DEPARTMENT OF THE ARMY
CORPS OF ENGINEERS, OMAHA DISTRICT
1616 CAPITOL AVENUE
OMAHA NE 68102-4901

September 8, 2017

Mr. Jim Lochhead
Denver Water
1600 West 12th Avenue
Denver, CO 80204

Re: Department of the Army Permit No. NWO-2002-80762-DEN; Moffat Collection System Project

Dear Mr. Lochhead:

Enclosed is the Department of the Army Permit No. NWO-2002-80762-DEN, for the Moffat Collection System Project (Project). The Project is located in Section 21 within Township 1 South and Range 71 West in Boulder County, Colorado.

General Condition No. 1 of the permit establishes the time limit for completing the work. It reflects a construction period of 8.5 years from the date of issuance of the permit, **expiring December 31, 2025**.

Please notify Mr. John Urbanic at (303) 979-4120, or at the above-stated address, when work on this project has begun. Also, please contact Mr. Urbanic if you have any questions concerning the permit. When communicating with our office regarding this project please reference File No. **NWO-2002-80762-DEN**.

Sincerely,

John L. Hudson, P.E.
Colonel, Corps of Engineers
District Commander

Enclosure

DENVER WATER

1600 West 12th Ave
Denver, CO 80204-3412
303.628.6000
denverwater.org

August 23, 2017

Mr. John Urbanic
Denver Regulatory Office
Corps of Engineers, Omaha District
9307 South Wadsworth Boulevard
Littleton, CO 80128-6901

Re: Department of the Army Permit No. NWO-2002-80762-DEN
Moffat Collection System Project

Dear John,

Enclosed are two signed copies of the above-referenced permit. We look forward to receiving the fully executed permit.

Please contact me at (303) 628-6524 if you have any questions.

Thank you.

Sincerely,

Paula Daukas

Paula Daukas
Manager of Environmental Planning

DEPARTMENT OF THE ARMY
SECTION 404 PERMIT

Project Name: Moffat Collection System Project

Permittee: Board of Water Commissioners for the City and County of Denver (Denver Water)

Permit No: NWO-2002-80762-DEN

Waterway: South Boulder Creek

Location: The Project is located in Section 21 within Township 1 South and Range 71 West in Boulder County, Colorado.

Issuing Office: Corps Omaha District, Denver Regulatory Office

Contents:

1. GENERAL INFORMATION, SIGNATURE BLOCKS

NOTE: The term "you" and its derivatives, as used in this permit, means the permittee or any future transferee. The term "this office" refers to the appropriate district or division office of the U.S. Army Corps of Engineers (Corps) having jurisdiction over the permitted activity or the appropriate official of that office acting under the authority of the commanding officer. You are authorized to perform work in accordance with the terms and conditions specified below.

1. **Congressional Authorities.** You have been authorized to undertake the activity described above pursuant to:

   ( ) Section 10 of the Rivers and Harbors Act of 1899 (33 United States Code [U.S.C.] 403).

   (**X**) Section 404 of the Clean Water Act (33 U.S.C. 1344).

   ( ) Section 103 of the Marine Protection, Research and Sanctuaries Act of 1972 (33 U.S.C. 1413).

2. **Limits of this authorization.**

   a. This permit does not obviate the need to obtain other Federal, state, or local authorizations required by law.

   b. This permit does not grant any property rights or exclusive privileges.

   c. This permit does not authorize any injury to the property or rights of others.

   d. This permit does not authorize interference with any existing or proposed Federal project.

3. **Limits of Federal Liability**. In issuing this permit, the Federal Government does not assume any liability for the following:

a. Damages to the permitted project or uses thereof as a result of other permitted or unpermitted activities or from natural causes.

b. Damages to the permitted project or uses thereof as a result of current or future activities undertaken by or on behalf of the United States in the public interest.

c. Damages to persons, property, or to other permitted or unpermitted activities or structures caused by the activity authorized by this permit.

d. Design or construction deficiencies associated with the permitted work.

e. Damage claims associated with any future modification, suspension, or revocation of this permit.

4. **Reliance on Applicant's Data.** The determination of this office that issuance of this permit is not contrary to the public interest was made in reliance on the information you provided.

5. **Reevaluation of Permit Decision**. This office may reevaluate its decision on this permit at any time the circumstances warrant. Circumstances that could require a reevaluation include, but are not limited to, the following:

   a. You fail to comply with the terms and conditions of this permit.

   b. The information provided by you in support of your permit application proves to have been false, incomplete, or inaccurate (see 4 above).

   c. Significant new information surfaces which this office did not consider in reaching the original public interest decision.

   Such a reevaluation may result in a determination that it is appropriate to use the suspension, modification, and revocation procedures contained in 33 Code of Federal Regulations (CFR) 325.7 or enforcement procedures such as those contained in 33 CFR 326.4 and 326.5. The referenced enforcement procedures provide for the issuance of an administrative order requiring you to comply with the terms and conditions of your permit and for the initiation of legal action where appropriate. You will be required to pay for any corrective measures ordered by this office, and if you fail to comply with such directive, this office may in certain situations (such as those specified in 33 CFR 209.170) accomplish the corrective measures by contract or otherwise and bill you for the cost.

6. **Extensions**. The time limit for completing the work authorized ends on **December 31, 2025**. If you find that you need more time to complete the authorized activity, submit your **request for a time extension to this office for consideration at least one month before the above date is reached.** Unless there are circumstances requiring either a prompt completion of the authorized activity or a reevaluation of the public interest decision, the Corps will normally give favorable consideration to a request for an extension of this time limit.

Your signature below, as permittee, indicates that you accept and agree to comply with the terms and conditions of this permit.

8/23/17

Permittee — Date

James S. Lochhead
CEO / Manager
Denver Water

This permit becomes effective when the Federal official, designated to act for the Secretary of the Army, has signed below.

8 SEP 2017

John L. Hudson, P.E. — Date
Colonel, Corps of Engineers
District Commander

When the structures or work authorized by this permit are still in existence at the time the property is transferred, the terms and conditions of this permit will continue to be binding on the new owner(s) of the property. To validate the transfer of this permit and the associated liabilities associated with compliance with its terms and conditions, the transferee must sign and date below.

Transferee Signature — Date

Transferee (Print or Type) — Title

Organization or Company (Print or Type)

Address (Print or Type) — Phone

2. DETAILED DESCRIPTION OF AUTHORIZED WORK

In accordance with the terms and conditions of this Department of the Army (DA) permit, the Board of Water Commissioners for the City and County of Denver (Denver Water) is granted authorization by the Secretary of the Army to impact 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.) associated with the enlargement of Gross Dam and Reservoir. Issuance of this permit and the description of the Project are based on documents submitted in the original permit application dated October 2009, and other supporting documentation provided to the Corps through June 2017.

2.1 Location

The Project is located in Section 21 within Township 1 South and Range 71 West in Boulder County, Colorado. The coordinates of the Project area are approximately 39.9513N and -105.3583W. The elevation of the Project area is approximately 7,282 feet above sea level.

2.2 Existing Conditions

Gross Dam is located in Boulder County, Colorado, approximately 35 miles northwest of Denver and 6 miles southwest of the City of Boulder. The existing Gross Reservoir Dam spans South Boulder Creek, impounding its waters and those of Winiger Gulch and Forsythe Canyon, which are small tributaries to South Boulder Creek. In addition, the reservoir is filled with water delivered to upper South Boulder Creek by the Moffat Tunnel, having been diverted from the Williams Fork and Fraser River basins. The existing dam crest elevation is 7,290 feet. At a surface elevation of 7,282 feet (the normal high water line), storage capacity of the existing reservoir is 41,811 acre-feet (AF). Lands adjacent to Gross Reservoir are owned by Denver Water, the U.S. Forest Service, and private landowners. The landscape around Gross Reservoir is comprised of 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. Wetland and riparian habitats are primarily associated in Winiger Gulch, South Boulder Creek, and Forsythe Canyon.

The Corps has regulatory authority under Section 404 of the Clean Water Act for actions that require the discharge of dredged or fill material into jurisdictional Waters of the U.S., including wetlands. In 2005-2006, all aquatic resources in the Project Area were assessed and delineated to determine whether the resources met the definition of Waters of the U.S. (40 CFR 230.3(o)). Alpine Ecological Resources, LLC, on behalf of Denver Water, prepared a wetland delineation report on April 24, 2015. The Corps prepared a Preliminary Jurisdictional Determination dated February 8, 2016 to document wetlands and waterways within the Project Area that will be treated as jurisdictional Waters of the U.S. for purposes of computation of impacts and compensatory mitigation requirements.

2.3 Description of Work

The Moffat Collection System Project is a water supply project proposed by the Board of Water Commissioners for the City and County of Denver (Denver Water) that spans Denver, Adams, Jefferson, Grand, Summit, Gilpin, and Park counties in Colorado. The existing water collection system for Denver Water is divided into two major geographically-distinct systems: the North System, or the Moffat Collection System, and the South System. The Project consists of enlarging Denver Water's existing 41,811 (AF) Gross Reservoir by 77,000 AF (i.e., 72,000 AF plus a 5,000 AF Environmental Pool) to a total storage capacity of 118,811 AF. The surface area of the reservoir would be expanded from approximately 418 acres to 842 acres. Using existing collection infrastructure, water from the Fraser River, Williams Fork River, and South Boulder Creek would be diverted and delivered during average to wet years via the Moffat Tunnel and South Boulder Creek to Gross Reservoir. There would be no additional diversions in dry years because Denver Water already diverts the maximum amount physically and legally available under its existing water rights without additional storage in its system. In a drought

or emergency, Denver Water would rely on the additional water it would have previously stored in the Moffat Collection System to provide the additional 18,000 acre-feet per year (AF/yr) of yield.

