The plan provides a vision of how local governments want to see the region develop over the next 25 years and provides a set of policies and implementation actions to achieve this.

Project Area Transportation

There are numerous interstate, state, and county highways and roads in the Project vicinity that would potentially be affected by the Project.

U.S. highways in the region include:

- US 36, which originates in eastern Colorado, runs through Denver, and then northwest to Boulder
- US 287, which originates in eastern Colorado, goes through Denver, and continues north to Fort Collins before entering Wyoming

Exhibit 4 includes the following figures that depict traffic volumes: Figure 2-3. Count Stations along SH 72, Figure 2-4. Count Stations along SH 119, Figure 2-5. Historical AADT Along SH 72, and Figure 2-6. Historical AADT Along SH 119.

Traffic volumes for these and all roadways mentioned in this section were gathered from two main sources, the DRCOG and the CDOT. As such, the traffic data were collected in different years, and data are not available for all locations, particularly minor roadways. Available data for traffic volumes are provided in Sections 2.0 (existing) and 4.0 (Project projections) of Exhibit 4.

Improvements are planned for several roadways in the Project vicinity. The major roadways in the Project vicinity, along with their existing condition and planned improvements, are listed in Table 71.

Union Pacific Railroad's Moffat line extends west from Denver and passes near Gross Reservoir.

Table 71:
Existing Roads and Planned Improvements

Facility	Segment	Existing	Improvement
US 287	Denver to Lafayette	4-lane major regional arterial	None
SH 72	Wheat Ridge to Nederland	2-lane principal arterial	4-lane principal arterial (Wheat Ridge to SH 93)
SH 93	Golden to Boulder	2-lane principal arterial	4-lane principal arterial (Golden to Boulder County line)
SH 119	US 6 to Boulder	2-lane principal arterial	None
SH 128	SH 93 to Broomfield	2-lane principal arterial	4-lane principal arterial
CR 77	Boulder to Gross Reservoir	2-lane arterial	None
CR 77S	SH 72 to Gross Reservoir	2-lane unpaved road	None
CR 2050	County Line Road to Aggregate Facilities	2-lane arterial	None
Arapahoe Road	US 287 Bypass to County Line Road	2-lane arterial	None
Brighton Road	I-76 to SH 22	2-lane arterial	None
County Line Road	Arapahoe Road to CR 2050	2-lane principal arterial	None

Source: DRCOG 2005, DRCOG 2011
Notes:
CR = County Road
I = Interstate
SH = State Highway
US = U.S. Highway

Gross Reservoir Transportation

The most direct route to Gross Reservoir from the Denver Metropolitan Area is from SH 72, a two-lane paved road that runs from Wheat Ridge through the western parts of Arvada, and up through Coal Creek Canyon to the Gross Reservoir area. SH 72 travels through Crescent Village and Wondervu and ultimately connects with SH 119 just south of Nederland and then continues north. At Crescent Village, CR 77S (Gross Dam Road) leads from SH 72 to the turnoff to Gross Dam. Approaching the dam, Gross Dam Road is an unpaved road with numerous sharp curves and steep grades. This portion of Gross Dam Road (Gross Reservoir Access Road) splits at the Gross Dam Headquarters to provide access to the Dam and Haul Road recreation areas to the west and to the Northshore area to the North and Flagstaff Road. CR 77 (Flagstaff Road) also provides access to Gross Reservoir from Boulder, and additional access to Gross Reservoir can be obtained from CR 97, CR 132, and CR 68 and by four-wheel-drive roads on NFS lands. However, these routes are unpaved roads and result in much longer travel times than the SH 72 and Gross Dam Road route.

PROJECT EFFECTS (TRANSPORTATION)

Pursuant to FERC Order Article 425, within one year of the date of FERC's Order and after conferring with certain governmental stakeholders, including Boulder County, Denver Water must submit a Traffic Management Plan for FERC's review and approval. Denver Water will provide the draft Traffic

Management Plan to Boulder County for review and comment in accordance with the terms of FERC's Order.

This section describes the direct and indirect impacts to transportation expected to occur as a result of implementing the Project.

A detailed description of how and where construction vehicles would gain access for the initial construction phase of the Project is provided in the Traffic Impact Analysis included as Exhibit 4.

Potential impacts to transportation on roadways in the Project area are associated with temporary construction traffic, ongoing maintenance and operations of Project facilities, and recreational traffic at Gross Reservoir. Other transportation issues include construction workforce, construction equipment, haul trucks, roadway standards and surface conditions, maintenance and operations, and recreational traffic. The volume of traffic during construction could vary significantly from month to month and day to day, depending upon phasing and the type and number of construction activities taking place.

The traffic impact analysis focused on the "worst case" traffic conditions, years 2025 and 2026, generated by construction traffic as the basis for evaluating traffic impacts. Total construction traffic on the east access to the Project jobsite in 2026 will consist of truck traffic delivering cement and fly ash, tree removal truck traffic, and traffic from construction workers commuting to and from the site.

The required construction workforce is expected to generate between 50 and 152 commuting worker vehicles and haul trucks (as presented in Exhibit 4), based on the latest construction evaluations prepared by Denver Water in coordination with the Construction Manager General Contractor (CM/GC) and feedback from stakeholders. This range is based on input from the CM/GC and considers a combination of carpooling and busing during periods of peak construction activities. Considering the expected range of commuting workforce vehicles the traffic analysis was completed for both a "Low" and a "High" estimated workforce, to provide a thorough review of the possible impacts. This range is expected to bracket the final estimate of construction workforce, which will be developed by the CM/GC based on the final schedule and estimate of resources for construction of the GRE project.

The timing for deliveries of cement and fly ash can easily be adjusted to accommodate the traffic restrictions established by Denver Water for the GRE project, as well as critical commute times. It is anticipated that time windows early in the morning and later at night will be favored. However, for the purposes of this study, the design hourly traffic volumes are conservatively assumed to occur during the morning peak hour outside of school bus timing (the afternoon school bus hours will be avoided as well). In addition, 2025 and 2026 are assumed as the construction years, which correspond to the higher demand of RCC production, based on the current schedule.

The following two scenarios are considered:

> **Material Delivery and Workforce Traffic, Scenario 1**: all cement and fly ash delivery trucks and the entire work force arrives at the site during the morning peak hour. This is considered a conservative assessment even during peak RCC placement periods.

Material Delivery and Workforce Traffic, Scenario 2: all cement and fly ash trucks arrive at the site in the early morning between 5:00 and 7:00 AM and are departing the site during the morning peak hour while the workers are arriving.

Total peak hour material delivery and workforce trip generation is therefore estimated with the following formula:

Total Peak Hour Material Delivery and Workforce Traffic = (# of trucks during the peak hour * passenger car equivalency factor) + (day shift labor force / auto occupancy factor)

Assuming a 3.0 passenger car equivalency factor for trailer trucks (as required by CDOT) and a 1.5 auto occupancy factor for the workers commuting to the site:

Scenario 1 Low: Total Peak Hour Material Delivery and Workforce Traffic =
(15 x 3) + (75 / 1.5) = 95 inbound passenger car equivalent trips.

Scenario 1 High: Total Peak Hour Material Delivery and Workforce Traffic =
(15 x 3) + (151 / 1.5) = 146 inbound passenger car equivalent trips.

Scenario 2 Low: Total Peak Hour Material Delivery and Workforce Traffic =
(75 / 1.5) = 50 inbound passenger car equivalent trips and (15 x 3) = 45 outbound passenger car equivalent trips.

Scenario 2 High: Total Peak Hour Material Delivery and Workforce Traffic =
(151 / 1.5) = 101 inbound passenger car equivalent trips and (15 x 3) = 45 outbound passenger car equivalent trips.

Implementation of the Project would create temporary transportation impacts related to construction. Numerous road segments on-site would need to be abandoned and relocated to facilitate construction activities and an expanded inundation area at Gross Reservoir. For example, road segments would need to be relocated out of the new reservoir inundation boundary and spillway facilities. A portion of the existing access road would be relocated in two locations around the saddle dam. Road improvements and relocations necessary for construction of the Project are provided in Exhibit 4.

North and south of Gross Dam, two road segments on-site that currently provide access to the dam would be abandoned due to inundation, and these segments would be relocated. Approximately 1,500 feet of the north abutment access road would be relocated to the east at an elevation 100 feet higher than the existing access road, and approximately 1,500 feet of the south abutment access road would be relocated farther to the south. Both relocated road segments would be gravel surfaced and approximately 30 feet wide. All abandoned road segments above new the normal water line would be restored by regrading and seeding.

Methodology

Construction Commuting Workforce Vehicles. Workers commuting to construction sites were estimated based on anticipated production rates. Estimated commuting workforce vehicle trips are summarized in Section 4.0 of Exhibit 4.

Construction Equipment. A wide variety of machinery would be used for construction activities. Construction equipment would travel little or not at all off site on public roads.

Supply Trucks for Gross Reservoir Expansion. Denver Water estimates up to 7,200 tons (approximately 288 trucks) of cement and fly ash deliveries will be required every week during RCC production. This volume of truck deliveries is considered to be a conservatively high estimate for planning purposes. Haul trucks (15-cubic-yard capacity) would import off-site concrete materials using public roads. Commercial suppliers in the Longmont area (48 miles one-way between Longmont and Gross Reservoir) are assumed for purposes of the analysis.

Construction Schedule. Concrete placing would occur over two-years and would be performed 24 hours per day during the construction season. Concrete would not be placed during the winter due to cold temperatures. During concrete placement, night work and noise impacts can be expected, although Denver Water will try to minimize disturbance at night. Otherwise, construction is expected 12 hours per day, 5 to 6 days per week. Expansion of the dam, reservoir, and related facilities is expected to be completed within a 5.5-year period and that includes offsite and ancillary improvements to support the dam construction.

Construction-Related Traffic Impacts

The Traffic Impact Analysis included as Exhibit 4 provides detailed information regarding construction-related traffic and travel trips.

Exhibit 4 also provides detailed information regarding construction supply delivery trips. For particular concern for these traffic studies is the delivery of cement and fly ash, which is anticipated to commence in late 2024, with the majority of deliveries taking place in years 2025 and 2026. According to the cement and the fly ash haul study and the current construction schedule, Denver Water estimates up to 7,200 tons (approximately 288 trucks) of cement and fly ash deliveries will be required every week during peak RCC production. This volume of truck deliveries is considered to be a conservatively high estimate. The proposed single route for deliveries of cement and fly ash material was determined with previous study efforts and includes approximately 13 miles of travel on SH 72 between SH 93 and Gross Dam Road and approximately 4 miles of travel on Gross Dam Road. The previous and current traffic studies use SH 93 as a starting point for this work as this is the point where the larger multiple lane roads change into a single lane in each direction.

In general, construction activities will result in increased traffic on SH 72 between SH 93 and Gross Dam. The highest impacts will be during deliveries of cement and fly ash materials during dam raise activities (Table 4). Exhibit 4 examines these traffic impacts, including mitigation of the intersection at SH 72/Gross Dam Road and along Gross Dam Road (a Boulder County road). Of the alternatives, CDOT prefers a new intersection as documented in a May 21, 2019 review memorandum included in Exhibit 4. Denver Water

is working with CDOT on the final design. Denver Water will coordinate with the Boulder County Transportation Department to obtain an access permit.

Additional information regarding material delivery traffic as combined with workforce traffic is provided in Section 3.2 of Exhibit 4.

Construction Commuting Workforce Vehicles. Workers commuting to construction sites were estimated to be between 75 and 151 trips based on anticipated production rates. Estimated commuting workforce vehicle trips are summarized in Section 4.0 of Exhibit 4, resulting in temporary minor impacts to SH72 and minor to moderate impacts to Gross Dam Road.

Construction Equipment Travel Trips. Due to the varying amount of construction equipment needed and the absence of a detailed mobilization schedule, the equipment is assumed to be mobilized over a 2-day period at the beginning of the Project and demobilized over a 2-day period at the end of the Project. An estimated 39 pieces of equipment are required for the dam and reservoir construction. This equates to an average of approximately 20 pieces of equipment transported per day during the 2-day mobilization and 2-day demobilization period. Assuming that 10 percent of this movement occurs during peak hours, there would be four peak-hour trips for construction equipment, resulting in temporary minor impacts.

Denver Water conducted detailed haul-related studies including the Traffic Impact Analysis provided in Exhibit 4. As part of a 2012 haul study, Denver Water evaluated industry criteria as defined by the American Association of State Highway and Transportation Officials (AASHTO) for adding a climbing lane to SH 72. The study determined that a climbing lane is not justified per the AASHTO criteria based on the existing traffic volumes obtained by CDOT and the estimated Project volumes. The study identified alternatives for providing passing opportunities along SH 72, including enhancing existing pullouts and/or shoulder sections.

Supply Delivery Trips. As with the construction equipment, the number of construction supply deliveries needed varies significantly over the construction period. Supply delivery trips are accounted for in the Traffic Impact Analysis in Exhibit 4.

The anticipated construction related traffic impacts would have negligible impact on the operating conditions (i.e., level of service) of the freeways, major arterials, and minor arterials that serve the Gross Reservoir site. The roadways that would be affected during construction of the dam and reservoir are CR 77S and SH 72. SH 93, SH 128, US 287, Arapahoe Road (US 287 bypass to County Line Road), County Line Road, and CR 2050 would be affected by haul and supply delivery traffic.

Most of the roadways serving the Gross Reservoir site are designed to accommodate large, heavy construction vehicles and are in good condition. However, Gross Dam Road (CR 77S) is a steep, curvy, unpaved road, and, although it is maintained in good condition, heavy equipment and haul trucks could cause rutting in this segment of the route. Denver Water would improve the roads in the Project vicinity to accommodate construction activities.

Temporary, moderate indirect impacts to traffic operations would include 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. Traffic on Gross Dam Road is predominantly recreational and typically does not occur during peak-hour times. During construction, dam access would be limited for all traffic. However, the frequency (times per day) and duration (total minutes) of traffic delays and the numbers of people affected by them would pose no significant indirect impacts.

Tree Removal. To minimize problems with floating debris, decaying vegetation, and water quality concerns, trees would be removed within the area of new inundation. It is assumed that trees would be removed between the normal pool elevation (7,282 feet) and 7,406 feet. Options for disposal include use of biochar, air curtain destructors to incinerate the material on site and disposal of the ash in a landfill, grinding whole trees and removing the chips to a landfill, hauling whole trees to a landfill, and/or removal of forest products (logs and firewood). Hauling whole trees to a landfill would require the most heavy truck traffic, and incinerating the trees on site and disposing of the ash in a landfill would require the least.

Exhibit 4 provides information regarding tree removal trips. The Project will require clearing of vegetation and removal of trees, which will be performed in phases. Vegetation and tree clearing will contribute to the additional heavy-haul trucks on highways near the Gross Dam site. Limited vegetation and tree removal are expected to occur in 2022 and 2023 to support Site Development construction activities, with the removal of trees within the footprint of the raised reservoir area as the last phase with the largest volume of tree removal expected to take place later in the construction phasing.

The tree removal materials are planned to be transported away from the site using different routes from the east and west sides of the Gross Reservoir. For tree removal from the east side of the Gross Reservoir, transport trucks are planned to use the proposed routes for cement and fly ash material deliveries to/from SH 93. For tree removal from the west side of the Gross Reservoir, the proposed route includes approximately 3.2 miles of travel on Lazy Z (CR 97E) road to CR 132 and approximately 24 miles of travel on SH 119 between US 6 and County Road (CR) 132. Transport of these materials will result in increased traffic on the west side access routes, however the existing traffic volumes on these roadways are very low and impacts to the traveling public will not be significant.

The Corps considered that traffic related to tree removal would result in moderate temporary impacts.

Maintenance and Operations

No changes in maintenance and operations trips for the dam and reservoir are anticipated once construction activities are complete. CDOT is responsible for maintenance of the state highways. Boulder County is responsible for maintenance of CR 77S from SH 72 to the railroad tracks, and Denver Water currently maintains CR 77S from the railroad track crossing to Flagstaff Road (CR 77), which will continue following the completion of the Project.

Recreational Traffic

At the anticipated normal water elevation of 7,406 feet, an enlarged Gross Reservoir is anticipated to have a surface area of approximately 842 acres under the Project. This represents an additional 424 acres, approximately double the existing surface area of the reservoir. Prior to 2005, no water boating

was permitted at the reservoir. Per the current FERC Gross Reservoir *Recreation Management Plan*, car-top boating is now allowed from Memorial Day through the end of September. Enlarging the surface area of Gross Reservoir would provide substantial additional space on which people could recreate via car-top boating. In addition, reservoir expansion would create additional shoreline. The enlarged reservoir is anticipated to have approximately 13.9 miles of shoreline, representing approximately 2.8 miles more shoreline than currently exists. The presence of additional shoreline may provide additional dispersed shoreline recreation opportunities such as fishing. However, in accordance with Denver Water's FERC License Amendment Application, no additional developed recreation sites are planned.