The enlarged reservoir would also store an additional 5,000 AF of water as a dedicated Environmental Pool that would be used to improve aquatic habitat downstream in South Boulder Creek. This additional storage would be filled with water provided by the cities of Boulder and Lafayette. None of Denver Water's existing or future water supply would be stored in the Environmental Pool. To allow storage of additional water, Denver Water proposes to raise the dam an additional 6 feet beyond the proposed 125-foot raise necessary for increasing the storage of water, to a total height of 131 feet. The storage and release of water in the Environmental Pool would be managed under an Intergovernmental Agreement between Denver Water, Boulder, and Lafayette. The Corps views the Environmental Pool and its operation as minimization of adverse effects of the Project on South Boulder Creek under 40 CFR 230.77(b).

2.4 Impacts and Mitigation

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. 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. Proposed mitigation to compensate for impacts resulting from the Project will be accomplished by using a combination of purchasing mitigation bank credits and Permittee-responsible mitigation, as detailed in Chapter 1 of the *Final Mitigation Plan for the Moffat Collection System Project* (Mitigation Plan) dated June 8, 2017, and is included as a Special Condition for this authorization.

Wetlands

Compensatory mitigation for the permanent loss of 2.24 acres of jurisdictional wetlands at the Gross Reservoir site will be provided through the purchase of Corps-approved mitigation bank credits at Denver Water's Four Mile Creek Fen Mitigation Bank. Denver Water will purchase 3.36 wetland credits from the Four Mile Creek Fen Mitigation Bank, which is based on a 1.5:1 (mitigation:impacts) ratio.

Other Waters of the U.S.

In order to compensate for the impacts to South Boulder Creek due to the expansion of Gross Reservoir and the indirect impacts associated with the Project, mitigation will be accomplished with Permittee-responsible mitigation at off-site locations within the watershed.

Mitigation for the Enlargement of Gross Reservoir

In order to compensate for the permanent loss of 3.54 acres (9,447 linear feet) of other Waters of the U.S. from the enlargement of Gross Reservoir, including two riffle and pool complexes, the Applicant is proposing Permittee-responsible mitigation. The South Boulder Creek Restoration Project as described in Section 1.2 of the Mitigation Plan was evaluated under the 2008 Mitigation Rule for compensatory mitigation because of its proximity to the impacts at Gross Reservoir and because it occurs within the South Boulder Creek Watershed (HUC 1019000505).

The Corps determined the South Boulder Creek Restoration Project will provide sufficient in-kind mitigation for the permanent impacts associated with the Project through rehabilitation activities including improving low-flow conditions; repairing natural instream diversity and channel stability; and establishing a minimum of two riffle and pool complexes. The specific components of the South Boulder Creek Restoration Project are provided in Section 1.2 of the Mitigation Plan. The functional lift of the mitigation site is intended to create comparable stream habitat and function to the streams being

inundated by the enlargement of Gross Reservoir. Measurement of the functional lift will be accomplished through ecological-based performance standards as defined in the Mitigation Plan.

Mitigation for Flow Changes Resulting from Increased Diversions on the Fraser and Williams Fork River Basins

The additional diversions on the West Slope would decrease the flows on Fraser River and Williams Fork River tributaries. Additionally, tributaries in the Colorado Headwater Watershed Basin, including West Elk Creek, Vasquez Creek, Little Vasquez Creek, and King Creek, may be pushed past an ecological tipping point. The reduced flows would also result in channel morphology changes including decreased sediment transport capacity within the Fraser and Williams Fork River basins. The Applicant is proposing Permittee-responsible mitigation for these impacts. The Colorado Headwaters Mitigation Project, as described in Section 1.3 of the Mitigation Plan, was evaluated under the 2008 Mitigation Rule for compensatory mitigation because of its proximity to the impacts to the Fraser and William Fork River basins and because it occurs within the Fraser River and Williams Fork River. The geographic scope of both the effects to and mitigation for aquatic resources includes streams located in the upper Fraser River (HUC 1401000102) and upper Williams Fork River (HUC 1401000104) watersheds, within the Colorado Headwater Watershed Basin (14010001) of the Project.

The Colorado Headwaters Mitigation Project was selected for compensatory mitigation to offset impacts to channel morphology and ecological tipping points due to reduced flows. The Corps determined the Colorado Headwaters Mitigation Project will provide 1.8 miles of stream rehabilitation activities, and 0.27 mile of stream preservation along the Williams Fork River. Additionally, the Applicant is proposing flushing flow releases from Denver Water diversion structures on the Fraser River, Vasquez Creek, Ranch Creek, Cabin Creek, and St. Louis Creek to increase the frequency and duration of flushing flows to mobilize sediment transport and increase aquatic habitat availability. The specific components of the Colorado Headwaters Mitigation Project are provided in Section 1.3 of the Mitigation Plan. The functional lift of the mitigation site is intended to create comparable stream habitat and function for the streams with reduced flows associated with the Project. This will "provide, where practicable, the suite of functions typically provided by the affected aquatic resources" (33 CFR Section 332.2(c)(2)(i)). Measurement of the functional lift will be accomplished through ecological-based performance standards as defined in the Mitigation Plan.

3. GENERAL CONDITIONS

1. The time limit for completing the work authorized ends on **December 31, 2025**. If you find that you need more time to complete the authorized activity, submit your request for a time extension to this office for consideration at least one month before the above date is reached.
2. You must maintain the activity authorized by this permit in good condition and in conformance with the terms and conditions of this permit. You are not relieved of this requirement if you abandon the permitted activity, although you may make a good faith transfer to a third party in compliance with General Condition 4 below. Should you wish to cease to maintain the authorized activity or should you desire to abandon it without a good faith transfer, you must obtain a modification of this permit from this office, which may require restoration of the area.
3. If you discover any previously unknown historic or archeological remains while accomplishing the activity authorized by this permit, you must immediately notify this office of what you have found. We will initiate the Federal and state coordination required to determine if the remains warrant a recovery effort or if the site is eligible for listing in the National Register of Historic Places.
4. If you sell the property associated with this permit, you must obtain the signature of the new owner in the space provided and forward a copy of the permit to this office to validate the transfer of this authorization.
5. If a conditioned water quality certification has been issued for your Project, you must comply with the conditions specified in the certification as special conditions to this permit. For your convenience, a copy of the certification is attached if it contains such conditions.
6. You must allow representatives from this office to inspect the authorized activity at any time deemed necessary to ensure that it is being or has been accomplished in accordance with the terms and conditions of your permit.

4. SPECIAL CONDITIONS

1. Based on information provided by the Permittee, the Corps has determined the overall Project purpose is to develop a firm annual yield of approximately 18,000 AF of water to the Moffat Treatment Plant and raw water customers upstream of the Moffat Treatment Plant. This Project purpose was the basis upon which the Corps conducted its review of the Section 404 Application, as well as the basis for the Corps determination that permit issuance is in the best interest of the public. The Corps authorization incorporates the Environmental Pool and Osprey Point Quarry site as minimization measures. This authorization does not allow Denver Water to use the Environmental Pool for storage of municipal supply. No change in the Project purpose may occur without prior review and approval by the Corps.

2. The Permittee agrees to follow the Clean Water Act Section 401 Colorado Water Quality Certification No. 4369, dated June 23, 2016. Pursuant to 33 U.S.C. 1341(d), special conditions of the Section 401 Water Quality Certification are made part of this permit.

3. The Permittee will to adhere to the National Historic Preservation Act of 1966, as amended (NHPA) Section 106 Programmatic Agreement dated October 26, 2015, and all of its stipulations. Furthermore, the Denver Regulatory Office must be immediately notified should the scope of the proposed undertaking change. In that instance, Section 106 consultation shall be re-initiated and mitigation may be required.

4. The Permittee will to adhere to the conservation measures included in the following Biological Opinions and all stipulations in those. Furthermore, the Denver Regulatory Office must be immediately notified should the scope of the action area change. In that instance, Section 7 consultation shall be re-initiated and mitigation may be required.

    a. **December 6, 2013** – Colorado River and Platte River depletions, and impacts to Preble's meadow jumping mouse.

    b. **June 17, 2016** – Green lineage cutthroat trout and the Moffat Collection System Project, including the continuation of Denver Water's existing operations and future operations of the Moffat Project.

5. The Permittee agrees to provide documentation of compliance with the January 29, 2016 Biological Opinion for the Gross Reservoir Environmental Pool to the Denver Regulatory Office.

6. The Permittee agrees to contact the U.S. Fish and Wildlife Service (USFWS), Office of Migratory Birds, at 303.236.8171, for permitting requirements for the Migratory Bird Treaty Act and Bald and Golden Eagle Protection Act prior to removal or destruction of any bird nest.

7. The Permittee is responsible for all work accomplished in accordance with the terms and conditions of this authorization. If a contractor or other authorized representative will be accomplishing the work hereby authorized on behalf of the Permittee, such parties shall be provided a copy of this authorization so they are aware of the terms and conditions. An activity that fails to comply with the terms and conditions of this authorization shall be considered unauthorized and all responsible parties may be subject to legal action.

8. Chapter 1 of the Mitigation Plan, dated June 8, 2017, is incorporated into the permit by reference according to 33 CFR 332.4(c)(1). Prior to any impacts authorized by this permit occurring to Waters of the U.S.:

    a. The Permittee shall provide compensatory mitigation for the loss of jurisdictional wetlands through the debit of credits at the Four Mile Creek Fen Mitigation Bank. The Permittee shall debit 3.36 mitigation credits (3.36 credits for wetland impacts at a ratio of 1.5:1). Written proof of the debit shall be provided to the Denver Regulatory Office prior to impacts occurring to Waters of the U.S. authorized by this permit. Upon receipt of such proof, all liabilities for the

success, monitoring, and long-term management of the mitigation bank jurisdictional wetlands covered by this authorization shall become the responsibility of the mitigation bank sponsor.

b. The Permittee shall provide compensatory mitigation for the direct loss of jurisdictional non-wetland Waters of the U.S., including loss of riffle and pool complexes, through the South Boulder Creek Restoration Project as described in Section 1.2 of the Mitigation Plan. Construction of the mitigation site shall occur prior to impacts occurring to Waters of the U.S. authorized by this permit. The Permittee shall hire a professional ecologist to be on site to oversee that the mitigation is accomplished in accordance with the Mitigation Plan and with these Special Conditions.

c. The Permittee shall provide compensatory mitigation for indirect effects that would occur in the Fraser and Williams Fork River basins due to reduced stream flows associated with the increased diversions from the Project, through the Colorado Headwaters Mitigation Project as described in Section 1.3 of the Mitigation Plan. Construction of the mitigation site shall occur prior to impacts occurring to Waters of the U.S. authorized by this permit. The Permittee shall hire a professional ecologist to be on site to oversee that the mitigation is accomplished in accordance with the Mitigation Plan and with these Special Conditions.

9. The Permittee shall record the site protection instruments related to the Williams Fork River Basin Stream Rehabilitation sites, such that anyone searching for the affected parcels shall be able to identify the restrictions on the properties. Proof of these recordings shall be provided to the Denver Regulatory Office prior to the impacts occurring to Waters of the U.S.

10. If, at any time during the first two years after initial construction of mitigation, site conditions indicate that the success criteria are not likely to be achieved, the Permittee agrees that remedial efforts shall be undertaken after consultation with the Corps. If the Corps determines that additional on-site efforts are ineffective, remedial efforts may include new mitigation plans and sites, the purchase of credits from a Corps-approved mitigation bank, or participation in an in-lieu fee program.

11. The Permittee shall submit annual mitigation monitoring reports to the Denver Regulatory Office prior to December 31 of each monitoring year for 5 years or until Performance Standards have been met and monitoring requirements are fulfilled. The format of those reports shall follow the requirements shown in Attachment H.

12. The Permittee shall comply with the mitigation measures contained in the June 9, 2011 *Moffat Collection System Project, Fish and Wildlife Mitigation Plan* (Fish and Wildlife Mitigation Plan) as endorsed by the Colorado Parks and Wildlife Commission and Colorado Water Conservation Board. The Corps understands that the commitment to fund stream habitat restoration on the Fraser and upper Williams Fork rivers is replaced by the Williams Fork River Basin Stream Rehabilitation project; the commitment for stream temperature monitoring in the Fraser River Basin and upper Colorado River is modified by the 401 Certification, and 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 the Permittee to the U.S. Forest Service.

13. The Permittee shall 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 shall be removed from equipment (tracks, turrets, buckets, drags, teeth, etc.) and equipment shall 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 shall be removed from equipment (tracks, turrets, buckets, drags, teeth, etc.) and equipment shall 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 shall be cleaned using one of the above options. Water shall not be moved from one water body to another. Equipment must be dry before use.

14. The Permittee shall submit a fugitive particulate emissions control plan and Best Management Practices (BMPs) that meet requirements for Colorado Air Quality Control Standards to the Denver Regulatory Office prior to construction.

15. The Permittee shall dispose of construction debris, and handle and convey materials in a manner such that they cannot enter a waterway or wetland except as approved herein.

16. The Permittee shall operate equipment for handling and conveying materials during construction in such a manner to prevent dumping or spilling the materials into the water except as approved herein.

17. The Permittee shall take care to prevent any petroleum products, chemicals, or other deleterious materials from entering the water.

18. The Permittee shall take steps to prevent materials spilled or stored on shore from washing into the water as a result of cleanup activities, natural runoff, and flooding, and ensure that during construction, any materials which are accidentally spilled into the water are retrieved.

19. The Permittee shall perform all work in the waterway in such a manner so as to minimize increases in suspended solids and turbidity, which may degrade water quality and damage aquatic life outside the immediate area of operation.

20. The Permittee shall ensure that any banks disturbed or created by the construction activity will be seeded with native vegetation for protection against subsequent erosion.

21. The Permittee shall ensure that the clearing of vegetation is limited to that which is absolutely necessary for construction of the Project.

22. The Permittee shall coordinate with downstream water users, advising them of any water quality changes to be caused by the construction.

23. The Permittee shall place all dredged or excavated materials, with the exception of that authorized herein, in an upland site above the existing ordinary high water line in a confined area, not classified as a wetland, to prevent the return of such materials to the waterway.

24. The Permittee shall carry out the deposition of excavated materials on shore and all earthwork operations in such a way that sediment runoff and soil erosion to the water are controlled.

25. The Permittee shall install culverts in any temporary crossing to carry normal flows and prevent the restriction of expected high flows during construction.

26. The Permittee shall wash concrete trucks at a site and in such a manner that wash water cannot enter the waterway.

27. The Permittee shall keep the use of machinery in the waterway to a minimum.

28. The Permittee agrees that if the Corps is notified that a filling activity is adversely affecting fish or wildlife resources or the harvest thereof, and the Corps subsequently directs remedial measures, the Permittee shall comply with such directions to suspend or modify the activity to the extent necessary to mitigate or eliminate the adverse effect as required.

29. The Permittee shall dike, curb, or use other suitable means of containing above-ground fuel storage tanks to prevent the spread of liquids in case of leakage in the tanks or piping.

30. After a detailed and careful review of all of the conditions contained in this permit, the Permittee acknowledges that, although said conditions are required by the Corps, the Permittee agrees to those conditions voluntarily to facilitate issuance of the permit. The Permittee shall comply fully with all the terms of the permit conditions.

5. FIGURES AND ATTACHMENTS

Figures

Engineering Drawings of Gross Reservoir

Figure 1	Cover Sheet
Figure 2	Site Layout
Figure 3	Enlarged Dam Plan
Figure 4	Dam Centerline Profile
Figure 5	Dam Section
Figure 6	Outlet Works Plan

Wetlands, Waters of the U.S., and Riffle Pool Complexes Map

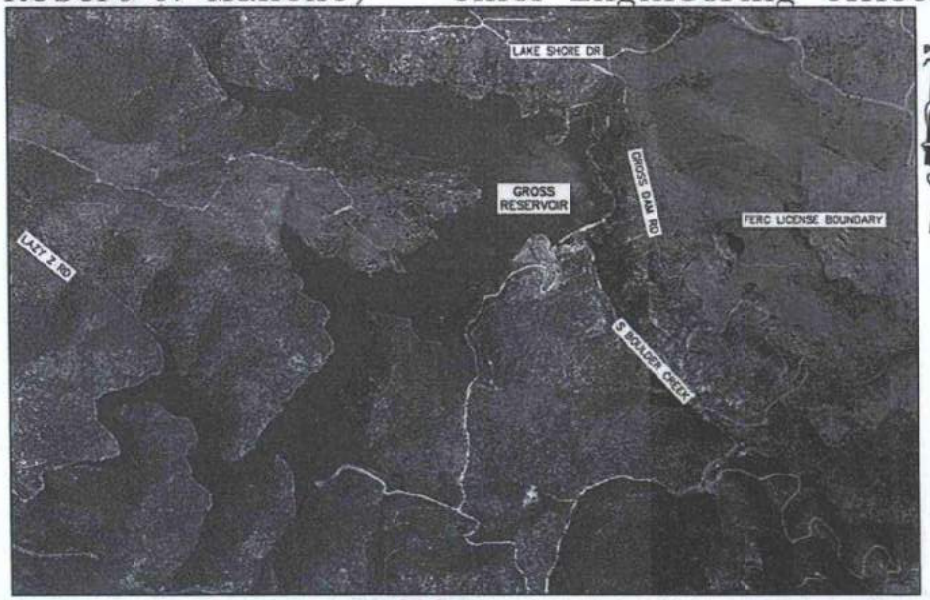
Attachments

Attachment A	Clean Water Act Section 401 Certification
Attachment B	Programmatic Agreement
Attachment C	Biological Opinions

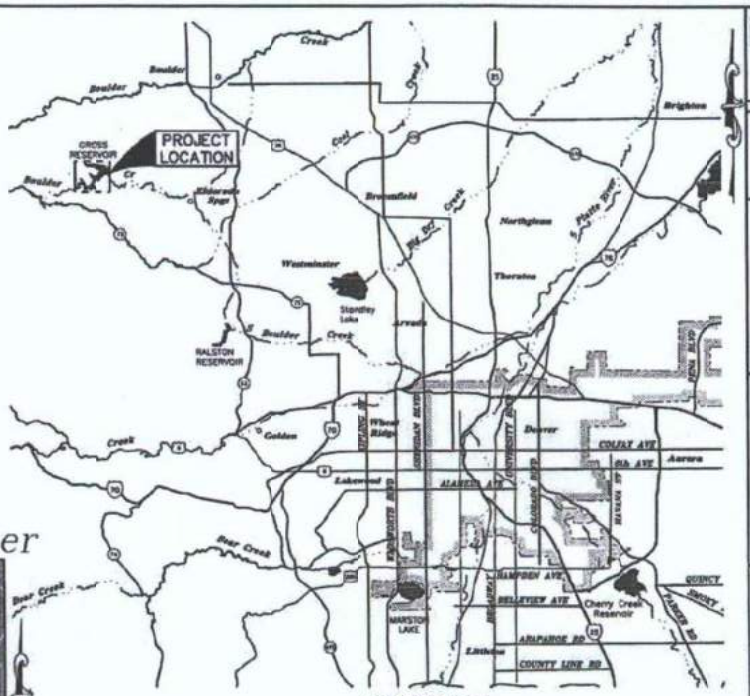
FIGURES

DENVER WATER
DENVER, COLORADO
GROSS RESERVOIR EXPANSION
MOFFAT COLLECTION SYSTEM PROJECT
CONCEPT DESIGN DRAWINGS

BOARD OF WATER COMMISSIONERS
DENVER, COLORADO
Penfield W. Tate, III – President
James S. Lochhead – CEO/Manager
Robert J. Mahoney – Chief Engineering Officer



VICINITY MAP
SCALE: 1" = 1000'



LOCATION MAP
SCALE: 1" = 3 MILES

DRAWING INDEX

DWG NO	DWG TITLE
G-1	COVER SHEET
C-1	SITE LAYOUT
C-2	ENLARGED DAM PLAN
C-3	DAM CENTERLINE PROFILE
C-4	DAM SECTION
C-5	OUTLET WORKS PLAN