The increased surface area and shoreline created as a result of an enlarged reservoir may result in some increased use and, consequently, increased traffic on certain roads leading to the reservoir. A major increase in visitation is not expected because the overall attractiveness of Gross Reservoir to recreation users is not expected to change substantially. Much of the shoreline would remain steep, and seasonal fluctuations in water levels would continue. In addition, Denver Water intends to adhere to the recreation use and opportunities in its current *Recreation Management Plan*, which was approved by the FERC with considerable stakeholder and agency input. In the amended Recreation Management Plan, Denver Water will relocate recreation facilities that will be inundated. Denver Water has not proposed to increase parking spaces, season of use, and/or hours of operation or to change the types of activities that are currently allowed. Under the Project, vehicle access to Gross Reservoir via the existing north and south public access points would remain unchanged.

During construction, recreational access in the area of the dam would be limited. The north side of the reservoir would still be accessible via Flagstaff Road (CR 77) from the City of Boulder and Gross Dam Road (CR 77 S).

During construction, recreational traffic would be routed and would experience delays due to queuing behind slower-moving equipment and haul trucks on two-lane roads and queuing at intersections. Many of the same physical roadway conditions that are issues for construction vehicles (e.g., sharp turns) also apply to recreational traffic and would result in moderate temporary impacts.

Safety and Emergency Access at Gross Reservoir

Comments related to bike safety were received on the Corps' Draft EIS for the Moffat Collection System Project. Denver Water evaluated establishing a bike path and determined that this option would not be feasible due to space constraints and cost. The assumption is that construction contractors will comply with health and safety plans and codes instituted by their respective companies and Denver Water. A contractor hired by Denver Water would be in charge of construction activity, including safety compliance. Denver Water also plans to have staff on site during construction.

With the exception of limited road closures planned near the dam, emergency vehicles would have access to the same response routes during construction as currently exist. If an emergency vehicle needs access to a closed road, access would be granted. Additionally, construction contractors would pull over to allow emergency response vehicles to pass, as needed.

Transportation Master Plan

Denver Water has reviewed the approved 2012 Boulder County Transportation Master Plan. The Plan includes Strategy No. 5: Enhance Mountain Area Connections. The proposed improvements to Gross Dam Road and the SH 72 intersection meet this strategic objective because the improvements will provide safer roadway geometry. CDOT and Denver Water have had preliminary discussion on a realignment of the Gross Dam Road and the SH 72 intersection and Denver Water is moving forward in the design process and incorporating CDOT's comments and preferences.

Summary of Project Effects to Transportation

The Corps considers the incremental effects on transportation associated with the Project to generally be minor and temporary. The maximum construction duration would be approximately 5.5 years including offsite and ancillary improvements to support the dam construction, and traffic impacts would end when construction is completed. The traffic impacts from facility maintenance operations would be ongoing and relatively minor and would be negligible.

Expansion of the dam, reservoir, and related facilities under the Project is expected to be completed within a 5.5-year timeline that includes offsite and ancillary improvements to support the dam construction

Additional shoreline created under the Project may increase recreational traffic on certain roads leading to the reservoir, creating negligible effects relative to current and projected regional traffic volumes and patterns in the Project area. Overall, long-term minimal effects to transportation are anticipated in the Gross Reservoir area.

Conclusions supported by the FERC in its review of the Project impacts related to transportation (Final SEA, Section 5.1.9, pages 73-74) were as follows.

> *The 2014 Final EIS reviewed effects on transportation, traffic, and public safety associated with Denver Water's proposal to raise Gross Dam and enlarge Gross Reservoir. The analysis in the Final EIS was based on the assumption that, in addition to all other materials and equipment needed for the construction of the dam and enlargement of the reservoir, approximately 370,000 cubic yards of aggregate would be trucked to the construction site at the dam. This estimate was based on the preliminary estimate of how much aggregate material could be obtained from a quarry site on Forest Service lands within the footprint of the proposed reservoir enlargement. In summary, the Final EIS found that there would be temporary, minor to moderate effects on traffic operations during construction.*
>
> *Since issuance of the 2014 Final EIS, Denver Water conducted additional on-site investigations that determined that all of the aggregate material can be obtained on-site, either from the Final EIS quarry location or from another site at Osprey Point. As such, a significant portion of the truck traffic required for transport of construction materials from off-site locations is no longer necessary.*

Conclusions supported by the FERC in its review of the Project impacts and mitigation related to transportation (Final SEA, Section 5.1.9.2, pages 74-78) were as follows.

> *Potential effects of transportation on roadways in the project area are associated with temporary construction traffic, ongoing maintenance and operations of project facilities, and recreational traffic at Gross Reservoir. Other transportation issues include construction workforce, construction equipment, haul trucks, and roadway standards and surface conditions. Section 5.12.1 of the Final EIS provides estimates of construction related impacts for the proposed action [the Project].*
>
> *When the Final EIS was prepared, Denver Water had estimated that only a portion (426,000 cubic yards of the total 796,000 cubic yards needed) of the aggregate needed could be extracted from a quarry site to be located on Forest Service land in the existing reservoir, with the remaining aggregate material trucked in from Fort Upton, Colorado (northeast of Denver), about 50 miles from the site. The potential route would use the following roads in Colorado: SH 52; I-25; SHs E-470, 128, 93, and 72; and CR 77S.*
>
> *Flyash material would be transported to the project site from the Jim Bridger coalfired power plant in Point of Rocks, Wyoming (southwestern Wyoming), approximately 350 miles away from the site. The potential route would use the following roads in Colorado: US Highway 287; I-25; SHs E-470, 128, 93, and 72; and CR 77S. Cement would be transported from Portland, Colorado (south-central Colorado), about 144.9 miles from the site. The potential route would use the following roads in Colorado: SH 115; I-25; SH 470; I-70; SHs 58, SH 93, and 72; and CR 77S.*
>
> *In its license application, Denver Water stated that subsequent investigations determined that all of the aggregate material could be derived onsite, thereby eliminating the need to truck aggregate material from the off-site location. With this significant change, Denver Water estimates that 6,552 truck trips would be necessary to haul only the materials that cannot be produced on-site (cement and flyash) from an off-site location. This represents an approximate 72% reduction from the approximate 23,452 truck trips estimate that can be calculated based on data in the FEIS. This would greatly reduce the traffic to the project site on local roads, and therefore, greatly reduce effects on local roadways. However, it is important to note that regardless of the quarry location, the estimates for certain types of traffic that are not associated with deliveries, including construction workforce travel trips, construction equipment travel trips, and tree removal and disposal, traffic impacts discussed in Section 5.12.1 of the Final EIS would remain unchanged.*
>
> *For the proposed action [the Project], numerous on-site road segments would need to be abandoned and relocated, or would be newly constructed, in order to facilitate construction operations. Road segments would need to be relocated out of the proposed reservoir inundation boundary and out of the proposed footprints for the dam enlargement and spillway facilities. An updated Erosion Control and Reclamation Plan (Forest Service 4(e) Condition 19) and a Road Maintenance Plan (Forest Service 4(e) Condition 10) would address requirements for road work on Forest Service lands. Access to the dam would be available using the existing Gross Dam Road. However, minor road relocations would be necessary at the north and south dam*

abutments. These relocated road segments would be gravel surfaced and approximately 30-50 feet wide. Postconstruction, abandoned road segments above the new normal water line would be restored using techniques such as re-grading and seeding. No other roads in the proposed project area would need permanent improvements.

To work towards minimizing effects of project construction on transportation, Denver Water developed its draft Traffic Control Plan (Denver Water 2015). The plan was developed to address the concerns related to truck traffic and to increase public awareness of trucking in the corridor. As discussed above, Denver Water plans to submit a final Traffic Management Plan to the Commission after incorporating input from stakeholders. Denver Water indicates that it developed its draft Traffic Control Plan to stimulate the discussions in that collaborative process. The draft Traffic Control Plan provides a basic understanding of the existing traffic conditions along SH 72 and an overview of the material hauling and construction traffic and the impacts caused by both. It recommends traffic control devices that will alert the public when active hauling is ongoing and when and where flagging operations are ongoing and only permit one-way travel on a roadway. These devices include dynamic signs that can change messages and static signs with flashing beacons that can be turned on or off during active hauling hours. The Traffic Control Plan contains recommendations for the maintenance of striping along SH 72 and supervision of these activities. It also addresses how to handle additional maintenance items such as the condition of the roadway surface and the presence of dust. The final Traffic Management Plan, once developed, would be submitted for Commission approval.

Boulder County stated that Denver Water did not discuss the effects of worker commuting traffic. However, this information was reviewed in Table 3.3.12-2 of Denver Water's amendment application Exhibit E, and in Table 5.12-1 in the Final EIS.

The updated information Denver Water provided in the amendment application, as discussed above, indicates that the use of an on-site quarry to obtain all of the aggregate material needed for construction would significantly reduce the transportation-related effects presented in the Final EIS.

Beverly Kurtz raised concerns about dust pollution from the quarry operations and the effects on residents and wildlife. Denver Water proposes BMPs to address dust in its draft Traffic Control Plan for control of erosion and sedimentation, and it also proposes to prepare a Fugitive Dust Control Plan. Denver Water indicates that BMPs in its final Traffic Management Plan would include measures such as application of water to reduce dust along project roadways. Also, Denver Water's proposed Quarry Operation Plan and Quarry Reclamation Plan would include measures to reduce, control, and/or mitigate effects of quarry development and operations, as well as final grading of the quarry site. In addition, Denver Water would include in its final tree removal plan (Forest Service 4(e) Condition 28) measures to address road construction, road improvements, and hauling associated with tree removal.

Several commenters expressed concerns about traffic safety on local roadways due to the size of the vehicles that would be using the roadways, the number of vehicles, and the existing roadway

conditions. Denver Water identified the roadways that would be used to bring workers and materials to the construction site. As discussed, Denver Water proposes to develop a Traffic Management Plan and to address effects of construction on project and local roadways and a Road Maintenance Plan for effects of construction on Forest Service lands and roads. Forest Service 4(e) condition 29 would require Denver Water to review its existing Public Safety and Law Enforcement Plan following construction and revise the plan as necessary, in consultation with the Forest Service, to address any new concerns on Forest Service lands. This measure would ensure any new safety hazards associated with the new reservoir level and modifications to project roads would be identified and addressed as appropriate.

In addition, Denver Water proposes to restrict vehicles associated with mass concrete placement from using Flagstaff Road. Denver Water proposes to provide public notices for project-related road closures and timelines for construction activities associated with the project. Denver Water proposes to develop a road maintenance plan for use, maintenance, reconstruction, and relocation of roads on Forest Service lands that are used for project purposes, including portions of Miramonte Road and Gross Dam Road that would be relocated. Finally, Denver Water proposes to provide parking for construction workers on Denver Water land at appropriate locations (e.g., stockpile and staging areas). These measures would help to reduce project effects on transportation, traffic, and public safety during the construction period.

Overall, effects on transportation, traffic, and public safety arising from the proposed action [the Project] are mostly consistent with those identified in the Final EIS. However, Denver Water being able to obtain all of the needed aggregate from an onsite quarry would significantly reduce (by 72%) the need to truck in material from locations about 50 miles from the construction site. The FEIS concluded that the "temporary moderate indirect impacts to traffic operations" would "pose no significant indirect impacts" to transportation. Therefore, approval of Denver Water's license amendment, in consideration of the new on-site quarry location and the implementation of a finalized Traffic Management Plan, Erosion Control and Reclamation Plan, Road Maintenance Plan, and Tree Removal Plan would reduce effects to transportation and traffic from those identified in the Final EIS.

MITIGATION (TRANSPORTATION)

Denver Water's License Amendment Application to the FERC evaluated all mitigation measures for transportation (Exhibit E, Table 5.1) as provided below. In consultation with Jefferson County, Boulder County, CDOT, the USFS, and the local community, Denver Water will prepare a Traffic Management Plan to manage construction traffic in a way that minimizes construction traffic impacts. Denver Water will submit the final Traffic Management Plan to the FERC prior to land-disturbing activities. The Traffic Management Plan will include various measures that Denver Water will implement, e.g., restricting the time or days for truck traffic and asking that contractors encourage carpooling to the work site. The Traffic Management Plan will also include road maintenance measures. For example, during construction, Denver Water or its contractor would be responsible for maintaining all of Gross Dam Road (CR 77S). Denver Water is committed to being responsible for any paving or other measures necessary to correct any damage caused by

project-related activities and will continue to do so during construction. After construction has ended, Denver Water will meet with CDOT and Boulder and Jefferson counties to address any road damage resulting from construction-related activities. It is Denver Water's intention to restore county roads to their pre-construction conditions should damage occur during construction activity at Gross Reservoir. The Traffic Management Plan will also consider development of necessary road improvements. The Traffic Management Plan will include goals from Boulder County regulations that are applicable to affected Boulder County roads, which are: to ensure that community traffic needs are met and that desirable community patterns are not disrupted. The Traffic Management Plan will also include consideration of avoidance and minimization of associated nuisance factors such as noise, light, and obnoxious odors.

Denver Water commits to restricting trucks hauling materials associated with mass concrete placement from using Flagstaff Road.

Denver Water will provide public notices for Project-related road closures and timelines for construction activities associated with the Project.

Denver Water will make any necessary road improvements in compliance with permits from local governments and CDOT.

Road maintenance of State and County roads: Boulder County maintains Gross Dam Road (CR77S) from SH 72 to the railroad tracks, and Denver Water maintains Gross Dam Road from the railroad tracks to Flagstaff Road. During construction, Denver Water or its contractor will be responsible for maintaining all of Gross Dam Road. Road maintenance measures are included in the Traffic Management Plan described above. The roadways of particular interest are SH 72 from Colorado 93 to the turnoff for Gross Dam Road and Gross Dam Road from SH 72 to the railroad tracks.

Per anticipated CDPHE air quality permits, prior to construction, Denver Water or its contractor will obtain and comply with necessary CDPHE air quality permits, including developing a Fugitive Dust Control Plan. The Fugitive Dust Control Plan will outline specific steps to be taken to minimize the generation of fugitive dust and will include control measures such as watering unpaved roads or applying chemical stabilizers, as necessary. Speed limits will be posted and enforced.

Per the proposed USFS Section 4(e) Condition 10 (Use of Roads on National Forest System Lands) from the Denver Water/USFS Settlement Agreement: Denver Water will develop a Road Maintenance Plan for use, maintenance, reconstruction, and relocation of roads on NFS lands that are used for Project purposes, including portions of Miramonte Road and Gross Dam Road that will need to be relocated. This plan will include cost sharing of USFS road maintenance and will also address road maintenance for non-USFS roads that are on NFS lands.

The more recent Traffic Impact Analysis included in Exhibit 4 evaluates traffic impacts and mitigation measures to reduce impacts. Most specifically, Section 8.0 of Exhibit 4 includes proposed 60% design traffic control measures.

8-507.D.7.b.ix, Less Damaging Alternatives

The following summary of alternatives and the Corps' conclusions about the environmentally preferable alternative were included in the Corps' ROD (Section 4.0, pages 8–15).

> *Conducting an alternatives analysis early in the EIS development process that meets both NEPA and Clean Water Act Section 404(b)(1) Guidelines is important in ensuring that alternatives evaluated in detail are reasonable and practicable, and meet the Corps independently verified purpose and need, overall Project purpose, and the Applicant's stated purpose and need.*
>
> *The Corps conducted extensive screening of more than 300 water supply sources and infrastructure components that were developed into 34 alternatives. Further screening using NEPA criteria and the Clean Water Act Section 404(b)(1) Guidelines, led to the development of five action alternatives and a No Action Alternative that were carried forward for analysis in Chapter 2 of the Final EIS. The six alternatives analyzed in detail in the Final EIS are presented below.*

NO ACTION ALTERNATIVE

> *NEPA requires the analysis of a No Action Alternative (40 CFR 1502.14). The No Action Alternative does not necessarily require the continuation of current conditions or the status quo, but rather a reasonable projection of future conditions or actions if the [Project is not implemented]. Under the No Action Alternative for the Moffat Project, Denver Water would not receive a Section 404 Permit for the Moffat Project. Denver Water would therefore need to consider components that would not require a Corps Section 404 Permit and primarily consisted of further developing and implementing conservation, non-potable recycling, and cooperative action programs, as well as making further refinements to the water supply and treatment system. Even with these measures, demand would exceed supply in the near future (currently estimated to be around 2022).*
>
> *To meet increasing demands under the No Action Alternative, Denver Water would be required to use a combination of strategies including using part of its Strategic Water Reserve and implementing more frequent and severe mandatory watering restrictions during droughts to reduce demand. These strategies, however, would not meet the overall Project purpose, and would not resolve the vulnerability, flexibility, and reliability needs as described in the ROD.*
>
> *In attempting to meet future demands with existing facilities, it is possible that additional operational costs for pumping or treatment might occur, but such costs would be episodic and cannot be predicted.*

ALTERNATIVES CONSIDERED

The Project—Applicant's Preferred Alternative (Alternative la) -- Gross Reservoir Expansion (72,000 AF) and Environmental Pool (5,000 AF)

Under the Applicant's Preferred Alternative [the Project], Denver Water would expand Gross Reservoir to a total storage capacity of 118,811 AF, of which 113,811 AF would be available for municipal and industrial use, and 5,000 AF would be used for an Environmental Pool. The Environmental Pool was incorporated as a minimization measure into the Applicant's Preferred Alternative between the Draft EIS and the Final EIS and did not increase impacts to jurisdictional Waters of the U.S. This additional storage would satisfy the Project need of 18,000 AF of new firm yield. Details of the components, construction, and operation of the Applicant's Preferred Alternative are provided in the Final EIS.

Alternative 1c—Gross Reservoir Expansion (40,700 AF)/New Leyden Gulch Reservoir (31,300 AF)

Alternative 1c consists of a smaller expansion of Gross Reservoir and construction of a new off-channel reservoir called Leyden Gulch. Gross Reservoir was assumed to be expanded to a total storage capacity of 82,511 AF, and Leyden Gulch Reservoir was assumed to provide 31,300 AF of storage. Details of components, construction, and operation of Alternative 1c are provided in the Final EIS.

Alternative 8a—Gross Reservoir Expansion (52,000 AF)/Reusable Return Flows/Gravel Pit Storage (5,000 AF)

Alternative 8a consisted of an expanded Gross Reservoir (total storage capacity of 93,811 AF) that would provide 13,000 AF/yr of new firm yield, as well as new diversion structures and gravel pit storage facilities along the South Platte River that would provide the remaining 5,000 AF/yr of new firm yield required. Details of components, construction, and operation of Alternative 8a are provided in the Final EIS.

Alternative 10a—Gross Reservoir Expansion (52,000 AF)/Reusable Return Flows/Denver Basin Aquifer Storage (20,000 AF)

Alternative 10a consisted of an expanded Gross Reservoir (total storage capacity of 93,811 AF) that would provide 13,000 AF/yr of new firm yield, as well as reusable return flows and deep aquifer storage and recovery to meet the required 18,000 AF of new firm yield. Details of components, construction, and operation of Alternative 10a are provided in the Final EIS.

Alternative 13a—Gross Reservoir Expansion (60,000 AF)/Transfer of Agricultural Water Rights/Gravel Pit Storage (3,625 AF)

Alternative 13a consisted of an expansion of Gross Reservoir to a total storage capacity of 101,811 AF, which would provide 15,000 AF/yr of new firm yield, and gravel pit storage and transfer of agricultural rights to make up the remaining 3,000 AF/yr of necessary firm yield. Details of components, construction, and operation of Alternative 13a are provided in the Final EIS.

As described in Section 8-507.D.7.a, Project Need, the Corps evaluated Denver Water's existing and future water conservation in assessing the purpose and need, and also considered multiple alternatives involving water reuse. The Corps identified the Project as the environmentally preferable alternative (Corps ROD, Section 4.8, page 15) as follows.

ENVIRONMENTALLY PREFERABLE ALTERNATIVE

> *The environmentally preferable alternative is the alternative that most closely fulfills the national environmental policy found in Section 101 of NEPA, 42 U.S.C. 4331. Essentially, the environmentally preferable alternative is the alternative the causes the least damage to the biological and physical environment. This alternative also best protects, preserves, and enhances historic, cultural, and natural resources. The environmentally preferable alternative is the Applicant's Preferred Alternative [the Project].*
>
> *The Section 404(b)(1) Guidelines require the Corps to identify the Least Environmentally Damaging Practicable Alternative (LEDPA). The Corps has identified the Applicant's Preferred Alternative, including the Environmental Pool, [the Project] as the LEDPA. The Corps LEDPA determination would not change if the Environmental Pool was not included in the construction and operation of the Applicant's Preferred Alternative.*

The FERC found that none of the elements in its review of the Project (which tiered to the Corps Final EIS) would result in significant impacts (FERC Final SEA, Section 9) as follows.

FINDING OF NO SIGNIFICANT IMPACT

> *[W]ith Denver Water's proposed measures, the project would continue to operate while providing protection and enhancements to water quality, aquatic resources, terrestrial resources, recreation, and cultural resources.*
>
> *Based on our [FERC's] independent analysis, Denver Water's proposed [Project], as mitigated by the environmental measures discussed in this Final Supplemental EA, would not constitute a major federal action significantly affecting the quality of the human environment.*

8-507.D.7.c, Mineral Estate Owners or Lessees

As also stated in Sections 8-507.A.1.d and 8-507.A.1.e, Denver Water has sent the U.S. Forest Service the required notices. The agreement with USFS are included in Exhibit 3. Denver Water will provide a signed certification to Boulder County when the notifications are completed as required.

Article 8, Sections 508–509: Application Procedures and Submittal Requirements

The following applicable sections (i.e., excluding conduct of the permit hearings) of the Boulder County Land Use Code are addressed herein:

- 8-508, Referral Requirements
- 8-509, Notice of Permit Hearing

8-508, Referral Requirements

Denver Water understands that Boulder County will refer this 1041 permit application to referral agencies and interest holders in any property within 1,500 feet of areas of project disturbance. Exhibit 16 includes a list of property owners within 1,500 feet of all areas that will be disturbed during construction of the project.

Denver Water has prepared the referral packets in the number and manner requested by Boulder County.

Denver Water has provided prepaid postage via U.S. Postal Service first-class mail as requested.

Denver Water understands that Boulder County will transmit comments from referral agencies and individuals as soon as possible following the required referral response period. Within 14 days after transmittal of those comments, or by a later date specified by the Director, Denver Water will respond in writing to issues raised during the referral process.

Denver Water may request, if needed, up to 95 days to provide Boulder County with responses to issues.

8-509, Notice of Permit Hearing

Denver Water is committed to working with Boulder County and fulfilling the requirements for this Project. We look forward to scheduling hearings with you after you deem the application complete. Denver Water can support Boulder County with required notifications as appropriate.

Article 8, Section 511, Standards for Approval of a Permit Application

8-511.A, General Approval Requirements

Denver Water respectfully asserts that this 1041 permit application meets all applicable standards in Boulder County's 1041 requirements, as described in the following sections.

8-511.B, Standards for Approval of All Permit Applications

8-511.B.1, Obtain Property Rights

Based on the information provided in the application and summarized below, Denver Water has obtained or will obtain all property rights, permits, and approvals necessary for the Project, including surface, mineral, and water rights and therefore Denver Water believes that the Standard has been attained.

Denver Water has obtained all water rights for the Project. Denver Water will obtain an NFS Mineral Materials Permit for the quarry on NFS lands, if needed. On September 7, 2016, Denver Water and the USFS executed an agreement for the utilization of NFS land associated with the construction, operation and maintenance of the Project as permitted by the Corps and as authorized under the amended FERC

license (Exhibit 3). Water rights are addressed in Sections 8-507.D.7.b.ii.B and C; and Section 8-511.B.3 of this 1041 permit application. The NFS Mineral Materials Permit is addressed in Section 8-507.D.

Forest Service mineral rights were addressed by the FERC (FERC Final SEA, Section 3.1.5) in its review of Project impacts as follows.

Mineral Rights

- *If the Final EIS quarry, which would occupy Forest Service lands, is developed, finalize a Pit Development and Reclamation Plan, pursuant to Forest Service 4(e) condition 26, to include quarry operation and reclamation, and obtain a Forest Service Mineral Materials Permit. Denver Water indicates that it would develop the plan in consultation with the Forest Service and the Colorado Division of Reclamation, Mining, and Safety, and that the plan would be filed with the Commission prior to ground disturbing or construction activities associated with pit development on Forest Service lands.*

8-511.B.2, Expertise and Financial Capability

Denver Water is Colorado's largest water utility, and it has the necessary expertise and finances to successfully implement the Project. Based on the information provided in this 1041 permit application and the specific information provided below, Denver Water has the necessary expertise and financial capability to develop and operate the Project consistent with all requirements and conditions, and therefore Denver Water believes this Standard has been attained.

The following Project cost and financial information and analysis was gathered for Denver Water's License Amendment Application to the FERC (Exhibit D) in 2016.

The net cost of the Project (outflows less inflows) is approximately $18 million per year through 2047. Project inflows consist primarily of participation by the City of Arvada for its portion of the Project and hydropower revenue generated by the Project. In addition to construction costs, project outflows include hydropower capital costs, overhead, carrying costs on debt, annual operation and maintenance expenses, and funded depreciation for future renewals and replacements. Taxes are excluded from this analysis because Denver Water is a non-taxable municipal entity.

Approximately 50.0 percent of the $380 million in project costs will be funded through bond issues, and 25.7 percent of the gross project costs will be offset through participation and development charges to the City of Arvada. The remaining 24.3 percent will be funded from monthly user charges. User charges will also fund the annual operation and maintenance expenses, as well as depreciation expense. Depreciation expense is the annual loss in value of an asset due to wear, tear, and/or obsolescence. In accounting terms, depreciation expense is a noncash item. However, this analysis considers depreciation as a cost to the Project in the form of the annual repair and replacement of capital facilities as they reach the end of their useful life. The depreciation expense estimates (or repair and replacement costs) included in this analysis will be most affected by changes in the value of depreciable capital facilities (e.g., land assets are non-depreciable).

The total cost for the Project, prior to any payments from third-party participation and any hydropower revenue, is estimated at approximately $493 million, including project cost of $380 million and carrying costs (interest on debt service) of approximately $113 million over the 30-year period but not O&M expenses, hydropower capital costs, or funded depreciation. Payments from third party participation are estimated to be $101 million, and increased hydropower revenues are estimated to be $6.4 million over the 30-year period.

Denver Water has sufficient sources of funds to construct and operate the project. Sources include water user charges, system development charges, participation fees, hydropower revenue, miscellaneous revenue, and interest income.

8-511.B.3, Adequate Water Supplies

Denver Water already holds all necessary water rights to fill the expanded Gross Reservoir, with the exception of water rights to be obtained and owned by the City of Boulder, the City of Lafayette, and/or the Colorado Water Conservation Board for the purpose of storing water in an environmental pool in the reservoir, per agreement with Denver Water. Denver Water would operate the Project in accordance with state water law and in priority, as determined by the State Engineer. Water delivered to Gross Reservoir comes from two different sources: West Slope Diversion delivered via the Moffat Tunnel and native flows in South Boulder Creek. Denver Water may store up to 113,078 acre-feet of water from South Boulder Creek under a decree entered in C.A. 12111, Boulder County District Court dated September 28, 1953. Denver Water may store up to 133,078 acre-feet of water diverted from the Fraser River and its tributaries under decrees entered in C.A. 657, Grand County District Court dated November 11, 1937 and April 15, 1946. As further described in Section 8-511.B.3; and Sections 8-507.D.7.b.ii.B and 8-507.D.7.b.ii.C of this 1041 permit application and the information provided below, Denver Water has adequate water supplies for the Project, and no further review or approval is needed from the Colorado State Engineer. Thus, Denver Water believes that the Standard has been attained.

The following information related to water supply was gathered for Denver Water's License Amendment Application to the FERC (page 24).

Denver Water would operate the project in accordance with the State of Colorado water law. Any bypasses to senior downstream water rights would be made as directed by the SEO. Denver Water does not need to purchase or modify any water rights with the project. Gross Reservoir is operated in the same manner as most other on-stream reservoirs throughout Colorado including Green Mountain Reservoir, Pueblo Reservoir, Reudi Reservoir, Cherry Creek Reservoir, Rio Grande Reservoir, Button Rock Reservoir, Turquoise Reservoir and Twin Lakes Reservoir. The water rights accounting for Gross Reservoir meets the requirements of the SEO, who is responsible for water rights administration in the South Platte Basin of Colorado. Denver Water is not recommending any changes to the current methods for water rights accounting or operations at Gross Reservoir after the expansion. Denver Water will continue passing all natural inflow to which it is not entitled to downstream water users under the careful administration of the SEO.

8-511.B.4, Agricultural Lands

The nearest mapped Boulder County Comprehensive Plan significant agricultural lands are more than four miles from the Project. Based on the information provided in this 1041 permit application as summarized and referenced below, the Project will not cause unreasonable loss of significant agricultural lands as identified in the Comprehensive Plan, or identifiable on or near the Project, therefore Denver Water believes that this Standard has been attained.

The nearest mapped significant agricultural lands are more than four miles from Gross Reservoir as shown in Figure 14 in Exhibit 1, Significant Agricultural Lands Map. Agricultural productivity and Agricultural Productivity Capability (SCS classification) is addressed in Section 8-507.D.7.b.i.B.

8-511.B.5, Consideration of Environmental Resources

Based on the information provided in this 1041 permit application, the Project will not significantly degrade or pose a significant hazard to any aspect of the environment, including environmental resources and open space areas as identified in the Comprehensive Plan, and other features or elements that are deemed to be significant components of the natural environment worthy of preservation, therefore Denver Water believes that these Standards have been attained. Each environmental resource is described in the subsequent sections, including a summary of impacts and mitigation measures, as applicable.

8-511.B.5.a, Air Quality

Based on the information provided in Section 8-507.D.7.b.v of this 1041 permit application and the sections below, the Project will not significantly degrade or pose a significant hazard to air quality and therefore Denver Water believes this standard has been attained. Air quality impacts and mitigation measures are addressed in Section 8-507.D.7.b.v and a summary of impacts and mitigation measures is provided in Table 6. During the construction phase of the Project, air quality impacts would be minor. Negligible air quality impacts are expected during operation.

8-511.B.5.a.i, Seasonal Ambient Air Quality

Estimates of equipment usage for each season throughout the construction phase of the Project have been incorporated in the air quality emissions analysis included in Exhibit 14. The need for BMPs to mitigate fugitive dust generation will depend on the seasonal fluctuation of meteorological conditions (e.g., snowfall in winter will considerably reduce fugitive dust generation). Based on the uniform equipment usage throughout the seasons, the use of BMPs to minimize fugitive dust formation, and the acquisition of permits for stationary source activities, the Project is not anticipated to have a seasonal effect on air quality.

8-511.B.5.a.ii, Visibility and Microclimates

Based on the use of BMPs, and the need to acquire permits for stationary sources, the Project is not anticipated to contribute to changes to visibility and microclimates. As part of the General Construction Permit, Denver Water would prepare a Fugitive Dust Control Plan that would include specific BMPs to be taken to minimize the generation of fugitive dust.

8-511.B.5.a.iii, Air Quality Standards

Based on the use of BMPs, and the need to acquire permits for stationary sources, the Project is anticipated to comply with applicable air quality standards. Additionally, the Corps determined that the Project conforms with the State's air quality implementation plan.

8-511.B.5.b, Visual Quality

Based on the information provided in Section 8-507.D.7.b.vii of this 1041 permit application and the sections below, the Project will not significantly degrade visual quality of the overall Project area and therefore Denver Water believes this standard has been attained. Visual resources, including Project effects and mitigation measures, are addressed in Section 8-507.D.7.b.vii and a summary of impacts and mitigation measures is provided in Table 6.

8-511.B.5.b.i, Visual Changes to Ground Cover, Vegetation, Waterfalls, and Streams

Visual changes to the existing visual condition are addressed in Section 8-507.D.7.B.vii. Mitigation measures are included in Table 6. The Project would not result in significant adverse visual changes to ground cover or vegetation, and would not significantly degrade waterfalls or streams, as affirmed by the Corps and the FERC in their evaluation of the potential Project impacts.