PROJECT DIRECTORY

OWNER:
DENVER WATER
1600 W 12TH AVE
DENVER, CO 80204
303-628-6000

CONTACT:
DESIGN PROJECT MANAGER
JEFF MARTIN, PE
303-628-6508
jeff.martin@denverwater.org

DENVER WATER
1600 West 12th Ave
Denver, Colorado 80204-3412
T: 303.628.6000
F: 303.628.6851
denverwater.org

CONSULTANT

GROSS RESERVOIR EXPANSION

MOFFAT COLLECTION SYSTEM PROJECT CONCEPT DESIGN DRAWINGS

REFERENCE:
CAPITAL PROJECTS CONSTRUCTION STANDARDS 2014
www.denverwater.org
/EngineeringDivision/EngineeringStandards/CPCS

THIS DRAWING IS BASED ON THE DW_GROSS_GRID COORDINATE SYSTEM

No	Date	Description
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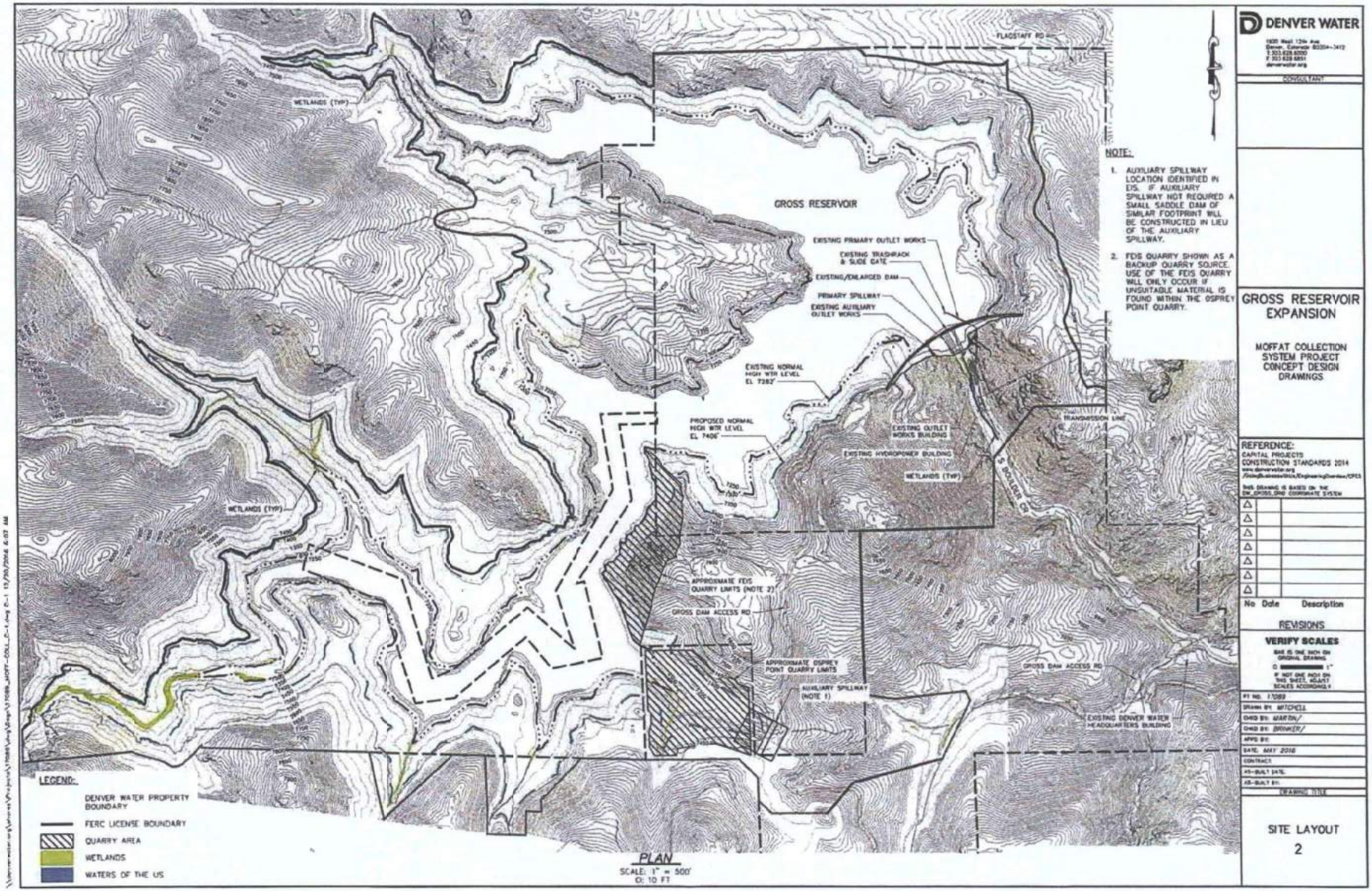
REVISIONS

VERIFY SCALES
BAR IS ONE INCH ON ORIGINAL DRAWING
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

PT NO: 17089
DRAWN BY: MITCHELL
CHKD BY: GARCIA/
CHKD BY: BRINKER/
APPD BY:
DATE: MAY 2016
CONTRACT:
AS-BUILT DATE:
AS-BUILT BY:
DRAWING TITLE

COVER SHEET

1



PLAN
SCALE: 1" = 500'
OR 10 FT

DENVER WATER
1600 West 12th Ave.
Denver, Colorado 80204-3412
T 303.628.6000
F 303.628.6851
denverwater.org

CONSULTANT

GROSS RESERVOIR EXPANSION

MOFFAT COLLECTION SYSTEM PROJECT CONCEPT DESIGN DRAWINGS

REFERENCE:
CAPITAL PROJECTS CONSTRUCTION STANDARDS 2014
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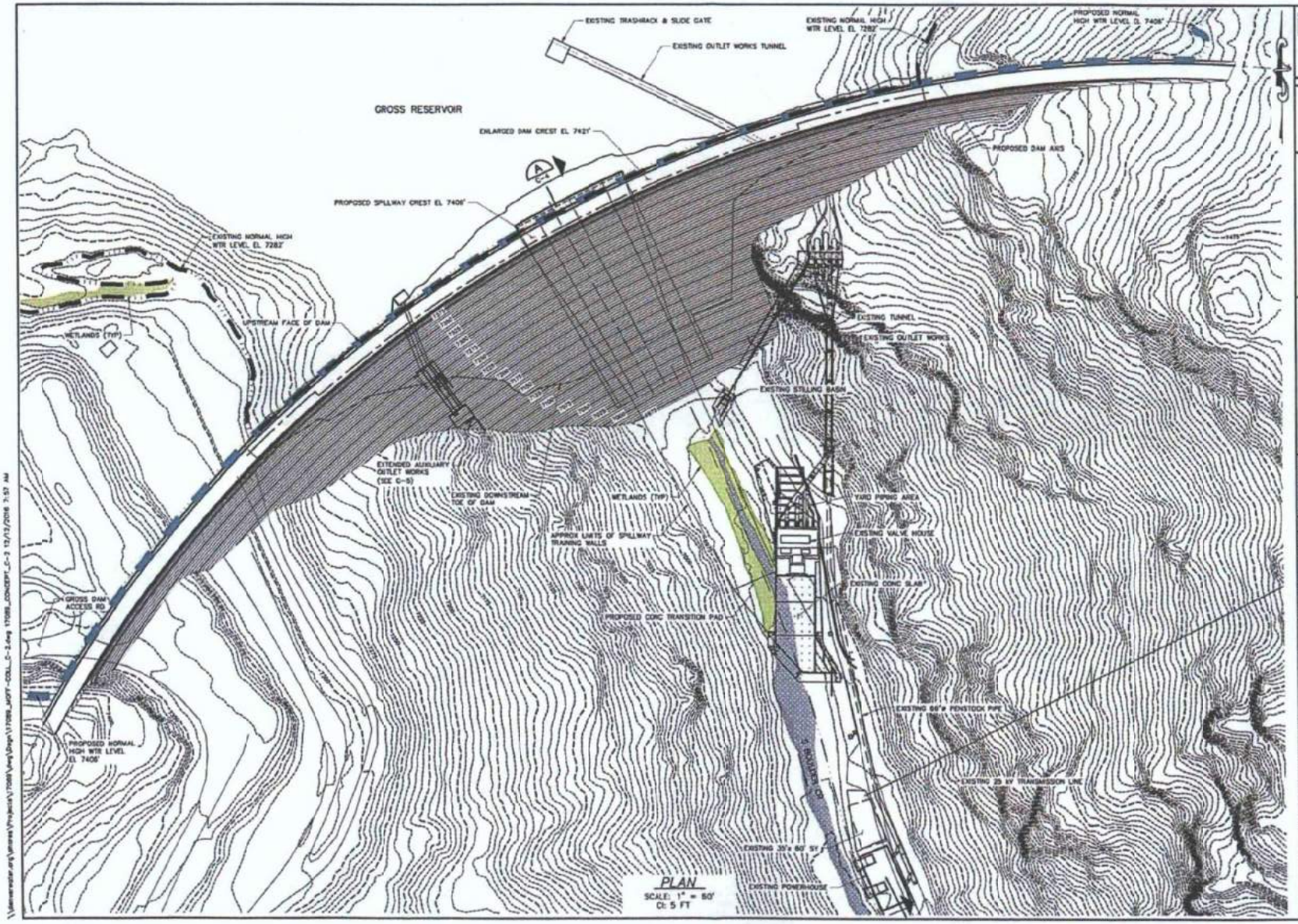

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Denver, Colorado 80204-3412
T: 303.628.6000
F: 303.628.6851
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CONSULTANT