8-511.B.5.b.ii, Viewsheds and Scenic Vistas

Viewsheds and scenic vistas are addressed in Section 8-507.D.7.b.vii.A. Mitigation measures are included in Table 6. The Project's permanent facilities, including the expanded reservoir, enlarged dam, saddle dam, and relocated recreation facilities would be visible but would not significantly degrade viewsheds or scenic vistas. For all visual resource impacts on NFS lands, Denver Water will continue to comply with existing FERC License Article 414 for visual resource protection. The Visual Resources Management Plan will address visual effects from developing an on-site quarry, including reclamation treatments and measures for re-shaping and revegetating disturbed areas to blend with surrounding visual characteristics of the landscape.

8-511.B.5.b.iii, Appearances of Forest Canopies

Changes in appearances of forest canopies (via tree removal) are addressed in the Project Description. The Project would remove trees to the new normal pool elevation (7,406 feet). For all visual resource impacts on NFS lands, Denver Water will continue to comply with existing FERC License Article 414 for visual resource protection. Denver Water will minimize impacts to vegetation on NFS lands through implementation of a new Erosion Control and Reclamation Plan and a new Road Management Plan. Denver Water will revegetate and reclaim NFS lands with seed mixtures and mulch materials approved by the USFS. Mitigation measures are included in Table 6. Given the focused extent of the tree removal activities in areas that would be inundated by the Project, the overall appearance of the forest canopy will not change significantly with the Project.

8-511.B.5.b.iv, Landscape Character and Unique Land Formations

Changes in landscape character types or unique land formations are not anticipated, as the Project is an expansion of an existing feature on the landscape and would not impact unique land formations.

8-511.B.5.b.v, Compatibility of Building and Structure Design with Land Use

Compatibility of recreation facility design is addressed in Section 8-507.D.7.b.vii.A. Improvements to all existing recreation areas and construction of one new site are proposed in Article 416: *Recreation Management Plan* and Article 414: *Visual Resource Protection Plan* of the 2020 FERC Order. Under these guidelines, the desired landscape character would continue to be achieved over time resulting in improvements to several degraded areas.

8-511.B.5.c, Surface Water Quality

Based on the information provided in Sections 8-507.D.7.b.ii.B and 8-507.D.7.b.ii.C, specifically the sections Project Effects (Water Quality), Mitigation (Water Quality), Project Effects (Channel Morphology), and Mitigation (Channel Morphology), this 1041 permit application and the sections below, the Project will not significantly degrade surface water quality and therefore Denver Water believes this standard has been attained. The summary of impacts and mitigation measures is provided in Table 6. Short-term changes in water quality in Gross Reservoir due to land inundation are expected to be minor and minimized through grubbing and land clearing prior to inundation. No long-term adverse impacts were identified for water quality within Gross Reservoir. Short-term minor increases in nutrients could lead to minor increases in biological productivity in South Boulder Creek downstream from Gross Reservoir. CDPHE concluded in the Project's 401 certification that the Project will be conducted in a manner that complies with applicable water quality requirements.

8-511.B.5.c.i, Changes to Existing Water Quality

Project effects on existing water quality are addressed in Sections 8-507.D.7.b.ii.B and of 8-507.D.7.b.ii.C, specifically the following sections: Project Effects (Water Quality), Mitigation (Water Quality), Project Effects (Channel Morphology), and Mitigation (Channel Morphology). The Project is anticipated to have minor to moderate short-term decreases in water quality in Gross Reservoir due to organic matter decay, including increases in methylmercury, as a result of filling the expanded reservoir. No long-term adverse impacts are expected. The 401 Certification acknowledges Denver Water's commitment to prepare a Tree Removal Plan "to remove as much organic matter as practicable from the inundation area" as a measure to preclude additional methylation or diminish the present level of methylation of mercury in Gross Reservoir. Denver Water will monitor general water quality parameters (nutrients, organic carbon, metals, major ions, temperature, and chlorophyll a) in Gross Reservoir. Monitoring results will be submitted annually to CDPHE.

8-511.B.5.c.ii, Applicable Narrative and Numeric Water Quality Standards

A narrative description of numeric water quality standards is addressed in Affected Environment (Water Quality), Sections 8-507.D.7.b.ii.B and 8-507.D.7.b.ii.C.

8-511.B.5.c.iii, Increases in Point and Non-Point Source Pollution Loads

Point and non-point source pollution loads are addressed in the Water temperature, Nutrient levels, and Wastewater Permits Effects subsection of Project Effects (Water Quality), Sections 8-507.D.7.b.ii.B and 8-507.D.7.b.ii.C. A summary of mitigation measures related to channel morphology is provided in Table 6 above. Construction may result in temporary minor erosion and sedimentation. Denver Water or its contractor will acquire a State General Permit for Stormwater Discharges Associated with Construction Activities. As required under this permit, Denver Water will prepare a Stormwater Management Plan that

will specify BMPs and inspection requirements to reduce pollutants in stormwater runoff from the construction sites. BMPs will be used to address erosion control, stockpiling of materials, dust control, revegetation, materials handling, fuel containment, etc.

8-511.B.5.c.iv, Increase in Erosion

Channel erosion is addressed in Project Effects (Channel Morphology), Sections 8-507.D.7.b.ii.B and 8-507.D.7.b.ii.C. Mitigation measures for impacts to channel morphology are included in Table 6 and are discussed in Mitigation (Channel Morphology), Sections 8-507.D.7.b.ii.B and 8-507.D.7.b.ii.C. Denver Water would need to file an Erosion and Sediment Control Plan prior to any land-disturbing activity. Erosion and sediment control measures in this plan would help to reduce possible impacts to water quality through erosion and sedimentation. Based on the information provided in this 1041 permit application and the specific information provided below, Denver Water believes that the Standard has been attained.

MITIGATION (EROSION)

Denver Water's License Amendment Application to the FERC (Exhibit 5) evaluated all mitigation measures for erosion (in Table 5.1-1) as provided below.

As described above, Denver Water or its contractor will acquire a State General Permit for Stormwater Discharges Associated with Construction Activities. As required under this permit, Denver Water will prepare a Stormwater Management Plan that will specify BMPs and inspection requirements to reduce pollutants in stormwater runoff from the construction sites. BMPs will be used to address erosion control, stockpiling of materials, dust control, revegetation, materials handling, fuel containment, etc.

Denver Water will minimize impacts to vegetation on NFS lands through implementation of a new Erosion Control and Reclamation Plan and a new Road Management Plan. Denver Water will revegetate and reclaim NFS lands with seed mixtures and mulch materials approved by the USFS according to a new Reclamation and Revegetation Seed Mixes and Mulch Materials plan.

Denver Water will develop a new Fire Management and Response Plan to reduce the risk of wildfires at and near Gross Reservoir.

Prior to construction, Denver Water or its contractor will obtain and comply with the necessary CDPHE air quality permits, including developing a Fugitive Dust Control Plan and obtaining a permit for concrete batch plant emissions.

Conclusions supported by the FERC in its review of the Project impacts relating to erosion (Final SEA, Section 5.1.1, pages 42-45) were as follows.

> *The Final EIS evaluated potential effects related to the modification of Gross Dam, including construction, quarry, spoil and laydown areas; tree removal in areas that would be inundated by the enlargement of the reservoir; and relocation of recreational facilities. The Final EIS also evaluated proposed measures to prevent erosion, including the development of a Soil Erosion Control Plan.*

Overall, effects on geology and soils under an approval of Denver Water's license amendment would not be significant enough to cause effects determined in the Final EIS for the project area to be exceeded.

8-511.B.5.c.v, Increases in Sediment Loading to Waterbodies

Sediment loading and effects to sedimentation (water quality and channel morphology) are addressed in Sections 8-507.D.7.b.ii.B, Surface Waters and 8-507.D.7.b.ii.C, Effects to Surface Waters—Project Effects (Water Quality) and Project Effects (Channel Morphology). Mitigation measures are included in Table 6 and in the Mitigation (Water Quality) and Mitigation (Channel Morphology) sections. The Project is anticipated to have a negligible to moderate increase in sediment transport and supply due to increase in flow upstream of the reservoir, which may result in localized bed and bank erosion. Denver Water will monitor general water quality parameters in Gross Reservoir. Monitoring results will be submitted annually to CDPHE. As a result, significant increases in sediment loading to waterbodies related to the Project will be avoided.

8-511.B.5.c.vi, Changes in Stream Channel or Shoreline Stability

Changes in stream channel and shoreline stability are addressed in 8-507.D.7.b.ii.B, Surface Waters and 8-507.D.7.b.ii.C, Effects to Surface Waters—Project Effects (Water Quality) and Project Effects (Channel Morphology). Mitigation measures are included in Table 6 and in the Mitigation (Water Quality) and Mitigation (Channel Morphology) sections. Shoreline impacts are addressed in the Project Effects subsection of Section 8-507.D.6.b.i. Flow regulation of Gross Reservoir would reduce peak flows downstream of reservoir, thereby making additional erosion less likely. Denver Water will file with the FERC a revised South Boulder Creek Channel Stability and Monitoring Plan developed in consultation with the USFS and CPW. As a result, significant changes in stream channel or shoreline stability related to the Project will be avoided.

8-511.B.5.c.vii, Changes in Stormwater Runoff Flows

Changes in stormwater runoff flows (Project effects to surface waters) are addressed in Project Effects (Hydrology) and Project Effects (Channel Morphology) of 8-507.D.7.b.ii.B, Surface Waters and 8-507.D.7.b.ii.C, Effects to Surface Waters. Mitigation measures are included in Table 6. Denver Water would file a Stormwater Management Plan with CDPHE, a Stormwater Quality Permit application with Boulder County, and an Erosion and Sediment Control Plan with the FERC prior to any land-disturbing activity. Erosion and sediment control measures and stormwater control measures in these plans would help to reduce possible impacts to water quality and to local drainage and stream flows through changes in stormwater runoff.

8-511.B.5.c.viii, Changes in Trophic Status or In Eutrophication Rates

Changes in trophic status or in eutrophication rates are discussed in addressed in Effects on the Trophic State of Gross Reservoir, Project Effects (Water Quality) of 8-507.D.7.b.ii.B, Surface Waters and 8-507.D.7.b.ii.C, Effects to Surface Waters. No long-term adverse effects on Gross Reservoir water quality, including trophic state, are anticipated.

8-511.B.5.c.ix, Changes in the Capacity or Functioning of Streams, Lakes or Reservoirs

Effects to surface water, wetlands, and riparian areas are addressed in Project Effects (Hydrology) and Project Effects (Channel Morphology) in Sections 8-507.D.7.b.ii.B and 8-507.D.7.b.ii.C; and Section 8-507.D.7.b.ii.E of this 1041 permit application. The Project would change the capacity of Gross Reservoir as described in the Project Description section of this 1041 permit application. As documented in these sections, no changes in the capacity and functioning of South Boulder Creek would be caused by the Project.

8-511.B.5.c.x, Changes in Flushing Flows

Effects to surface water, wetlands, and riparian areas are addressed in Project Effects (Hydrology) and Project Effects (Channel Morphology), Sections 8-507.D.7.b.ii.B and 8-507.D.7.b.ii.B; and Section 8-507.D.7.b.ii.E of this 1041 permit application. As documented in these sections, significant changes in flushing flows would not be caused by the Project.

8-511.B.5.c.xi, Changes in Dilution Rates

Changes in dilution rates are addressed in the Project Effects (Water Quality) subsection of Section 8-507.D.7.b.ii.B, Surface Waters and 8-507.D.7.b.ii.C, Effects to Surface Waters. Mitigation measures are included in Table 6. The Project would not change dilution rates related to any potential unregulated sources of pollutants in the area.

8-511.B.5.d, Groundwater Quality

Based on the information provided in Section 8-507.D.7.b.ii.D.7 of this 1041 permit application and the sections below, the Project will not significantly degrade groundwater quality and therefore Denver Water believes this standard has been attained. Groundwater quality impacts and mitigation measures are addressed in Section 8-507.D.7.b.ii.D.7. The impacts of these flow changes on groundwater are expected to be negligible. The surface water diverted into the stream is of very high quality, and so groundwater quality would not be affected by the Project. Because no impacts to groundwater quality are anticipated, no mitigation measures are proposed.

8-511.B.5.d.i, Changes in Aquifer Recharge Rates, Groundwater Levels, and Aquifer Capacity

Aquifer recharge rates and groundwater levels are anticipated to be slightly increased in the immediate area of Gross Reservoir. As a result, the Project would not degrade groundwater levels or aquifer properties.

8-511.B.5.d.ii, Changes in Capacity and Function of Wells within the Impact Area

Changes in capacity and function of wells from the Project are addressed in Project Effects (Groundwater) of Section 8-507.D.7.b.ii.D, and Section 8-507.D.7.b.ii.E. Changes in the capacity and function of wells in the vicinity of the Project are not anticipated.

The groundwater analysis indicates that regional groundwater sources would not be affected by the Project. Localized impacts would be restricted to the immediate vicinity of the streams and would not be any larger than stream elevation changes. These changes would be related only to groundwater storage from high flows; groundwater levels and discharge from regional and local aquifers would remain the same except for a slight increase in discharge to streams in gaining reaches.

8-511.B.5.d.iii, Changes in Quality of Well Water within the Impact Area

Section 8-507.D.7.b.ii.D of this 1041 permit application addresses changes in groundwater quality. Changes in the quality of well water in the vicinity of the Project are not expected.

8-511.B.5.e, Wetlands and Riparian Areas

Based on the information provided in Section 8-507.D.7.b.ii.E of this 1041 permit application and the sections below, the Project will not significantly degrade the quality of wetlands and riparian areas and therefore Denver Water believes that the Standard has been attained. Impacts to existing wetlands and riparian areas and mitigation measures for Gross Reservoir and South Boulder Creek are described in Project Effects and Mitigation, Section 8-507.D.7.b.ii.E and a summary of impacts and mitigation measures is provided in Table 6. Denver Water would address and mitigate effects on riparian and wetland habitats through BMPs, credits from an approved wetland mitigation bank, and operation of the Environmental Pool which would enhance low flows in South Boulder Creek downstream of Gross Dam, providing benefiting riparian vegetation. Denver water would also, through its off-license agreement with the USFS, convey the 539-acre Toll Property to the USFS, to be administered and protected as part of the Roosevelt National Forest. This would provide permanent offsite mitigation by preserving about 43 acres of high-quality wetlands and fens.

8-511.B.5.e.i, Changes in the Structure and Function of Wetlands

Impacts to wetlands and changes in the structure and function of wetlands are addressed in Project Effects, Section 8-507.D.7.b.ii.E. Mitigation measures are included in Table 6.

8-511.B.5.e.ii, Changes to the Filtering and Pollutant Uptake Capacities of Wetlands and Riparian Areas

Based on the information provided in this 1041 permit application, Denver Water believes that the Standard has been attained. Project Effects, Section 8-507.D.7.b.ii.E and addresses effects to wetlands and riparian areas, and Project Effects (Water Quality), Project Effects (Channel Morphology), Sections 8-507.D.7.b.ii.B and 8-507.D.7.b.ii.C addresses effects to surface water quality. Although direct impacts to wetlands and riparian areas would occur from implementation of the Project, these impacts would not result in significant effects to the water quality of surface water or groundwater.

8-511.B.5.e.iii, Changes to Aerial Extent of Wetlands

Changes to aerial extent of wetlands are addressed in Table 28, Summary of Direct Impacts to Wetlands and Riparian Habitats at Gross Reservoir and to Other Water Features Associated with Gross Reservoir, in Project Effects, Section 8-507.D.7.b.ii.E. Mitigation measures are included in Table 6 and the Mitigation subsection of Section 8-507.D.7.b.ii.E. As affirmed by the Corps in their 404 Permit, the Project will not significantly change the aerial extent of wetlands.

8-511.B.5.e.iv, Changes in Species' Characteristics and Diversity

Changes in species' characteristics and diversity related to wetlands and riparian areas are addressed in of the Project Effects subsection of Section 8-507.D.7.b.ii.E. Mitigation measures are included in Table 6. Because the Project will not have significant impacts to wetlands, the Project also will not significantly degrade species' characteristics or diversity.

8-511.B.5.e.v, Transition from Wetland to Upland Species

Transition from wetland to upland species is addressed in Sections 8-507.D.7.b.ii.E and 8-507.D.7.b.iv. Mitigation measures are included in Table 6. Existing wetland, riparian, and other vegetation areas have been documented, including effects from the Project. Denver Water will establish a 5,000-AF Environmental Pool in Gross Reservoir to augment flows during low flow periods, thereby benefiting 17 miles of aquatic habitat in South Boulder Creek from Gross Dam to its confluence with Boulder Creek. The Environmental Pool will enhance flows in South Boulder Creek below Gross Reservoir and provide flows in the lower section of South Boulder Creek, which currently goes dry at times due to diversions by other water users. These changes will support Boulder County's goals to minimize transitioning from wetland to upland species.

8-511.B.5.e.vi, Changes in Function and Aerial Extent of Floodplains

Based on the information provided in this 1041 permit application, Denver Water believes that the Standard has been attained. Floodplains are addressed in Sections 8-507.D.6.a, 8-507.D.7.b.ii.B, and 8-507.D.7.b.ii.C of this 1041 permit application. Effects to water flow for the project are addressed in Sections 8-507.D.b.a, 8-507.D.7.b.ii.A, 8-507.b.ii.B and 8-511.B.5.c of this 1041 permit application. Effects to channel morphology are addressed in Section 8-507.D.7.b.ii.C, Effects to Surface Waters, of this 1041 permit application. The Project will not result in significant changes in function or aerial extent of floodplains.

8-511.B.5.f, Terrestrial and Aquatic Animal Life

It is anticipated that the Project will have a long-term impact on habitat due to the loss of 465 acres of vegetation. Denver Water will mitigate permanent impacts to wildlife habitat through the preservation (through USFS protection and administration of NFS lands) of 539 acres of diverse wildlife habitat, including elk and mule deer summer range and migration corridors, potential habitat for lynx (federally threatened and state endangered species), habitat for boreal toad (state endangered and USFS sensitive species), and a wide range of habitats for native wildlife such as coyote, American marten, weasel, elk, moose, mule deer, snowshoe hare, broad-tailed hummingbird, red-naped sapsucker, warbling vireo, and other small mammals and birds.

Based on the information provided in Section 8-507.D.7.biii.A of this 1041 permit application and the sections below, the Project will not significantly degrade the quality of terrestrial and aquatic animal life and therefore Denver Water believes that the Standard has been attained. Terrestrial and aquatic animal life, including Project effects and mitigation measures, are addressed in Section 8-507.D.7.biii.A and a summary of impacts and mitigation measures is provided in Table 6.

8-511.B.5.f.i, Changes that Result in Loss of Oxygen for Aquatic Life

Changes that result in loss of oxygen for aquatic life are addressed in the Project Effects (Aquatic Resources subsection of Section 8-507.D.7.b.iii and impacts and mitigation measures for aquatic biological resources are addressed in Table 6. The Project is anticipated to cause a short-term change in water quality due to increased organics in Gross Reservoir after inundation. Water temperatures will be colder downstream of Gross Reservoir. No impacts are anticipated upstream of Gross Reservoir. Denver Water will monitor temperature and dissolved oxygen (DO) in the Gross Reservoir outflow consistent with the existing FERC-approved DO Monitoring Plan (which was completed under Article 402) for 3 years

after construction of the Project is complete. The purpose of the monitoring is to ensure that stream flows downstream from the Project maintain adequate temperature and DO levels. As a result, the Project will not result in loss of oxygen for aquatic life.

8-511.B.5.f.ii, Changes in Flushing Flows

Effects to surface water, wetlands, and riparian areas are addressed in Sections 8-507.D.7.b.ii.B, 8-507.D.7.b.ii.C, and 8-507.D.7.b.ii.E of this 1041 permit application. As documented in these sections, significant changes in flushing flows would not be caused by the Project. Therefore, effects to aquatic species are not anticipated in association with changes in flushing flows.

8-511.B.5.f.iii, Changes in Species Composition or Density

Changes in species composition or density are addressed in Section 8-507.D.7.biii and impacts and mitigation measures are addressed in Table 6. Outside of the inundation area, significant changes in species composition or density are not anticipated related to the Project. Denver water has mitigated the changes associated with the inundation area, including though the Environment Pool, which will benefit species downstream.

8-511.B.5.f.iv, Changes in Number of Threatened or Endangered Species

Changes in the number of threatened or endangered species is addressed in Subsection Project Effects (Special Status Species) of Section 8-507.D.5.a and mitigation measures are included in Table 6.

The Corps summarized its consultation efforts regarding endangered species in the its ROD (Section 6.3, page 16, and Attachment G).

> *The Endangered Species Act of 1973 (16 U.S.C. 1531-1544), as amended, requires Federal agencies to use their authority to conserve endangered and threatened species. Section 7(a)(2) of the Endangered Species Act requires Federal agencies to consult with the USFWS and/or the National Oceanic and Atmospheric Administration's National Marine Fisheries Service to ensure that the actions they authorize, fund, or conduct are not likely to jeopardize the continued existence of any listed species or adversely modify designated critical habitat of such species.*
>
> *On December 6, 2013, the USFWS issued a Biological Opinion for the Colorado River and Platte River depletions, and impacts to Preble's meadow jumping mouse (Zapus hudsonius preblei). On June 17, 2016, the USFWS issued a Biological Opinion for green lineage cutthroat trout and the Project, including the continuation of Denver Water's existing operations and future operations of the Moffat Project. The Corps requested consultation for Platte River depletions for the Gross Reservoir Environmental Pool and a Biological Opinion was issued by the USFWS in 2016 (USFWS 2016).*
>
> *In order to ensure continued compliance under the Endangered Species Act, in January 2017 the lists of endangered, threatened, and other sensitive species presented in the Final EIS were checked to evaluate whether there were species that had been listed and/or removed since the publication of the Final EIS. The Corps concluded that there are no new listed Federal or state endangered or threatened species for any of the alternatives.*

Based on the Biological Opinions issued by the USFWS, the Corps' ROD (Section 8) concluded that the Project will not jeopardize endangered or threatened species or their critical habitat. The FERC final SEA (section 5.1.6.1) provides the following conclusions related to threatened and endangered species:

> *Regarding threatened greenback cutthroat trout, FWS, in its June 17, 2016 BO, clarified that any greenback cutthroat present in Gross Reservoir are not considered a protected population under the ESA. Regarding threatened Preble's meadow jumping mouse, FWS, in its December 6, 2013, BO, concurred with the Corps' determination that enlarging Gross Reservoir is not likely to adversely affect the Preble's meadow jumping mouse because, although it has the potential to occur in the project area, it is not known or expected to be present. By letter dated February 7, 2018, Commission staff requested concurrence from FWS on its determination of effects to federal-listed threatened and endangered species. FWS responded by letter filed April 10, 2018, concurring with the Commission's assessment in its February 6, 2018 Supplemental EA that the proposed action [the Project] may affect, but is not likely to adversely affect, the Preble's meadow jumping mouse.*
>
> *Based on our review and the concurrence provided by the FWS, we conclude that Denver Water's proposed action [the Project] before the Commission to raise Gross Dam and enlarge Gross Reservoir is not likely to adversely affect Preble's meadow jumping mouse.*

8-511.B.5.f.v, Habitat and Critical Habitat Necessary for Protection and Propagation of Terrestrial Animals

Changes to terrestrial animal habitat are addressed in Section 8-507.D.5.b. Figure 11 in Exhibit 1, Terrestrial and Aquatic Animals and Habitat Map—Sensitive Areas and Wildlife Corridors, provides a map of sensitive areas and wildlife corridors. Mitigation measures are included in Table 6. The Project is anticipated to impact habitat due to the loss of 465 acres of vegetation. Denver Water will mitigate habitat impacts through the preservation (through USFS protection and administration of NFS lands) of 539 acres of diverse wildlife habitat, including elk and mule deer summer range and migration corridors, potential habitat for lynx (federally threatened and state endangered species), habitat for boreal toad (state endangered and USFS sensitive species), and a wide range of habitats for native wildlife such as coyote, American marten, weasel, elk, moose, mule deer, snowshoe hare, broad-tailed hummingbird, red-naped sapsucker, warbling vireo, and other small mammals and birds. As a result, the Project will not significantly degrade critical terrestrial habitat.

8-511.B.5.f.vi, Changes to Habitat and Critical Habitat Necessary for the Protection and Propagation of Aquatic Species

Changes to the habitat of aquatic species is addressed in Subsection Project Effects (Biological Aquatic Resources) of Section 8-507.D.7.biii. Mitigation measures are included in Table 6. The Project is anticipated to have a minor impact to fish and macroinvertebrates upstream of Gross Reservoir due to flow increases and overall minor beneficial impacts to fish and macroinvertebrates downstream of Gross Reservoir due to increases in winter flows and reductions in runoff flows. Denver Water will establish a 5,000-AF Environmental Pool in Gross Reservoir to augment flows during low flow periods, thereby benefiting 17 miles of aquatic habitat in South Boulder Creek from Gross Dam to its confluence with Boulder Creek. The Environmental Pool will enhance flows in South Boulder Creek below Gross

Reservoir and will provide flows in the lower section of South Boulder Creek, which currently goes dry due to diversions by other water users. Denver Water will also mitigate for impacts to aquatic biological resources through habitat restoration of a 1.9-mile reach of South Boulder Creek according to the compensatory mitigation outlined in the Final Mitigation Plan. As a result, the Project will not significantly degrade critical aquatic habitat.

8-511.B.5.f.vii, Changes to Aquatic and Terrestrial Food Webs

Changes to aquatic food webs are addressed in Subsection Project Effects (Biological Aquatic Resources) of Section 8-507.D.7.biii. Figure 9 in Exhibit 1 Terrestrial and Aquatic Animals and Habitat Map—Mule Deer Habitat, provides a map of mule deer habitat in the area of the Project. Figure 10 in Exhibit 1 Terrestrial and Aquatic Animals and Habitat Map—American Elk Habitat, provides a map of elk habitat in the area of the Project. Figure 12 in Exhibit 1 Terrestrial and Aquatic Animals and Habitat Map—Bald Eagle Habitat, provides a map of bald eagle habitat in the area of the Project. Mitigation measures are included in Table 6. Because the Project would not degrade habitat or significantly affect aquatic or terrestrial wildlife, it also would not significantly degrade their food webs.

8-511.B.5.g, Terrestrial and Aquatic Plant Life

Based on the information provided in Section 8-507.D.7.biv of this 1041 permit application and the sections below, the Project will not significantly degrade the quality of terrestrial and aquatic plant life and therefore Denver Water believes that the Standard has been attained. Terrestrial and aquatic plant life, including Project effects and mitigation measures, are addressed in Section 8-507.D.7.b.iv and a summary of impacts and mitigation measures is provided in Table 6. Denver Water would address and mitigate effects on special status plants through its BMPs, and pre-construction surveys, identification of buffers, and relocation of plants through its proposed Special Status Plants Relocation Plan that it would develop to supplement its approved Article 410 Rare and Sensitive Plant Species Protection Plan. The off-license conveyance of the 539-acre Toll Property to the USFS, to be administered and protected as part of the Roosevelt National Forest, would provide further mitigation for effects to special status plants. With compliance with these plans and measures, effects to sensitive plants in the Gross Reservoir Project area would not exceed minor, short-term effects.

8-511.B.5.g.i, Changes to Habitat of Threatened or Endangered Plant Species

Changes to habitat of threatened or endangered plant species are addressed in the Project Effects (Special Status Plant Species) subsection of Section 8-507.D.7.b.iv. Only one Ute Ladies'-tresses orchid was found in the Project area. No other federal- or state-listed plant species are known to occur around Gross Reservoir, therefore the Project would have no or negligible adverse effect to federal- and state-listed plant species habitat.

8-511.B.5.g.ii, Changes to Structure and Function of Vegetation

Changes to structure and function of vegetation, including species composition, diversity, biomass, and productivity, are addressed in the Project Effects subsection of Section 8-507.D.7.b.iv. Mitigation measures are included in Table 6. The Project would remove approximately 456 acres of vegetation, including forest vegetation, from construction and inundation. Denver Water will convey the 539-acre Toll Property to the USFS to be administered and protected as part of the Roosevelt National Forest as mitigation. The Toll Property parcels are surrounded by the Roosevelt National Forest and contain

diverse vegetation types (forest, grassland, fens, wet meadows, pond, stream, and riparian habitat). As a result, the Project would not result in significant changes to the structure or function of vegetation.

8-511.B.5.g.iii, Changes in Advancement or Succession of Desirable and Less Desirable Species

Changes in advancement or succession of desirable and less desirable species, including noxious weeds, are addressed in the Project Effects subsection of Section 8-507.D.7.b.iv. Mitigation measures are included in Table 6. The Project may cause a potential spread of aquatic invasive species. Denver Water will develop an Aquatic Invasive Species Monitoring Plan, including guidelines for conducting inspections of construction-related equipment for the presence of invasive plant and noxious weed species. Based on this mitigation, the Project would not promote less desirable species.

8-511.B.5.g.iv, Changes in Threatened or Endangered Species

Changes in threatened or endangered plant species are addressed in the Project Effects (Special Status Plant Species) subsection of Section 8-507.D.7.b.iv. Mitigation measures are included in Table 6. Only one Ute Ladies'-tresses orchid was found in the Project area. No other federal- or state-listed plant species are known to occur around Gross Reservoir, therefore the Project would have no or negligible adverse effect to federal- and state-listed plant species.

8-511.B.5.h, Soils and Geologic Conditions

Soils, geology, and geologic hazards, including Project effects and mitigation measures, are addressed in Sections 8-507.D.7.b.vi.A.4, 8-507.D.6.b, and 8-507.D.7.b.vi.A.3, respectively, and a summary of impacts and mitigation measures is provided in Table 6. Based on the information provided in Sections 8-507.D.6.b and 8-507.D.7.b.vi.A.3 of this 1041 permit application and the sections below, the Project will not significantly degrade soils and geologic conditions and therefore Denver Water believes that the Standard has been attained.

8-511.B.5.h.i, Changes to Topography, Natural Drainage Patterns, Soil Morphology and Productivity, Soil Erosion Potential, and Flood Hazard Areas

Changes to reservoir topography are addressed in the Project Effects subsection of Section 8-507.D.6.b.i. Changes to surface water conditions are addressed in Section 8-507.D.7.b.ii.B. Soils are addressed above in this section. Changes to flood hazard areas are addressed in Section 8-507.D.6.a.i. Mitigation measures are included in Table 6. The Project is anticipated to cause loss of geological resources and alteration of topography due to quarry activities. Denver Water will consult with Boulder County and the Mine Safety and Training Program arm of the Colorado Division of Reclamation, Mining, and Safety to develop quarry operation procedures, and with the Corps, Boulder County and the Colorado Division of Reclamation, Mining, and Safety to develop reclamation measures for Denver Water land. Denver Water or its contractor will acquire a State General Permit for Stormwater Discharges Associated with Construction Activities and an accompanying Stormwater Management Plan. Implantation of the Stormwater Management Plan will minimize soil erosion potential. Natural drainage patterns would not be affected due to the expansion of the reservoir.

8-511.B.5.h.ii, Changes to Stream Sedimentation, Geomorphology, and Channel Stability

Changes to stream sedimentation are addressed in the Soils section above. Changes to geomorphology are addressed in the Project Effects subsection of Section 8-507.D.6.b.i. Changes to channel stability will

be monitored and mitigated via Denver Water's South Boulder Creek Channel Stability Monitoring Plan; incorporating the monitoring and consultation for South Boulder Creek's channel stability upstream of Gross Reservoir would help to mitigate the possibility of changes in channel erosion and any potential need for localized bank stabilization in this reach (see additional discussion in the Summary of Potential Changes in the Water Quality and Channel Morphology of South Boulder Creek are addressed in Section 8-507.D.7.b.ii.B, Surface Waters and 8-507.D.7.b.ii.C, Effects to Surface Waters). Mitigation measures are included in Table 6. The Project is anticipated to cause a negligible to moderate increase in sediment transport and supply in the South Boulder Creek due to increase in flow upstream of the reservoir, which may result in localized bed and bank erosion. Denver Water will file with the FERC a revised South Boulder Creek Channel Stability and Monitoring Plan developed in consultation with the USFS and CPW. Based on this mitigation, the Project would not significantly change stream sedimentation, geomorphology, or channel stability.

8-511.B.5.h.iii, Changes to Lake and Reservoir Bank Stability and Sedimentation, and Safety of Existing Reservoirs

Changes to lake and reservoir bank stability and sedimentation, and safety of Gross Reservoir are addressed in the Project Effects subsection of Section 8-507.D.6.b.i. Mitigation measures are included in Table 6. Based on the FERC requirements, the Project would not result in changes to bank stability or reservoir safety.

8-511.B.5.h.iv, Changes to Avalanche Areas, Mudflows and Debris Fans, and Other Unstable Slopes

Changes to avalanche areas and mudflows (i.e., landslides), and potentially unstable reservoir slopes are addressed in the Project Effects subsection of Section 8-507.D.6.b.i. Mitigation measures are included in Table 6. Denver Water has addressed the potential for mass movements in the Project design, as demonstrated in this 1041 permit application. The Project would not increase the risk that one of these processes could occur.