GROSS RESERVOIR EXPANSION

MOFFAT COLLECTION SYSTEM PROJECT CONCEPT DESIGN DRAWINGS

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ENLARGED DAM PLAN
3

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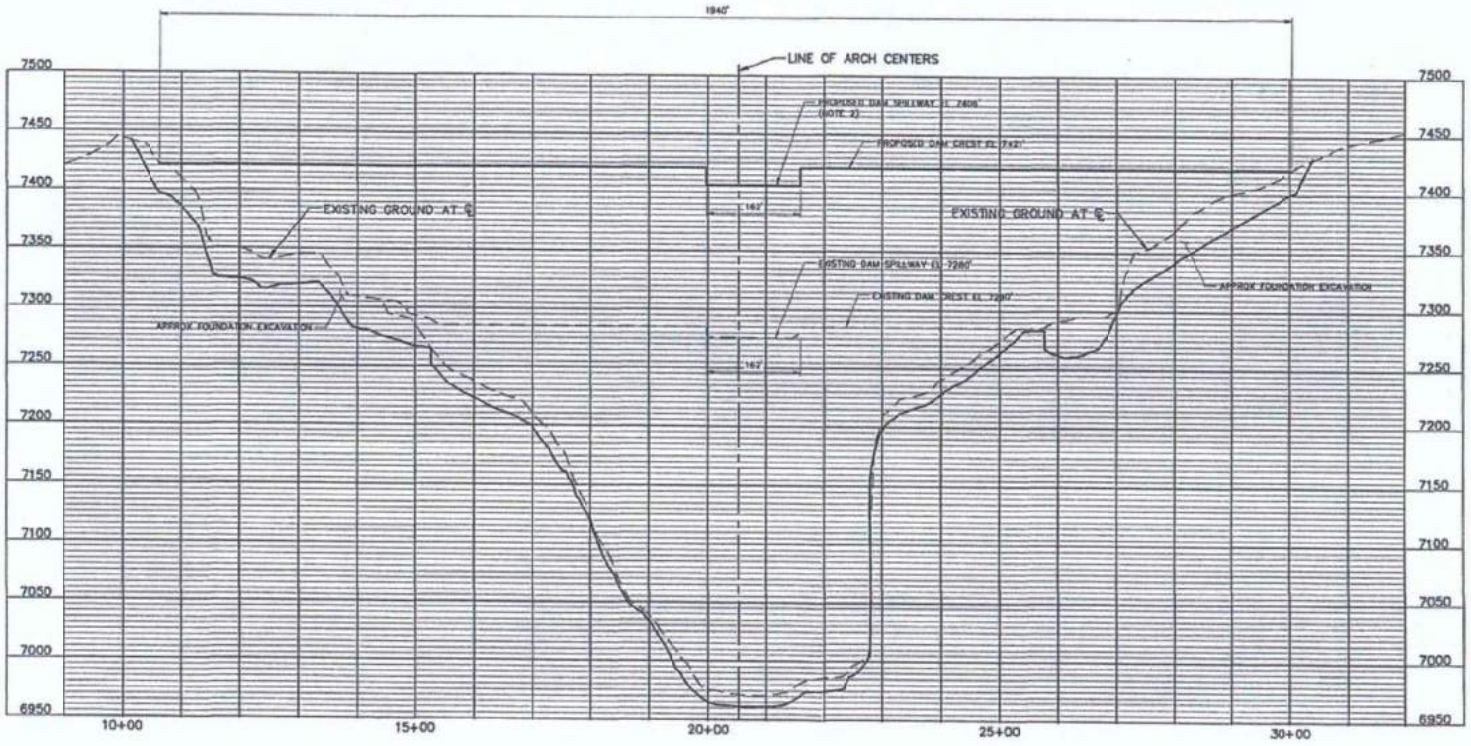

PROFILE

SCALE: 1" = 100' HORIZ
1" = 50' VERT

NOTES:

1. PROFILE DEVELOPED ALONG AXIS OF NEW DAM, LOOKING UPSTREAM.
2. THE FINAL SPILLWAY WIDTH WILL BE DETERMINED DURING FINAL DESIGN.

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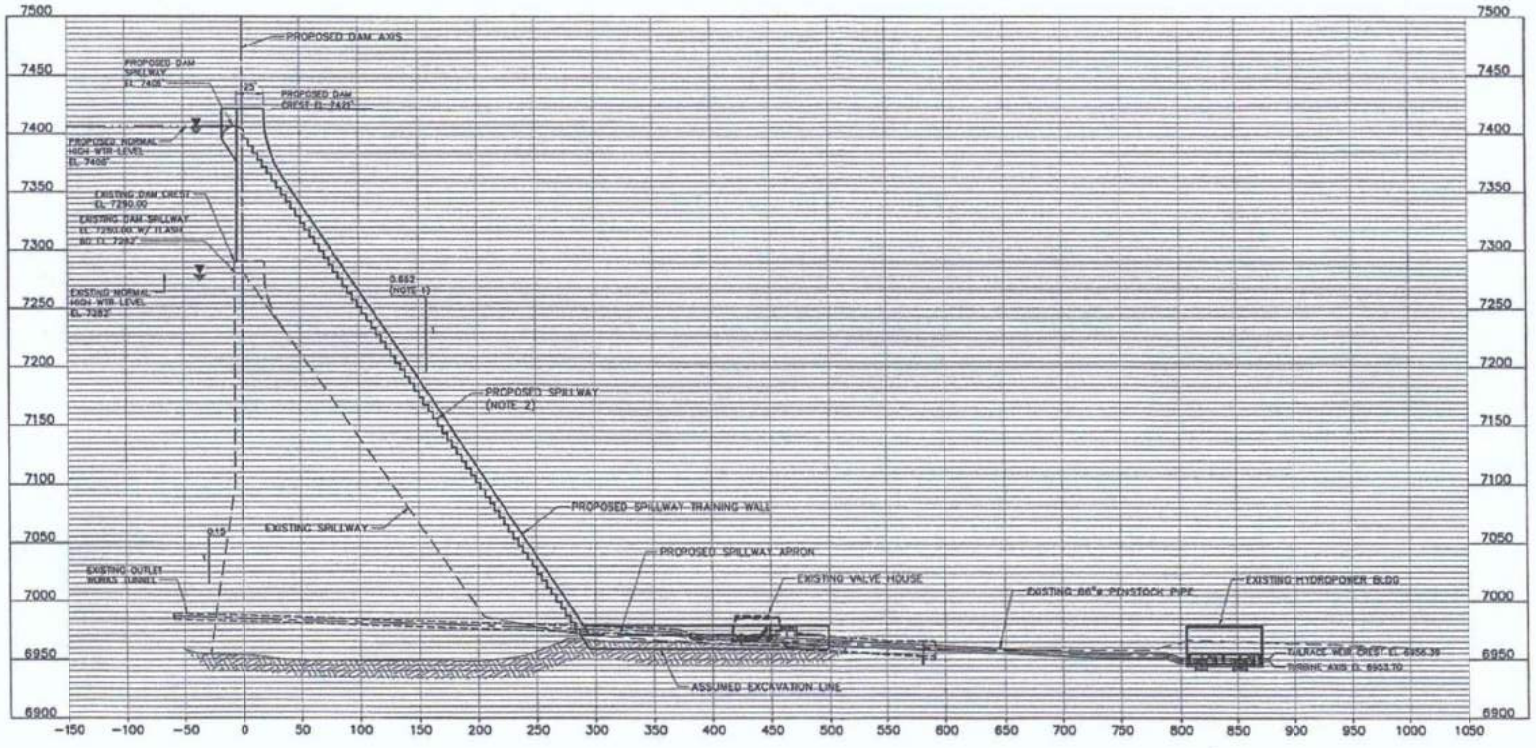
DAM CENTERLINE PROFILE

4



SECTION OF EXISTING & PROPOSED DAM (A, C-2)
SCALE: 1" = 50'

NOTES:

1. DOWNSTREAM SLOPE OF DAM AND SPILLWAY SHOWN TO MATCH EXISTING. ACTUAL SLOPE WILL BE DEVELOPED DURING FINAL DESIGN.
2. THE FINAL SPILLWAY CONFIGURATION WILL BE DETERMINED DURING FINAL DESIGN.
3. SEE C-2 FOR LIMITS OF WETLANDS.

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DAM SECTION
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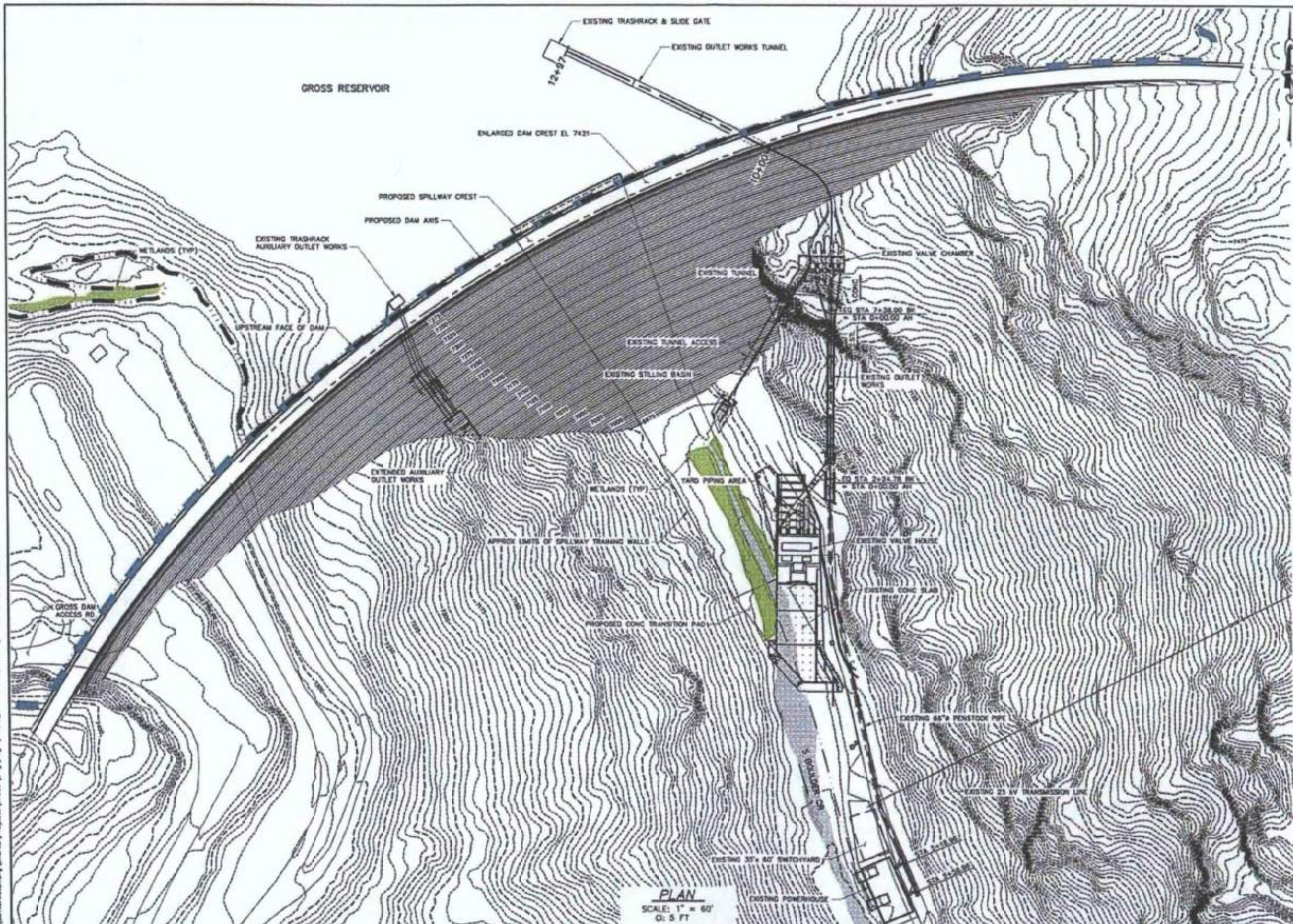

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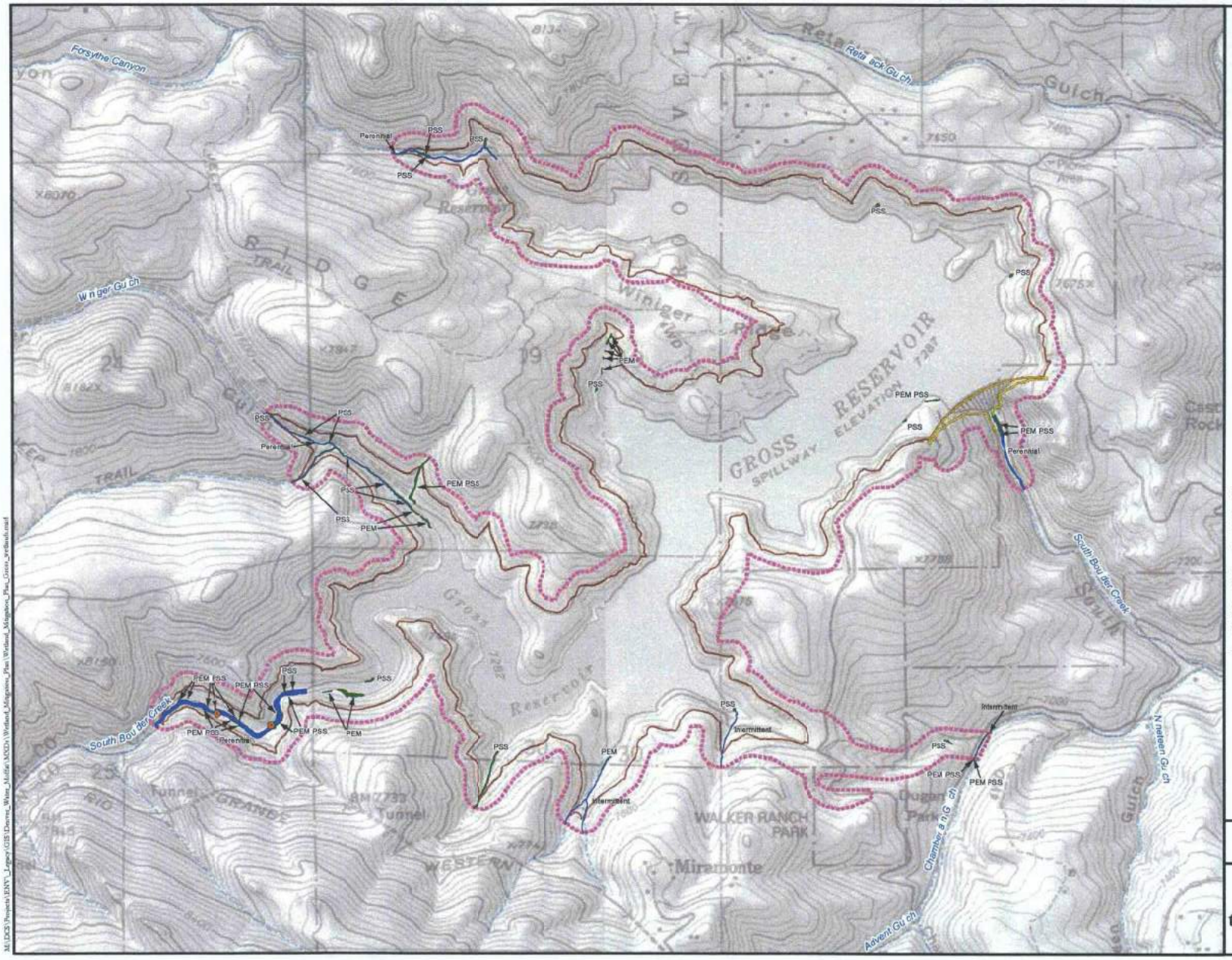
OUTLET WORKS PLAN

6



Wetland
Other Waters of the U.S.
Riffle Pool Location
Wetlands Study Area
Gross Reservoir with Environmental Pool - 77,000 AF Enlargement
Dam Footprint
Stream/River

Figure 1.
Topographic Map of Impact Site

References:
1:24,000-scale quad maps originally from USGS (1972 & 1994) and created with TOPO!, ©2006 National Geographic Maps, All Rights Reserved.

Wetlands and other waters from AlpineEco, (4/2015).

Riffle pool locations provided by Ecological Resource Consultants (8/2016).

Notes:
PEM denotes Palustrine Emergent wetland and PSS denotes Palustrine Scrub/Shrub wetland.

Figure prepared by URS.

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Moffat Collection System Project

Wetlands, Waters of the U.S., and Riffle Pools

8/22/16

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ATTACHMENT A
CLEAN WATER ACT SECTION 401 CERTIFICATION

COLORADO
Department of Public
Health & Environment

Dedicated to protecting and improving the health and environment of the people of Colorado

June 23, 2016

Paula Daukas
City and County of Denver
Board of Water Commissioners
1600 West 12th Avenue
Denver, Colorado 80204

Re: Section 401 Colorado Water Quality Certification No.: 4369
US Army Corps of Engineers 404 Permit No.: 200280762
FERC Project No. 2035
Project Name: Moffat Collection System
Location: Grand, Boulder, Park, Summit, Jefferson and Denver Counties
Water Course: South Boulder Creek, Gross Reservoir, North Fork South Platte River, South Platte River, Chatfield Reservoir, Fraser River, Williams Fork River, Blue River, and Colorado River
Reviewable Designation: COSPUS04, COSPUS06a, COSPUS06b, COSPUS14, COSPUS15, COSPBO04a, COSPBO04b, COSPBO15, COUCUC03, COUCUC08, COUCUC10a, COUCUC10b, COUCUC10C, COUCBL17

Dear Ms. Daukas:

The Colorado Department of Public Health and Environment (CDPHE), Water Quality Control Division (Division) has completed its review of the Moffat Collection System Project Clean Water Act (CWA) Section 401 Permit Application. We have also reviewed our preliminary determination with the issuance of the State of Colorado 401 Certification Public Notice (5 CCR 1002-82, § 82.5(B)) and have completed an antidegradation review pursuant to Regulation 31, Basic Standards and Methodologies for Surface Water (5 CCR 1002-31, § 31.8(3)).

Regulation 82 Requirements

Regulation 82, (5 CCR 1002-82) which addresses certifications under Section 401 of the Clean Water Act, directs the Division to consider antidegradation requirements indentified in the state's Procedural Regulation, Regulation 21 (5 CCR 1002-21), requirements contained in the Basic Standards and Methodologies for Surface Water, Regulation 31 (5 CCR 1002-31), the Basic Standards for Ground Water, Regulation 41 (5 CCR1002-41), as well as appropriate classifications and water quality standards, effluent limits, control regulations, Best Management Practices (BMPs), water quality mitigation measures and public comments. The Division is directed to provide either a regular certification, conditional certification, or to deny certification based upon review of the application and the applicable water quality requirements as listed in section 82.5(A)(1) of Regulation 82.

Section 82.5(B)(6) provides that "[c]ertifcation shall not be denied where the imposition of conditions or denial would result in material injury to water rights as prohibited under section 25-8-104 C.R.S." The pertinent part of § 25-8-104(1) states as follows:

> No provision of this article shall be interpreted as to supersede, abrogate, or impair rights to divert water and apply water to beneficial uses in accordance with the

> provisions of sections 5 and 6 of article XVI of the constitution of the State of Colorado, compacts entered into by the State of Colorado, or the provisions of articles 80 to 93 of title 37, C.R.S., or Colorado court determinations with respect to the determination and administration of water rights. Nothing in this article shall be construed, enforced, or applied so as to cause or result in material injury to water rights.... Nothing in this article shall be construed to allow the commission or the division to require minimum stream flows or minimum water levels in any lakes or impoundments.