8-511.B.5.h.v, Exacerbation of Seismic Concerns and Subsidence

Exacerbation of seismic concerns are addressed in the Seismicity subsection of the Project Effects subsection of Section 8-507.D.6.b.i. Expansion of Gross Reservoir may increase stress on faults at or near the reservoir site and result in negligible seismic activity. The dam raise and reservoir expansion may increase the potential for reservoir-induced seismicity, but not at substantial levels. Denver Water will perform detailed geotechnical and seismic studies, with review by FERC, as part of final design and during requirement construction. The Project will be subject to a series of design reviews by several organizations including Colorado State Engineer's Office, FERC Division of Dam Safety and Inspection, and an independent Board of Consultants review panel made up of expert dam engineers approved by FERC. These reviews will ensure that the structure is designed and constructed to be safe and structurally sound. Subsidence concerns are not relevant in the vicinity of the Project. Therefore, exacerbation of subsidence in the vicinity of the Project is not anticipated.

8-511.B.5.i, Degradation of Quality of Environmental Resources

Based on the information provided throughout this 1041 permit application, the Project will not degrade the quality of any other Environmental Resources as defined in Article 18 of the Land Use Code and

therefore Denver Water believes that the Standard has been attained. Information regarding various Environmental Resources is provided throughout this 1041 permit application, including analyses related to air (Section 8-507.D.7.b.v and Exhibit 14), water (Sections 8-507.D.7.b.ii.B through D), soil (Section 8-507.D.7.b.vi.A.4) native plant and animal populations and their associated habitat (Sections 8-507.D.7.b.iii through iv), and the unique, distinctive, or significant natural features of the County's landscapes and related ecosystems, as mapped in Boulder County's Comprehensive Plan (Exhibit 1 and 8-511.B.14).

8-511.B.6, Recreational Opportunities

Based on the information provided in Section 8-507.D.7.b.vi.A.2 of this 1041 permit application, the Project will not have a significant adverse effect on the quality or quantity of recreational opportunities and experience and therefore Denver Water believes that the Standard has been attained. Recreational opportunities, including Project impacts and mitigation measures, are addressed in Section 8-507.D.7.b.vi.A.2 and a summary of impacts and mitigation measures is provided in Table 6. Project construction would result in temporary effects on recreation. Denver Water would relocate recreation facilities as described in this 1041 permit application. Denver Water also would construct two new areas: Scenic Ridge Trail and Upper Viewshed Trail. The existing North Shore Recreation Area and South Boulder Creek Recreation Access (Outlet) would not be affected. Despite some impacts to South Boulder Creek and recreationist destinations, kayakers would still be able to utilize South Boulder Creek at the inlet to Gross Reservoir and hikers would still be able to use the many trails at Gross Reservoir including the Forsythe Canyon Trail.

8-511.B.7, Cultural Resources

Based on the information provided in Section 8-507.D.7.b.vi.A.3 of this 1041 permit application and the sections below, the Project will not cause unreasonable loss of significant cultural resources, including but not necessarily limited to historical structures or sites and archaeological artifacts or sites, as identified in the Comprehensive Plan or identifiable on or near the Project and therefore Denver Water believes that the Standard has been attained. The Project is not located in Historical and Archeological Resource Areas of Statewide Importance or an Archaeologically Sensitive Area as identified in the Boulder County Comprehensive Plan (see Figure 8, Exhibit 1). A summary of impacts and mitigation measures is provided in Table 6. The dam and reservoir and a portion of the Resumption Flume would be adversely affected. Denver Water, in conjunction with FERC and the SHPO executed a Programmatic Agreement to take into account the effects of the Project on these two historic properties and memorialize agreed-upon mitigation for the effects.

8-511.B.8, Blight or Other Nuisance Factors such as Excessive Noise or Obnoxious Odors

Based on the information provided in Section 8-507.D.7.b.vii.B of this 1041 permit application, the Project will not create blight, or cause other nuisance factors such as excessive noise or obnoxious odors and therefore Denver Water believes that the Standard has been attained. Noise and odor, including Project impacts and mitigation measures, are addressed in Section 8-507.D.7.b.vii.B. A summary of impacts and mitigation measures is provided in Table 6.

The effects of construction on noise would be short-term and moderate. Off-site noise impacts associated with haul trucks would be significantly reduced with Denver Water's proposed use of a quarry on Denver Water's land. Denver Water recognizes that any increase in noise levels above ambient will be a different environment than normal in this mountain community. Denver Water intends to use available studies as a tool to work with the local community, including Miramonte, to develop measures that aim to monitor, minimize, and mitigate noise disturbance during construction, to the extent reasonable and possible. Denver Water plans to minimize impacts from trucks, such as odors and dust.

8-511.B.9, Risk from Floods, Fires, Earthquakes or Other Disasters or Natural Hazards

Based on the information provided in Sections 8-507.D.6 and 8-507.D.7.b.vi of this 1041 permit application, the Project will not be subject to significant risk from floods, fires, earthquakes or other disasters or natural hazards and therefore Denver Water believes that the Standard has been attained. Natural hazards, including Project impacts and mitigation measures, are addressed in Sections 8-507.D.6 and 8-507.D.7.b.vi and a summary of impacts and mitigation measures is provided in Table 6.

Gross Reservoir is currently not operated to provide flood control along South Boulder Creek, and that would not change under the Project. However, an enlarged Gross Reservoir would generally be able to capture flows that would be spilled. As a result, annual flood flows below Gross Reservoir would consistently be lower with the Project.

The USFS, Denver Water, and other agencies have conducted and will continue to implement programs to reduce the potential for wildfire. Construction activities at the site and vehicle movement along the access routes may cause a temporary increase in the potential for initiation of wildfires. With standard safety precautions and training of construction workers, fires are likely to be quickly contained or extinguished and are not expected to adversely affect forest and other vegetation. Per USFS Section 4(e) Condition 20 (Fire Management and Response Plan), Denver Water will develop a new Fire Management and Response Plan to reduce the risk of wildfires at and near Gross Reservoir.

The dam raise and expansion of Gross Reservoir may increase the potential for reservoir-induced seismicity, but not at substantial levels. Potential issues related to seismicity will be addressed through geotechnical and seismic studies in the design and construction phases.

8-511.B.10, Undue Financial Burden on Existing or Future Residents of the County To Provide Services

Section 8-511.B.2 describes the Project costs and confirms that Denver Water has sufficient sources of funds to construct and operate the Project. Based on that information, the Project will not create an undue financial burden on existing or future residents of the County and therefore Denver Water believes that the Standard has been attained.

8-511.B.11, Effects on the Capability of Local Government

Based on the information provided below, the Project will not have a significant adverse effect on the capability of local government to provide services or exceed the capacity of service delivery systems and

therefore Denver Water believes that the Standard has been attained. Exhibit 4 addresses access for emergency services.

Information on the effects of the Project on local government was gathered for Denver Water's License Amendment Application to the FERC (Exhibit E, Section 3.3.19.2, page E-317).

Impacts to public services are generally the result of changes in population or changes in funding. Population changes are not expected as a result of the Project.

8-511.B.12, Resource Conservation, Energy Efficiency and Recycling or Reuse

Based on the information provided in Section 8-507.D.7.a of this 1041 permit application and below, the planning, design and operation of the Project reflects appropriate principles of resource conservation, energy efficiency and recycling and therefore Denver Water believes that the Standard has been attained.

A key part of Denver Water's water supply strategy is being as efficient as possible with the supplies we have. By capturing reusable water and using it for water exchanges or in our recycling plant, we are developing up to 50,000 acre-feet of additional supply that we would otherwise need to acquire from agriculture or other water basins in Colorado.

On an annual basis since 2000 Denver Water hydroelectric facilities have produced more electricity than the organization consumes 63 percent of the time.

Water conservation is another way of maximizing the efficiency of what we have. After decades of commitment to water conservation, Denver Water is now recognized as a national leader among major national municipalities.

Conservation is integral to our supply and demand strategies. Denver Water works hard to educate our customers through our award-winning Use Only What You Need campaign and other efforts. Residents have responded robustly.

The Corps Final EIS analyzed Denver Water's conservation efforts and stated that Denver Water's customers achieved approximately 29,000 AF/yr of conservation between 1980 and 2000. The Corps also factored conservation into their approval of the Project, stating in the Corps ROD that Denver Water's analysis shows that it will face water supply shortages despite its implementation of additional conservation measures, that existing water supply and storage would not meet the projected shortfall, and that additional conservation measures would not correct the imbalance in Denver Water's storage and supply system or address the reliability, flexibility, and vulnerability needs for the Project.

8-511.B.13, Least Damaging and Reasonable Cost of Alternative

Based on the information provided in Section 8-507.D.7.b.ix of this 1041 permit application, the Project represents the least damaging alternative of reasonable cost among the alternatives analyzed and therefore Denver Water believes that the Standard has been attained.

This conclusion was supported by the Corps ROD (Section 4.8) as follows.

> *The Section 404(b)(1) Guidelines require the Corps to identify the Least Environmentally Damaging Practicable Alternative (LEDPA). The Corps has identified the Applicant's Preferred Alternative, including the Environmental Pool, as the LEDPA. The Corps LEDPA determination would not change if the Environmental Pool was not included in the construction and operation of the Applicant's Preferred Alternative.*

FERC also evaluated the Projects impacts (Page 105) and concluded the following:

> *… the project would continue to operate while providing protection and enhancements to water quality, aquatic resources, terrestrial resources, recreation, and cultural resources.*

8-511.B.14, Accordance with the Boulder County Comprehensive Plan and Applicable Intergovernmental Agreements

Based on the information provided in Section 8-507.D.7.b.i of this 1041 permit application and the section below, the Project is in accordance with the Boulder County Comprehensive Plan and any applicable intergovernmental agreement affecting land use and development and therefore Denver Water believes that the Standard has been attained.

Boulder County Comprehensive Plan

Denver Water has conducted an independent review of the Boulder County Comprehensive Plan to evaluate the Project's consistency with the County's plans. As part of the review, Denver Water compared the Project area and potential impacts with the resource maps included in the Boulder County Comprehensive Plan. Based on this comparison, Denver Water has concluded that the Project is consistent with the Boulder County Comprehensive Plan. The resource maps from the Boulder County Comprehensive Plan are included as figures in Exhibit 1 of the 1041 permit application. Following is a summary of this comparison, described by the applicable Boulder County Comprehensive Plan resource map:

- **Parks and Open Space Map (Figure 20)**: Review of this map shows that no Boulder County Parks or Open Space are identified within the Project area. Walker Ranch is adjacent to the Project. The Project would not affect resources within the County open space (see Section 8-507.D.7.b.vi.A.2).
- **Archaeologically Sensitive Areas Map (Figure 8)**: This Boulder County Comprehensive Plan map shows travel routes for archaeologically sensitive areas within the Project area. Impacts to archeological resources are analyzed in Section 8-507.D.7.b.vi.A.3.
- **Critical Wildlife Habitat and Migration Corridors Map (Figure 5)**: This Boulder County Comprehensive Plan map identifies wildlife migration corridors within the Project area. Impacts to wildlife, including habitat and migration are analyzed in Section 8-507.D.7.b.ii.
- **Environmental Conservation Areas Map (Figure 6)**: This Boulder County Comprehensive Plan map identifies environmental conservation areas and overland habitat connectors pertaining to wildlife movement/migration within the Project area. These wildlife habitats and migration corridor resources are analyzed in Section 8-507.D.7.b.ii .

- **Geologic Hazard and Constraint Areas Map (Figure 3-1)**: This Boulder County Comprehensive Plan map identifies geologic hazard and constraint areas within the Project area. Geologic hazards are analyzed in Section 8-507.D.6. b.
- **High Biodiversity Areas Map (Figure 18)**: This Boulder County Comprehensive Plan map identifies high biodiversity significance area (concentration of rare environmental resources that represent preservation opportunities) within the Project area. Sections 8-507.D.7.b.ii.E, 8-507.D.7.b.iii, and 8-507.D.7.b.iv address biological resources for the Project.
- **Mineral Resource Areas**: A review of the Boulder County Comprehensive Plan map identified no mineral resource areas within the Project area. (see Section 8 -507.A.1.d).
- **Natural Landmarks and Natural Areas Map (Figure 22)**: This Boulder County Comprehensive Plan map identifies Winiger Ridge as a natural landmark (designated for its visual and scenic prominence) adjacent to the Project area. No areas of the Winiger Ridge Natural Landmark would be inundated by the Project (see Section 8-507.D.7.b.vii.A).
- **Habitat Conservation Areas for Preble's Meadow Jumping Mouse Map (Figure 4)**: In this Boulder County Comprehensive Plan map, perennial stream habitat for the Preble's Meadow Jumping Mouse is identified within the Project area. Through the Corps' EIS, impacts to threatened and endangered species, including the Preble's meadow jumping mouse, were analyzed and the USFWS was consulted in accordance with ESA requirements. The USFWS Biological Opinion concluded that the Project is "not likely to adversely affect" the species (see Section 8-507.D.7.b.iii).
- **Public Lands Map (Figure 20)**: This Boulder County Comprehensive Plan map identifies Public lands within the Project area. These lands will continue to be maintained for public use and access (see Section 8-507.D.7.b.vi.A.2).
- **Rare Plant Areas and Significant Natural Communities Map (Figure 19)**: In this Boulder County Comprehensive Plan map, no rare plant areas or significant natural communities are identified within the Project area. Impacts to rare plants were estimated based on the results of riparian and wetland surveys (see Section 8-507.D.7.b.iv).
- **Significant Agricultural Lands Map (Figure 14)**: In this Boulder County Comprehensive Plan map, no significant agricultural lands are identified within the Project area (see Section 8-507.D.7.b.i.B).
- **Wetlands and Riparian Areas Map (Figure 17)**: In this Boulder County Comprehensive Plan map, wetlands and riparian areas are identified within the Project area. Wetlands and riparian areas are analyzed in Section 8-507.D.7.b.ii.E.
- **County Trail Map (Figure 21)**: In this Boulder County Comprehensive Plan map, a conceptual trail corridor is identified within the Project area. Denver Water does not believe the Project would impact a trail corridor should Boulder County decide to develop this concept. As described in Section 8-507.D.7.b.vi.A.2, any existing or planned trails that will be affected by construction activities will be replaced in-kind.
- **County Open Space Plan Map (Figure 20)**: In this Boulder County Comprehensive Plan map, streamside and roadside corridors are identified within the Project Boundary. This map depicts potential corridors to access County Open Space but notes that not all properties are open to public access. Both Denver Water property and NFS lands within the Project area are open to the public for designated recreational use (see Section 8-507.D.7.b.vi.A.2).
- **View Protection Corridors Map (Figure 24):** Information regarding the View Protection Corridor Scores designations is included in the *Boulder County Comprehensive Plan Appendix Open Space*

Element Mapping: Background and Guidance for Use (Boulder County 2017). Boulder County's View Protection Corridor framework draws on the National Scenic Byways Program's "intrinsic qualities" of scenic roadways and is organized into three categories of "mappable" criteria that align with those intrinsic qualities: scenic, cultural and natural. The criteria reflect the range of data sources and other possible means by which to identify roads that possess exceptional scenic characteristics. The View Protection Corridor scoring system developed by Boulder County uses weighted averages that factor in both length of roadway meeting a criterion and the number of criteria met. It gives higher scores to road segments that either: 1) meet some criteria for a long stretch of roadway; or 2) meet a significant number of criteria for a shorter stretch of roadway. In this Boulder County Comprehensive Plan Map, roads adjacent to Gross Reservoir on the east side of the reservoir are assigned View Protection Corridor Scores of 2 or more, and 1 or more and less than 2. Roads adjacent to Gross Reservoir on the north side of the reservoir are assigned View Protection Corridor Scores of 1 or more and less than 2, less than 1, and no criteria found. Visual impacts are analyzed in Section 8-507.D.7.b.vii.

Boulder-Lafayette IGA

As mentioned in the Project Description, Denver Water entered into an IGA (Boulder-Lafayette IGA) with the cities of Boulder and Lafayette. The Boulder-Lafayette IGA provides that the City of Boulder and/or the City of Lafayette will use existing water rights or will acquire new water rights to store water for the 5,000-acre-foot Environmental Pool. Denver Water will increase the size of Gross Dam and Reservoir to accommodate the Environmental Pool. The Environmental Pool will store water for the cities of Boulder and Lafayette, i.e., Denver Water would make no additional diversions using its water rights for the Environmental Pool. The Environmental Pool would provide an environmental benefit to the aquatic environment of South Boulder Creek downstream from Gross Reservoir by increasing flows during times of low flow. The Boulder-Lafayette IGA requires Denver Water to operate the reservoir to make releases from the Environmental Pool in accordance with the terms of the Boulder-Lafayette IGA.