Project Background

The Moffat Collection System Project is expected to provide larger water deliveries to the Denver metropolitan area by increasing the storage capacity of the existing Gross Reservoir by raising the current dam height. On the West Slope the project is expected to have impacts to the Fraser River and its tributaries, Grand Lake, Shadow Mountain Reservoir, the Colorado River after it enters Shadow Mountain Reservoir through Granby Reservoir and Windy Gap Reservoir to the confluence with the Williams Fork River and the Williams Fork River and its upper tributaries. Impacts have also been identified in the Blue River below Dillon Reservoir, North Fork South Platte River, Chatfield Reservoir, South Platte River and South Boulder Creek. The impacted portion of the Colorado River is identified as Upper Colorado River Basin segment 3. Grand Lake, Shadow Mountain Reservoir, and Granby Reservoir are identified as Upper Colorado River Basin segment 12. Windy Gap Reservoir is Upper Colorado River Basin segment 13. The Colorado River from Shadow Mountain Reservoir to Granby Reservoir is Upper Colorado segment 2. The Williams Fork River and tributaries are Upper Colorado River Basin segment 8. The Blue River below Dillon Reservoir is Blue River segment 17.

The project impacts the following water bodies on the East Slope -North Fork South Platte River is Upper South Platte River Basin segment 4. South Platte River above Chatfield Reservoir is segment 6a. Chatfield Reservoir is Upper South Platte segment 6b. The South Platte River mainstem through Denver is Upper South Platte River segments 14 and 15. South Boulder Creek, Gross Reservoir and South Boulder Creek below Gross Reservoir are Boulder Creek segments 4a, 15 and 4b respectively.

All of these segments are "reviewable," meaning that an antidegradation review is required. The antidegradation review process requires a determination as to whether the activity is likely to result in significant degradation of the impacted waters. The Division's "significance determinations" consider the "net effect of the new or increased water quality impacts .... Taking into account any environmental benefits resulting from the regulated activity and any water quality enhancements or mitigation measures...." 5 CCR 1002-31, § 31.8(3)(c).

Division Comments and Antidegradation Review

The Division has reviewed information submitted concerning the Moffat Collection System Project against the requirements of Regulation 82 and the other applicable regulations cited herein. The construction activities described in the Moffat Collection System are expected to be only short-term in nature and are therefore not significant in the context of an antidegradation review. Operation of the Moffat Collection System Project does not involve discharges, but it does lead to potential long-term water quality impacts. These potential impacts and the required conditions to mitigate such impacts are explained in detail in the attached *Rationale for Conditional 401 Certification of the Moffat Collection System Project.*

Certification Statement

Based on the Division's analysis and evaluation, as further explained in the attached *Rationale for Conditional 401 Certification for the Moffat Collection System 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*.

This § 401 Water Quality Certification shall apply to both the construction and operation of the project for which a federal license or permit is required, and shall apply to the water quality impacts associated with the Moffat Collection System Project. This certification does not constitute a relinquishment of the Division's authority as defined in the Colorado Water Quality Control Act, nor does it fulfill or waive any other local, state, or federal requirements.

If you have any questions or need additional information, please contact John Hranac of my staff at (303) 692-3586.

Sincerely,

Patrick Pfaltzgraff
Director, Water Quality Control Division
Colorado Department of Public Health and Environment

Enclosures: *Rationale for Conditional 401 Certification of the Moffat Collection System Project*
Regulation 82.6 Certification Requirements

C: Tim Carey, US Army Corps of Engineers, Denver Regulatory Office, Littleton, CO
Kimberly D. Bose, Federal Energy Regulatory Commission, Washington, D.C.
Peter Yarrington, Federal Energy Regulatory Commission, Washington, D.C.
Steve Hocking, Federal Energy Regulatory Commission, Washington, D.C.
Lurline Underbrink Curran, Grand County Manager, Hot Sulphur Springs, CO
Lane Wyatt, Northwest Colorado Council of Governments, Silverthorne, CO
Lisa Buchanan, Scientist/Engineer, Boulder, Colorado
Chris Garre, The Environmental Group, chris@tegcolorado.org
Gary Wockner, Save the Colorado, Ft. Collins, CO, gary@savethecolorado.org
Mely Whiting, Trout Unlimited, mwhiting@tu.org
Karen Hamilton, US EPA Region 8, Denver, CO

Rationale for Conditional 401 Certification of the Moffat Collection System Project

The proposed Moffat Collection System Project (Moffat Project or project) will provide an additional 18,000 acre-feet per year (AF/y) to meet future demands of the Applicant[1] and its customers. It includes an enlargement of Gross Reservoir and will rely on existing infrastructure to fill the added storage capacity. Expansion of the dam and enlargement of the reservoir will have direct impacts to waters of the United States, including adjacent wetlands. Although the project does not discharge pollutants, it does involve significant "hydrologic modifications." By altering flows on both sides of the Continental Divide, the project directly affects the quantity and quality of aquatic habitat, and it indirectly affects water quality by changing contributions to mass balance for all constituents.

The project requires certification under Section 401 (certification) of the Federal Clean Water Act, and it is the responsibility of the Water Quality Control Division (Division) to determine whether to certify, conditionally certify or deny certification for the project. This certification applies to two federal actions required by the project: the Section 404 permit from the U.S. Army Corps of Engineers (Corps) and an amendment to the license from the Federal Energy Regulatory Commission (FERC) for a hydropower project[2]. The Corps, as the lead agency responsible for compliance with the National Environmental Policy Act (NEPA), prepared an Environmental Impact Statement (EIS), with the Final EIS (FEIS) issued on April 18, 2014.

Water Quality Control Commission (Commission) Regulation 82 provides direction to the Division concerning the nature and scope of the evaluation of potential water quality impacts, including those resulting from hydrologic modifications. The regulation, in section 82.5(A), specifies what the Division will review and consider in reaching its determination about certification. Items relevant to the determination for this project include the certification application, anti-degradation (AD) review, maintenance of water quality standards and protection of designated uses in waters in the affected area, information received in the public comment period, and commitments already made by the Applicant for mitigation of anticipated impacts and enhancements to water quality that may yield environmental benefit.

The "Request for Clean Water Act Section 401 Water Quality Certification Final Report" (Final Report) dated June 2015 provides the Applicant's

[1] City and County of Denver, acting by and through its Board of Water Commissioners (Denver Water)
[2] Project No. 2035

characterization of water quality impacts and a catalog of the commitments the Applicant has made to mitigate those impacts or otherwise improve water quality in the project area. The Division generally agrees with much of the Applicant's characterization of impacts and also recognizes the value of the commitments the Applicant has made to improve water quality. The Division's ability to issue a certification for this project is based on a determination of "reasonable assurance" that the proposed mitigation and enhancement measures will perform as expected and counteract the predicted adverse impacts of the project. Thus, the Division is imposing conditions on the certification as a means of clarifying expectations for, and assessing the performance of, these mitigation and enhancement measures.

Development of Conditions

The Division seeks to satisfy two objectives by imposing conditions. The first objective is to ensure that significant water quality impacts are mitigated wherever possible. Opportunities for direct mitigation are relatively limited insofar as the impacts are the result of hydrologic modifications and not the discharge of pollutants. The challenge is to craft conditions that are effective and also consistent with section 25-8-104 of the Water Quality Control Act, as specified in Regulation 82[3]. Although it is beyond the Division's authority to unilaterally impose a condition inconsistent with section 25-8-104, such a condition could be included if the Applicant finds it acceptable[4].

The second objective is to provide reasonable assurance that the Applicant's commitments to mitigate the impacts of the project and enhance water quality provide the expected benefits. The 401 certification application lists the existing commitments and associated agreements. These mitigation and enhancement measures, if successful, may contribute to "net environmental benefit" as it relates to the significance determination in the AD review.

Each commitment for mitigation or an enhancement measure in the Final Report makes a prediction, usually based on modeling, about the expected benefit. Consequently, there is an implicit, but untested, assumption that the proposed measures will be successful in mitigating impacts or improving some aspect of water quality. The Division will impose conditions to clarify expectations and to determine the actual benefit after the mitigation and enhancement measures have been implemented and the project has been completed.

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[3] Section 82.14: "There may be hydrologic modification impacts that can be mitigated without materially injuring water rights. The Commission believes that it has a responsibility to assure the maximum practical water quality protection that does not conflict with the provisions of section 25-8-104."

[4] Section 82.5(A)(3)

The Division recognizes that the Applicant's commitments for mitigation and enhancement measures have been made in good faith and with the expectation that those measures will prove successful. There is no way to ensure success, however. Consequently, it is important to have a process for handling situations where those measures fall short and impairments[5] occur. Thus, conditions include a requirement for the Applicant to investigate sources and mechanisms contributing to the impairment and, if necessary, to develop an appropriate response.

There has been considerable discussion, including public comment, about including a condition that would require the Applicant to participate in the Learning by Doing (LBD)[6] process. The Division views LBD as a potentially valuable strategy for adaptive management that is well-suited for optimizing allocation of resources for maintenance and improvement of the stream environment. Through the certification process the Division and parties that commented on this issue have come to a resolution. The Division has not included the Applicant's participation in LBD as a condition because the Division only has authority to require the Applicant to comply with the conditions, and LBD includes multiple parties. However, the Applicant may fulfill its obligations under this 401 certification through participation in external groups and processes, including but not limited to LBD.

Lastly, the Division may modify the certification, by revising existing conditions or proposing new water quality conditions, based on new evidence or changed circumstances determined to result in significant water quality impacts due to the project. For example, the conditions presented below are based on an important assumption regarding another large water project - the Windy Gap Firming Project (WGFP) - that was also subject to the 401 certification process. The Moffat Project and the WGFP are each considered to be one of the Reasonably Foreseeable Future Actions affecting the other project. All previous

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[5] Throughout the text, the terms "impaired" and "impairment" refer in all instances to conclusions reached on the basis of water quality assessment protocols given in the Division's 303(d) Listing Methodology, which is revised biennially. A formal listing in Regulation 93 is not required for reaching an impairment conclusion.