8-511.B.15, Complete, Reasonably Foreseeable Development

Based on the information provided in the Project Description in this 1041 permit application and the information provided below, the Project as described in this 1041 permit application represents the complete, reasonably foreseeable development for the subject property as required under Section 8-501.D of the 1041 regulations and therefore Denver Water believes that the Standard has been attained.

Reasonably foreseeable future actions were addressed by the FERC (FERC Final SEA, Section 6.0) in its review of the Project impacts as follows.

> *The Final EIS fully reviewed possible cumulative effects of expanding the Moffat Collection System in Chapter 4.0. Specifically related to the enlargement of Gross Reservoir, the Final EIS identified cumulative effects on the following resources: groundwater; geology; soils; vegetation; riparian and wetland areas; wildlife; special status species; aquatic biological; transportation; air quality; noise; recreation; visual; cultural; socioeconomics, and hazardous materials. We [FERC] have identified no cumulative effects outside of those identified in the Final EIS that would result from a Commission [FERC] approval of Denver Water's proposal regarding the Gross Reservoir Project, including an amendment of the project license.*

8-511.C, Additional Standards for Approval of Municipal and Industrial Water Projects

8-511.C.1, Efficient Use of Water

Based on the information provided in the Project Description and Sections 8-511.B.12 and 8-507.D.7.a of this 1041 permit application, the Project emphasizes the most efficient use of water, including recycling and reuse of water and therefore Denver Water believes that the Standard has been attained. Section 8-507.D.7.a describes Denver Water's need for 18,000 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, all of which Denver Water is already undertaking. As described in the Corps' ROD, "Denver Water evaluated existing and future water supplies and demands, as well as treated water infrastructure and conservation measures. Denver Water determined it would be facing water supply shortages as early as 2022, and that existing water supply and storage would not meet the projected shortfall."

In the Final EIS, the Corps describes the comprehensive screening process and alternatives analysis it undertook pursuant to NEPA as well as the Clean Water Act prior to selecting the Project as the preferred alternative and least environmentally damaging practicable alternative. In short, the Corps screened a broad range of 303 potential water supply sources and infrastructure components, which yielded 34 project alternatives. Of those, 20 were eliminated due to impracticability, leaving 14 project alternatives that were carried into the second phase of the alternatives analysis for a more in-depth review. Based on that more detailed analysis, the Corps selected five alternatives with comparatively low environmental impacts, representing a range of practicable alternatives. Through this screening and analysis process, the Corps chose the Project as the preferred alternative.

8-511.C.2, Efficient Utilization of Municipal and Industrial Water Projects

Based on the information provided in Section 8-511.B.12 of this 1041 permit application and the sections below, the Project promotes the efficient utilization of municipal and industrial water and therefore Denver Water believes that the Standard has been attained.

8-511.C.2.a, Utilization of Existing Municipal and Industrial Water Supplies

As noted above, Denver Water has utilized a multi-pronged approach including water conservation, efficiency programs, and the promotion of the use of recycled water where appropriate to maximize the use of its municipal supply.

Approximately half of Denver Water's water supplies are fully reusable. Denver Water reuses its reusable supplies for municipal and industrial uses, first, by using reusable effluent as a substitute supply in exchange for upstream out-of-priority diversions and for plans for augmentation. Denver Water reuses any remaining available reusable water at its water recycling plant.

Denver Water is developing approximately 30,000 acre-feet of downstream gravel pit reservoirs along the South Platte River to maximize its ability to use existing reusable water supply through exchanges, to the full extent legally and physically feasible, and provide a more reliable reusable supply for its 17,500 acre-foot capacity water recycling plant.

In addition, Denver Water has led efforts to expand the state reclaimed water regulation to allow the use of reclaimed water for toilet flushing. Denver Water has taken advantage of the new regulation by installing a water recycling system at its new administration building, which will be used for on-site toilet flushing and landscape irrigation.

As determined by the Corps in the Final EIS, even with Denver Water's reuse strategies, the Project is necessary to meet the identified purpose and need. Denver Water already has the water rights needed to fill the expanded reservoir. Thus, no water leases, exchanges or other agreements are needed for the Project.

8-511.C.2.b, Removal of Water Supplies from Irrigated Agriculture or Open Space or Preserved Lands or Increased Use of Native Flows of Water

Under the Project, Denver Water would collect water from upper South Boulder Creek and water diverted from West Slope rivers for storage in Gross Reservoir. When in priority, Denver Water will store water that is physically and legally available in Gross Reservoir and, when needed, release the stored water from Gross Reservoir for delivery to Ralston Reservoir via the South Boulder Canal. The Project will not remove any water from irrigated agriculture or open space or preserved lands in Boulder County. Through an intergovernmental agreement among Denver Water, the City of Boulder, and the City of Lafayette, the Project would enhance the flows downstream of Gross Reservoir. Specifically, the agreement provides that Denver Water would increase the height of the dam to create an environmental pool in the reservoir that would store up to 5,000 acre-feet of water to be released at their direction for environmental flows to enhance aquatic habitat in certain reaches of South Boulder Creek. In addition, the Project will allow Denver Water to decrease its West Slope diversions through a bypass of up to 1,000 acre-feet of water that will be delivered down the Fraser River for environmental enhancement during low flow conditions.

8-511.D, Additional Standards for Approval of New Domestic Water and Sewage Treatment Systems

8-511.D.1, Proper Utilization of Existing Water Treatment Plants in the County

Denver Water's water treatment facilities are not located within Boulder County. The Project nevertheless meets this standard because it expands an existing reservoir in Boulder County, rather than seeking a location for a new reservoir. As explained in Sections 8-507.D.7.b.ix and 8-511.B.12 of this application, the Corps identified expanding Gross Reservoir as the environmentally preferable and least environmentally damaging practicable alternative to meet Denver Water's present and future needs. The Project also will not interfere with the orderly development of domestic water treatment systems of adjacent communities because, under the Colorado River Cooperative Agreement (CRCA), Denver Water's service area is fixed and the Project therefore will not lead to an expansion of that service area. As explained in as explained in Section 8-511.B.3, Denver Water also already owns all of the water rights necessary to expand Gross Reservoir. Additionally, as explained in the Introduction to this application, the Project will benefit the domestic water treatment systems of nearby communities, such as the City of Boulder and City of Lafayette, by storing 5,000 acre feet of those jurisdictions' water for use in the Environmental Pool. Water from the Environmental Pool will be released to augment flows in South Boulder Creek during periods of low flow and then will continue downstream, where it will be diverted at

existing diversion structures operated by the cities of Boulder and Lafayette for use in the domestic water supplies of those cities.

8-511.D.2, Siting Major Extensions where Financial and Environmental Capacity can Sustain Resulting Growth and Development

Denver Water's water treatment facilities will not be in Boulder County. The Project nevertheless meets this standard. The expanded Gross Reservoir will not have a long-term impact on financial capacity within the area, but a short-term increase in sales associated with construction workers is expected. The environmental impacts of expanding Gross Reservoir were identified and mitigated in the Corps and FERC's approval process. Additional agencies (CPW, CWCB, USFS, USFWS et al.) provided an independent review of impacts and mitigation as well. Additionally, the Project is not intended to and will not drive development within Denver Water's service area, which is fixed under the CRCA. Rather, as explained in Section 8-507.D.7.a of this application, the Project responds to a projected water supply shortfall that would occur even in the absence of the Project, and it also responds to the vulnerability, reliability, and flexibility problems that Denver Water already is experiencing due to the imbalance in Denver's existing supply system.

8-511.D.3, Existing Water Treatment Systems at or Near Capacity

Denver Water is not expanding its treated water system. The Project nevertheless meets this standard because, as explained in Section 8-507.D.7.a of this application, the water collection system is being expanded to address a projected water supply shortfall in Denver Water's combined service area and to address current system vulnerabilities and increase system flexibility and reliability (as discussed above).

8-511.D.4, No Competition with or Duplication of Existing Water Treatment Systems

The Project meets this standard because, as explained in Section 8-511.D.1 of this application, Denver Water already owns the water rights necessary to complete this Project, and Denver Water's service area is fixed and will not be expanding due to the CRCA. The Project also will benefit—not compete with—the water supply systems of adjacent jurisdictions, such as the cities of Boulder and Lafayette, through a 5,000 acre foot Environmental Pool.

8-511.D.5, Condition of Existing Water Treatment Systems Warrants Replacement

As explained in Section 8-511.D.1., the Project does not replace an existing facility, but rather expands on an existing facility thereby reducing the environmental impact of building a new separate facility (i.e., a new reservoir). Denver Water notes that it is currently in the process of replacing its Moffat WTP with a new "North Water" Treatment plant located just below Ralston Reservoir. This is an effort unrelated to the expansion of Gross Reservoir and is not located in Boulder County.

8-511.D.6, Existing Facilities Cannot be Upgraded or Expanded to Meet Colorado Water Control Division Permit Conditions

Denver Water is not expanding Gross Reservoir to meet discharge permit conditions.

8-511.E, Additional Standards for Major Facilities of a Public Utility

Boulder County highlighted applicable sections of Article 8 during the pre-application conference. Staff did not highlight 8-308.A.4, the criteria involving "selection and construction of major facilities of a public utility", but staff did highlight Section 8-511.E. For the reasons explained in Sections 8-503 and 8-507.D.3 of this application, Denver Water maintains that the approval criteria in Section 8-511.E of the Boulder County Code do not apply. Despite Denver Water's request to Boulder County that these requirements be waived (see Section 8-503), information is provided in the following sections to support Boulder County's reviews.

8-511.E.1, Utilization of Existing Facilities

Based on the information provided in the Project Description section of this 1041 permit application and the information provided below, the Project will be sited and constructed in areas which will result in the proper utilization of existing facilities and associated systems within or serving the County and therefore Denver Water believes that the Standard has been attained. The Project Description discusses how the project would expand existing facilities. Figures 1-1 and 1-2 in Exhibit 1 provide an overview of the project facilities. Table 72 provides a comparison of Gross Dam Reservoir features with those of the existing facility.

Table 72:
Comparison of Existing and Expanded Gross Dam and Reservoir Features

Gross Dam and Reservoir Features Existing	Existing	Project with Environmental Pool
Additional storage volume (AF)	—	77,000
Total storage volume (AF)	41,811	118,811
Normal water elevation (feet)	7,282	7,406
Surface area at the spillway crest (acres)	418	842
Dam raise (feet)	—	131
Dam height (feet)	340	471
Crest length (feet)	1,050	1,940
Dam raise concrete volume (in cubic yards; including spillway)	—	930,000
Spillway elevation	7,282	7,406
Saddle dam	—	Added
Outlet works	Existing	No change

8-511.E.2, Growth Accommodation

Based on the information provided in Sections 8-507.D.7.a, 8-511.B.10, 8-511.B.3, and 8-511.B.14 of this 1041 permit application and the information provided below, the anticipated growth and development that may occur as a result of the Project can be accommodated within the financial and environmental capacity of the area to sustain such growth and development and are in accordance with the applicable County land use plans and therefore Denver Water believes that the Standard has been attained. Section 8-507.D.7.a discusses project need, specifically the population to be served, types of users, design capacity, excessive service capacity and long-range planning. Section 8-511.B.10 demonstrates that the Project will not create an undue financial burden on existing or future residents of the County. Section 8-

511.B.3 demonstrates that adequate water supplies, as determined by the Colorado State Engineer, are available for the Project. Section 8-511.B.14 demonstrates that the Project complies with existing land uses and IGAs.

The following socioeconomic information and analysis was gathered for Denver Water's application to the FERC (Exhibit E, Section 3.3.19):

Population of the Gross Reservoir Primary Impact Area (PIA). The PIA generally includes areas in the immediate vicinity of facilities for construction activities or inundation. The Project would not result in a change in the population within the Gross Reservoir PIA. No homes would be demolished, inundated, or relocated as a result of the reservoir expansion. Therefore, no residents would be required to move out of the PIA as a result of the Project. Additionally, no new residents would be expected to move into the PIA and no additional homes would be built in the PIA as a result of construction or operation of the enlarged reservoir. Construction workers would generally travel to the construction site each day from the Denver Metropolitan Area and would not relocate to the PIA. No additional Denver Water or other employees would be required to operate or maintain the enlarged reservoir. Although temporary construction activities would be a nuisance to local residents during the construction period, it is unlikely that Project construction would cause permanent residents to leave the area.

Population of the Denver Metropolitan Area Secondary Impact Area (SIA). The SIA is the geographic area in which indirect or linked socioeconomic effects may occur, such as the larger area from which the construction workforce might be drawn. Neither the construction activities associated with implementation of the Project nor the operation of the enlarged Gross Reservoir would change the population within the Denver Metropolitan Area. As described previously, the majority of construction workers would likely be hired from the existing construction labor force in the Denver Metropolitan Area. Given the small size of the workforce required for the raising Gross Dam under the Project compared to the existing construction workforce in the Denver Metropolitan Area, the expansion of Gross Reservoir is expected to attract few, if any, people to relocate to the Denver Metropolitan Area for employment. The small number of specialized workers that might relocate would likely be spread out over the region and would not cause a noticeable impact on the population of any individual Denver Metropolitan Area entity.

It is likely that growth will occur within the Denver Metropolitan Area without an expansion of Gross Reservoir (DRCOG 2005, see Final EIS for reference materials). The increased storage capacity of Gross Reservoir and the availability of additional or more reliable water supplies for Denver Water customers resulting from the Project would not cause growth in the Denver Metropolitan Area; Denver Water is only one of many water providers in the Denver Metropolitan Area, and an increase in the water supply or firm yield for any one of these providers would not be an incentive for regional growth.

Conclusions supported by the FERC in its review of the Project impacts (FERC Final SEA, Section 5.1.8) were as follows.

> *Socioeconomic effects of Denver Water's proposal to raise the Gross Reservoir were discussed in the Final EIS. These reviews found that minor, beneficial, cumulative socioeconomic effects would be experienced throughout the region during project construction due to generated employment and income, increased sales tax collections, and other associated spending, as well*

as supporting economic activity in the region by improving the ability to meet the existing and future water demands of water users. The population and demographics of the area would remain unchanged as a result of the proposed project; however, construction activities would result in certain temporary inconveniences to some local residents, including increased traffic volume and a short-term reduction in recreational opportunities. It is unlikely that construction would cause permanent residents to leave the area. Neither temporary construction activities nor the long-term operation of the enlarged reservoir would affect home values in these areas over the long term. Based on available information, the populations of Boulder County, Denver Metropolitan area Counties, and Grand County would be expected to remain relatively unchanged, and demand for homes in these areas would not increase or decrease as a result of Denver Water's proposed plan. We [FERC] do not believe Denver Water's proposed license amendment would cause socioeconomic effects such as changes in property values or property tax rates for private residents and businesses in the area outside those determined in the Final EIS.

8-511.E.3, Existing Capacity

Based on the information provided in the Purpose of Action subsection of Section 8-507.D.7.a of this 1041 permit application and the information provided below, Denver Water has demonstrated that the existing reservoir is at or near operational capacity and therefore Denver Water believes that the Standard has been attained. Section 8-507.D.7.a describes Denver Water's need for 18,000 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. Additionally, water supply is only a portion of Denver Water's need for the Project. The proposed additional supply and reservoir storage also addresses an imbalance in Denver Water's water collection system, which has resulted in system-wide vulnerability issues, limited operational flexibility to respond to water collection system outages, and can seriously jeopardize Denver Water's ability to meet its present-day water needs.

8-511.E.4, Project is Warranted

Based on the information provided in the Purpose of Action subsection of Section 8-507.D.7.a of this 1041 permit application and the information provided below, Denver Water has demonstrated and the Corps and FERC have concluded that the level of service of the Project is such that extension is warranted and therefore Denver Water believes that the Standard has been attained. The need for the Project is discussed in Section 8-507.D.7.a, including population to be served, types of users, design capacity, excess service capacity, and long-range planning. These changes are necessary to address existing reliability, flexibility, and vulnerability issues, as well as to increase Denver Water's water supply to meet projected demand shortfalls that were verified by the Corps through its permitting process.

8-511.E.5, New Facility Proposed Instead of Upgrading or Expanding Existing Facilities

The Project does not propose new facilities (i.e., a new reservoir); therefore, this section is not applicable. The Project will expand existing facilities.

8-511.F, Site Selection of Arterial Highways and Interchanges and Collector Highways

Although Boulder County did not identify these standards as applying to the Project during the pre-application process and Denver Water agrees that they do not apply, the Project nevertheless could meet these standards for approval. Denver Water therefore provides the information below for Boulder County's review:

8-511.F.1, Community Traffic Needs

Based on the information provided in Section 8-507.D.7.B.viii of this 1041 permit application, construction of the Project will address community traffic needs and therefore Denver Water believes that the Standard has been attained. Existing transportation infrastructure, transportation impacts, and mitigation measures are addressed in Section 8-507.D.7.B.viii and a summary of impacts and mitigation measures is provided below. In addition, Denver Water has provided the Traffic Impact Analysis in Exhibit 4 that includes evaluation and proposed mitigation for roads that will be used during Project construction including SH 72 and the intersection with Gross Dam Road. A summary of impacts and mitigation measures is provided in Table 6.

8-511.F.2, Community Patterns

Based on the information provided in Section 8-507.D.7.B.viii of this 1041 permit application, construction of the Project will minimize disruption of community traffic patterns and therefore Denver Water believes that the Standard has been attained. Existing transportation infrastructure, transportation impacts, and mitigation measures are addressed in Section 8-507.D.7.B.viii and a summary of impacts and mitigation measures is provided in Section 8-511.F.1. In addition, Denver Water has provided the Traffic Impact Analysis in Exhibit 4 that includes evaluation of impacts during construction and proposed mitigation for roads that will be used during Project construction including SH 72 and the intersection with Gross Dam Road.

8-511.F.3, Compatiblity with Master Plans

Based on the information provided in Section 8-507.D.7.B.viii of this 1041 permit application, the Project avoids direct conflicts with adopted local, regional and state master plans and therefore Denver Water believes that the Standard has been attained. Existing transportation infrastructure, transportation impacts, and mitigation measures are addressed in Section 8-507.D.7.B.viii and a summary of impacts and mitigation measures is provided in Section 8-511.F.1.

8-511.G, Site Selection of New Communities

The Project is not a new community; therefore, this section is not applicable.

8-511.H, Additional Standards to Development of Historical or Archaeological Resource Areas of Statewide Importance

The Project is not located in Historical and Archeological Resource Areas of Statewide Importance or an Archaeologically Sensitive Area as identified in the Boulder County Comprehensive Plan (see Figure 8 in Exhibit 1), therefore the additional standards for development in historical or archaeological resource areas of statewide importance do not apply.

8-511.I, Development of Natural Resource Areas of Statewide Importance

Denver Water requested a wavier for this requirement prior to meeting with the Parks and Open Space staff. Staff suggested that the shoreland areas qualify as Natural Resource Areas of Statewide Importance. As discussed in Sections 8-507.D.7.b.iv and 8-507.D.7.b.vi.A.2 of this 1041 permit application, reservoir expansion would create additional shoreline. At the anticipated normal water elevation of 7,406 feet, the reservoir would gain an additional 2.8 miles of shoreline, for a total of 13.9 miles. The existing Gross Reservoir has about 0.5 acre of wetland and 2 acres of riparian vegetation along its shoreline (excluding stream inlets), and a roughly similar extent of wetland and riparian vegetation can be expected to become established along the new shoreline. As a result, the Project will preserve the integrity of the shoreline resource that Parks and Open Space staff have suggested qualifies as a Natural Resource Area of Statewide Importance.

8-511.I.1, Preserve Integrity of the Resource

Based on the information provided in Section 8-507.5 of this 1041 permit application, as well as in Sections 8-507.D.7.b.ii (Water Resources), 8-507.D.7.b.iii (Terrestrial and Aquatic Animals and Habitat), 8-507.D.7.b.iv (Terrestrial and Aquatic Plant Life), and 8-507.D.7.b.vi (Significant Environmentally Sensitive Factors), construction of the Project will preserve the integrity of both the reservoir shoreline and significant wildlife habitats and therefore Denver Water believes that the Standard has been attained.

8-511.I.2, Compatible with Resource Preservation and Minimize Resource Damage

The elevation of Gross Reservoir will rise by 124 feet, from 7,282 to 7,406 feet msl, which will increase the surface area of the reservoir from 418 to 842 acres. Denver Water's reservoir operations will not change; however, the amount of water being delivered to, stored in and released from Gross Reservoir will increase. Based on these changes, the Project will continue to provide a reservoir shoreline. A summary of impacts and mitigation measures to wildlife habitat is provided in Table 6 of this 1041 permit application. With these required measures, the Project will be compatible with preservation of significant wildlife habitats and therefore Denver Water believes that the Standard has been attained.

8-511.I.3, Not Adversely Affect Surface or Subsurface Water Rights

Denver Water does not need to purchase or modify any water rights with the project. Denver Water is not recommending any changes to the current methods for water rights accounting or operations at Gross Reservoir after the expansion. Denver Water will continue passing all natural inflow to which it is not entitled to downstream water users under the careful administration of the SEO. As a result, the Project will not adversely affect surface or subsurface water rights and therefore Denver Water believes that the Standard has been attained.

8-511.I.4, Not Significantly Deteriorate Significant Wildlife Habitat

Based on the information provided in Section 8 507.D.7.biii.A of this 1041 permit application and Section 8-511.B.5.g, the Project will not significantly deteriorate significant wildlife habitat and therefore Denver Water believes that the Standard has been attained. Significant wildlife habitat, including Project effects and mitigation measures, are addressed in Section 8 507.D.7.biii.A and a summary of impacts and mitigation measures is provided in Table 6.

8-511.I.5, Not Significantly Degrade Existing Natural Scenic Characteristics, Create Blight, or Cause Other Nuisance Factors

Based on the information provided in Sections 8-507.D. 7.b.vii and 8-511.B.5.b of this 1041 permit application, the Project will not significantly degrade existing natural scenic characteristics. Based on the information provided in Sections 8-507.D.7.b.vii.B and 8-511.B.8 of this 1041 permit application, the Project will not create blight, or cause other nuisance factors such as excessive noise or obnoxious odors. Therefore, Denver Water believes that this Standard has been attained.8-511.J, Additional Standards for Development in Areas Around Interchanges Involving Arterial Highways

Although Boulder County did not identify these standards as applying to the Project during the pre-application process and Denver Water agrees that they do not apply, the Project nevertheless could meet these standards for approval. Denver Water therefore provides the information below for Boulder County's review:

8-511.J.1, Danger to Public Health or Safety or to Property

Based on the information provided in the Summary subsection of Section 8-507.D.7.B.viii of this 1041 permit application, the Project will not pose a danger to public health or safety or to property (including the subject property, other impacted properties, and the environment) and therefore Denver Water believes that the Standard has been attained. The project is consistent with protection of public health, safety, welfare, and the environment. See 8-507.D.7.b for additional details on potential natural hazards, safety, and environmental resources. In addition, Denver Water has provided a Traffic Impact Analysis in Exhibit 4 that includes evaluation of impacts during construction and proposed mitigation for roads that will be used during Project construction including SH 72 and the intersection with Gross Dam Road.

8-511.J.2, Compatibility with Existing Traffic Volumes

Based on the information provided in Section 8-507.D.7.B.viii of this 1041 permit application and the information provided below, the volume of traffic to be generated during construction of the Project will be compatible with the traffic handling characteristics of the existing, affected traffic roads and therefore Denver Water believes that the Standard has been attained. Existing transportation infrastructure, transportation impacts, and mitigation measures are addressed in Section 8-507.D.7.B.viii and a summary of impacts and mitigation measures is provided in Section 8-511.F.1. Denver Water has provided the Traffic Impact Analysis in Exhibit 4 that includes evaluation of impacts to local roads, as well as SH 72 during Project construction. The Plan also includes proposed mitigation for roads that will be used during Project construction including SH 72 and the intersection with Gross Dam Road. Although local traffic would be affected during construction of the Project, additional traffic would not be generated during Project operation.

8-511.J.3, Compatibility with Existing Character of the Neighborhood or Resource of Special Scenic, Historical, or Cultural Significance

Based on the information provided in Sections 8-507.D.7.b.vii, 8-511.B.5.b, 8-507.D.7.b.vi.A.3, and 8-511.B.7 of this 1041 permit application and the information provided below, the Project will be compatible with existing developments and with the character of the neighborhood, and will not significantly impair an

area or resource of special scenic, historical, or cultural significance and therefore Denver Water believes that the Standard has been attained. Section 8-507.D.7.b.vii addresses the Project in relation to viewsheds, scenic vistas, and unique landmarks; as discussed in Section 8-511.B.5.b, the Project will not significantly degrade visual quality. The Project is not located in Historical and Archeological Resource Areas of Statewide Importance or an Archaeologically Sensitive Area as identified in the Boulder County Comprehensive Plan (see Figure 8 in Exhibit 1). Section 8-507.D.7.b.vi.A.3 addresses the project in relation to areas of geologic, historic, and archaeological importance; as discussed in Section 8-511.B.7, the Project will not cause unreasonable loss of significant cultural resources.

8-511.J.4, Preservation of Desirable Existing Community Patterns

Based on the information provided in Sections 8-507.D.7.b.i, 8-511.B.14, and 8-507.D.b.7.viii of this 1041 permit application and the information provided below, the Project will preserve desirable existing community patterns and therefore Denver Water believes that the Standard has been attained. Section 8-507.D.7.b.i addresses land use impacts, and Section 8-511.B.14 demonstrates that the Project complies with existing land uses and IGAs. Section 8-507.D.b.7.viii addresses transportation impacts, and Section 8-511.J.2 demonstrates that the Project will be compatible with existing traffic volumes.

8-511.J.5, Burdens or Deprivations on the Communities of a Region

The Project will involve improvement to the intersection between SH 72 and Gross Dam Road that will result in temporary impacts to regional and local users of these roads during construction. However, a long-term benefit will be provided after construction of CDOT's recommended alternative because the intersection at SH 72 will be safer with better lines of sight and access to Gross Dam Road. Additionally, Gross Dam Road improvements will benefit users (motorists, cyclists, and hikers) with improved sight line distance and widening in narrow locations which will provide safer conditions for two-way traffic.

8-511.K, Additional Standards for Development in Flood Hazard Areas

8-511.K.1, Preservation of Integrity of the Flood Hazard Area

Based on the information provided in the Project Description and Section 8-507.D.6.a.i of this 1041 permit application, the Project will not alter or impact the flood hazard area in any way which is likely to pose a significant threat to public health or safety or to property (including the subject property, other impacted properties, and the environment) and therefore Denver Water believes that the Standard has been attained.

The Project Description section describes the Project in relation to water supply. Flood hazards are addressed in Sections 8-507.D.6.a, 8-507.D.7.b.ii.A, and 8-511.B.5e.vi of this 1041 permit application. Sections 8-507.D.6.a, 8-507.D.7.b.ii.B, and 8-511.B.5.c of this 1041 permit application address effects to surface water flow. Section 8-507.D.7.b.ii.D addresses groundwater and water wells. Section 8-507.D.7.b.ii addresses water quality. Effects to open space are addressed in Section 8-507.D.7.b.vi.A.2.

As described in the South Boulder Creek Stream Flow subsection of Section 8-507.D.6.a.i, while flows in South Boulder Creek upstream of Gross Reservoir would increase on average, there would be no change in the maximum flows experienced in this reach because the capacity of South Boulder Creek above

Gross Reservoir is limited to approximately 1,200 cfs. During high runoff, Denver Water must limit Moffat Tunnel deliveries to meet this constraint. From Gross Reservoir to the South Boulder Canal Diversion Canal, changes in flow reflect Gross Reservoir operations. In general, flows would be higher during winter months as water is moved out of Gross Reservoir and into Ralston Reservoir in response to the WTP load shift from the southern WTPs to the Moffat WTP. Increases in outflow from Gross Reservoir would generally be greatest in dry years because Denver Water would typically draw more water from its North System storage as a drought begins. Flows during the summer would be lower on average because the 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.

The 100-year storm discharge from the Project (expanded reservoir) will be slightly less due to greater attenuation potential of the reservoir. However, the new spillway would result in a greater discharge than the existing spillway at the same water level. Denver Water would perform an analysis of impacts to the 100-year floodplain during the final design of the Project. However, Denver Water has determined that the 100-yr discharge is less than 5,000 cfs, and that that the future 100-yr floodplain (with the completed Project) will be similar to the existing floodplain and is well within the typical margin of error for a hydraulic model.

8-511.K.2, Flooding Threat to Public Health, Safety, or Property

Based on the information provided in Section 8-507.D.6.a.i of this 1041 permit application, the Project will not pose a significant threat to public health or safety or to property in times of flooding (including the subject property, other impacted properties, and the environment) and therefore Denver Water believes that the Standard has been attained.

As described in the South Boulder Creek Floodplain subsection of Section 8-507.D.6.a.i, during a major, rare flood event that exceeds channel capacity, the Moffat Tunnel would not be diverting water, and there would be no increase in floodplain boundaries that could be attributed to the Project. Floods can occur in this stream reach due to local snowmelt or precipitation but not due to changes in the Moffat Collection System. Gross Reservoir is currently not operated to provide flood control along South Boulder Creek, and that would not change under the Project. However, an enlarged Gross Reservoir would generally be able to capture flows that would be spilled with the existing system at full use. As a result, annual flood flows below Gross Reservoir would consistently be lower under the Project.

8-511.K.3, Compliance with Floodplain Overlay District Regulations

Denver Water is committed to meet with Floodplain staff in the Transportation Department to discuss compliance requirements and to submit a Floodplain Development Permit application if required.

8-511.K.4, Development in the Flood Hazard Area

Based on the information provided in the Project Description section, Section 8-507.D.7.b.vi.A.2, and Section 8-511.B of this 1041 permit application, Gross Reservoir would continue to be used for passive recreation and would not significantly increase the structural coverage or impervious surface on the land, therefore Denver Water believes that the Standard has been attained.

8-511.L, Standards for Development in Geologic Hazard Areas

8-511.L.1, Risk to Public Health and Safety or to Property

Based on the information provided in Sections 8-507.D.7.b.vi.A.1, 8-507.D.6.a, and 8-511.B.5.h of this 1041 permit application, the Project will not aggravate the hazardous condition or otherwise pose a significant risk to public health and safety or to property and therefore Denver Water believes that the Standard has been attained. Section 8-507.D.7.b.vi.A.1, Potential Natural Hazards, describes the dam safety analysis that will be developed during final design. The expansion of Gross Reservoir will be subject to design reviews by the Colorado SEO and FERC. Floodplain hazards are addressed in Section 8-507.D.6.a of this 1041 permit application. Geology and soil mitigation measures are summarized in Section 8-511.B.5.h.

8-511.L.2, Encouragement of Open Space Activities like Passive Recreation

Based on the information provided in the Project Description section, Sections 8-507.D.7.b.vi.A.2, 8-511.B.6, 8-511.B.5.h and 8-511.B.9 of this 1041 permit application, Gross Reservoir would continue to be used for passive recreation and will not aggravate geologic hazards and therefore Denver Water believes that the Standard has been attained. The Project would involve passive recreation, as summarized in Section 8-511.B.6, which would not increase natural hazards.

8-511.L.3, Mitigation of Geologic Risk

Based on the information provided in Section 8-507.D.6.b.i of this 1041 permit application, the Project will be designed in a manner that mitigates any significant risk posed by the geologic hazard, as confirmed by a registered professional engineer and therefore Denver Water believes that the Standard has been attained. Exhibit 12 includes recent geotechnical reports prepared by Professional Geologists. Mitigation of geologic hazards is addressed in Sections 8-507.D.6.b and 8-511.B.5.h.

8-511.L.4, Protection of Shallow Wells, Solid Waste Disposal Sites, Water Supply Systems, and On-Site Wastewater Systems And Sewage Disposal Systems

Based on the information provided in Sections 8-507.D.7.b.iii and 8-511.B.5.c of this 1041 permit application, shallow wells, solid waste disposal sites, water supply systems, and on-site wastewater systems and sewage disposal systems would not be impacted by the Project and therefore Denver Water believes that the Standard has been attained. Water wells in the area of the project are addressed in Section 8-507.D.7.b.ii of this 1041 permit application. Water quality is addressed in Section 8-507.D.7.b.ii of this 1041 permit application. Mitigation for water quality is summarized in Section 8-511.B.5.c.

8-511.L.5, Compliance with County Building Code and Public Health Department Regulations

Based on the information provided in the Project Description section of this 1041 permit application and the information provided below, the Project will comply with all applicable County Building Code and Public Health Department regulations and therefore Denver Water believes that the Standard has been attained. The Project Description addresses the general Project design and Exhibit 1, Figures 25 through 27, address the detailed Project design.

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