[6] Learning by Doing is a cooperative process that has a goal of maintaining or improving the "stream environment" in the project area. An adaptive management strategy is employed to make decisions about allocating resources to meet the goal. The management committee includes representatives from Denver Water, Grand County, the Colorado River Conservation District, Middle Park Water Conservancy District, Northern Colorado Water Conservancy District (Municipal Subdistrict), Colorado Parks and Wildlife, and Trout Unlimited. The Applicant has signed the 2012 Intergovernmental Agreement for the LBD Cooperative Effort, and the Applicant's participation is further required through other commitments, including the Colorado River Cooperative Agreement.

modeling of hydrology and water quality, as well as the environmental impact analysis, has assumed that both projects would receive the necessary permits and be operated concurrently. The Division has evaluated both projects in the 401 certification process and sees no reason to question the assumption that both will move forward for permitting. However, in the event that the WGFP does not receive a 404 permit, or if there are any other material changes to the assumptions that form the basis of the Division's certification that will adversely impact water quality to the extent that the conditions herein no longer yield an environmental benefit, then the Applicant must submit a request to the Division for a modification to the 401 certification.

General Considerations for Water Quality Monitoring

Water quality monitoring provides the information necessary for evaluating the performance of mitigation and enhancement measures. As such, there are general requirements regarding locations, sampling frequency, analytical precision, and reporting that affect the usefulness of the data for reaching conclusions about performance and about the possible occurrence of impairments as defined by the most recent version of the Division's 303(d) Listing Methodology. The general considerations for monitoring are specified in this section, and requirements specific to individual parameters are described within the conditions. General monitoring requirements are also added for Gross Reservoir, because water quality may change as a result of the enlargement of the reservoir, and for selected source water areas where public comment identified further need of data.

For sampling locations, preference is given to sites that have been sampled in the past, especially where the sites were important for assessing the potential for project impacts. The historical record at these sites establishes context for baseline conditions and for the magnitude and patterns of variability that will facilitate interpretation of data obtained in the future.

When the Division specifies site selection(s) in a condition, it is based on the assumption the site(s) will continue to fulfill the original purpose (e.g., provide continuity with the historical data record) and be accessible to the Applicant. The Division recognizes that factors beyond the Applicant's control may alter the representativeness of data at a particular location (e.g., construction of a beaver dam) or access to private land may be denied. When such situations arise, the Applicant will submit as soon as possible a proposed alternate location to the Division for approval.

Sampling frequency depends to some extent on the parameter, the nature of the expected impacts, and the needs for evaluating the performance of mitigation and enhancement measures. For stream temperature, continuous monitoring (15-min intervals) is required for establishing the temporal patterns

of variation and for assessing attainment[7] of standards. Water chemistry sampling in streams and in Gross Reservoir must be monthly or more frequent, with the caveat that Gross Reservoir may not be safe to sample under ice cover and some stream sampling locations identified in the conditions may not be accessible in winter. Biennial sampling for fish and annual sampling for aquatic macroinvertebrates are required.

Analytical precision determines the usefulness of data for constituents that are present in relatively low concentrations. Laboratory analyses must include an empirical determination of the method detection limit (MDL), and readings below the MDL are to be treated as non-detects. Readings between the MDL and the reporting limit must be reported as estimated concentrations (i.e., flagged accordingly and not shown as a "less than" value).

All monitoring data - lab and field results - must be compiled annually and provided to the Division in electronic form by April 1 following each calendar year of sampling. The requirement for sampling and reporting will begin as soon as the issuance of the 404 permit or the FERC license, whichever is later, and the obligation will remain in place until five years after the project is fully operational[8]. The annual report will include assessments of attainment utilizing the most recent edition of the Division's 303(d) Listing Methodology for all parameters specified in the conditions and a brief discussion of any impairments.

General Considerations for Response to Impairment

Based on the information provided in the application the Division expects that the mitigation or enhancement measures will be successful; however, there is no guarantee. It is possible that, despite best efforts, water quality will become, or continue to be, impaired. It is important to anticipate this possibility by including conditions that, if triggered, will specify a course of action to foster improved water quality to the extent possible. The course of action described below is essentially an adaptive management strategy for developing the appropriate remedial action.

For parameters included in the conditions, when an impairment is identified in annual reports submitted by the Applicant or through the Division's assessment process, the Applicant will be required to investigate sources and mechanisms in an effort to determine the extent to which operation of the Moffat Project

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[7] Throughout the text, the term "attainment" refers consistently to situations where assessment of ambient water quality data shows that the applicable water quality standard is met.

[8] "Fully operational" is defined as the date of the initial fill of the Gross Reservoir enlargement, not including water that is part of the Environmental Pool.

causes or contributes to the impairment. The Applicant is well-positioned to investigate these impairments by having collected the data, through familiarity with the project area, and with the information to separate project effects from those attributable to full use of the existing system.

The Applicant will have one year following the detection of the impairment to prepare an impairment investigation report in which conclusions will be presented about the main source(s) and mechanism(s) at work, and the responsibility attributable to the project. Results of the impairment investigation will be discussed with the Division to determine what further actions are required of the Applicant. This report may be developed with contractor support or through external processes such as Learning by Doing. If, after diligently working on the impairment investigation, the Applicant requires more time to finish the impairment investigation the Applicant may request an extension from the Division. The Applicant must request the extension at least two months prior to the one year deadline and must explain the reason and need for the extension. The Division will review the request and determine whether to grant the extension.

Where the Division concludes that operation of the project bears little or no responsibility for the impairment, the Division will use the impairment investigation report to facilitate development of a Total Maximum Daily Load (TMDL) consistent with regulatory requirements. If the Division concludes that operation of the project is primarily responsible for the impairment, the Division will require that the Applicant actively explore preparation of a Category 4b Plan[9] that will define the actions necessary to bring water quality back to attainment of the standard. In doing so, the Applicant will be encouraged to work with other significant contributors to impairment, if applicable.

A Category 4b Plan must ensure attainment with all applicable water quality standards through agreed upon pollution control mechanisms within a reasonable time period, must be consistent with CRS 25-8-104, and must be submitted to the Division no more than two years after the Division's determination that the plan is applicable. If a Category 4b Plan cannot ensure attainment with all applicable water quality standards through agreed upon pollution control mechanisms within a reasonable time period, is not accepted by the Division or the Environmental Protection Agency (EPA), or is precluded by or inconsistent with the water rights provisions in section CRS 25-8-104, then the Division anticipates a 303(d) listing and, in cooperation with the Applicant, preparation of a TMDL to bring water quality back to attainment of the

[9] A Category 4b Demonstration Plan addresses water quality impairments in a manner that makes the TMDL process unnecessary. The plan identifies mechanisms that are expected to result in attainment of water quality standards in a reasonable period of time.

standard. The Applicant, at its discretion, may agree to remedial actions to restore water quality that are inconsistent with the water rights provisions of CRS 25-8-104. If, after diligently working on the Category 4b Plan, the Applicant requires more time to finish the Category 4b Plan, the Applicant may request an extension from the Division. The Applicant must request the extension at least two months prior to the two year deadline and must explain the reason and need for the extension. The Division will review the request and determine whether to grant the extension.

Rationales and Conditions

Conditions are organized by water quality parameters. Each condition is accompanied by a rationale that describes the anticipated impact, what is proposed for mitigation or enhancement, and what reliance is placed on commitments that the Applicant has made to other parties. An impact may be considered significant when it erodes assimilative capacity beyond what is allowed by the rules set forth in the AD review guidance in Regulation 31. Also, any impact that causes an impairment or contributes to an existing impairment is considered significant. In the case of cause-or-contribute impacts, the Division will include consideration of qualitative assessments, especially where modeling was not feasible or data were not available.

Temperature

The Applicant analyzed temperature impacts to the Fraser River, the Colorado River, and South Boulder Creek. Regarding the Fraser River and Colorado River, the predicted impacts of the project include the loss of assimilative capacity and increases in the number of exceedances of temperature standards. Conclusions for the Fraser River are based on results produced by a dynamic temperature model developed for the Fraser River by the Applicant and calibrated with recent temperature data. Predictions for the Colorado River are based on modeling work performed as part of a separate certification application for the Windy Gap Firming Project. Conclusions for South Boulder Creek are based on reservoir modeling conducted as part of the EIS process and additional analyses performed by the Division, as explained below. The Division has reviewed the modeling work and has determined it is credible.

Project diversions in the Fraser River basin will reduce stream flows with the expected impact of causing or contributing to existing impairments for temperature and further erosion of assimilative capacity. Specific areas of concern include Ranch Creek, the Fraser River, and St Louis Creek. According to the FEIS, the potential for impact extends to the Colorado River below the confluence with the Fraser River. A robust monitoring program will be especially important for identifying temperature impacts related to operation of the project. Conditions will be imposed to establish and maintain temperature monitoring stations at key locations.

The Applicant has made commitments to bypass flows from 15 July through 31 August in response to specific temperature action levels at specified locations in the Fraser River basin and in the Colorado River below Windy Gap Reservoir. The "Temperature Mitigation Response", which is presented in the Final Report, is a commitment to release up to 250 AF (at a rate of up to 4 cfs) when temperature action levels are reached at any of the following locations at which real-time temperature monitoring is required.

- Fraser River below Crooked Creek near Tabernash (USGS gage 09033300)
- Ranch Creek near Fraser, CO (USGS gage 09032000)
- Ranch Creek below Meadow Creek (USGS gage 09033100)
- Colorado River at the Windy Gap gage (CR-WGD; USGS gage 09034250)
- Colorado River upstream of the confluence with the Williams Fork River (CR-WFU)

The Division has two concerns about the list of locations proposed for triggering the Temperature Mitigation Response. The first is a need for assurance that the Applicant will be responsible for obtaining the data in the event that the operator (e.g., USGS) ceases to support the site. The second is the absence of a real-time temperature station in the Fraser River at Rendezvous Bridge, which is the last point on the mainstem of the Fraser with a Tier 1 (CS-I) classification for temperature. From that point to the confluence with the Colorado River, the mainstem of the Fraser (including USGS gage 09033300) is classified as Tier 2 (CS-II), which has less stringent temperature standards. In other words, exceedances of the temperature standard are more likely at Rendezvous Bridge than at the site below Crooked Creek. This problem can be remedied by adding a real-time monitoring site at Rendezvous Bridge, or by applying the CS-1 action levels, irrespective of the actual classification, at the existing real-time site below Crooked Creek.

The commitment for Temperature Mitigation Response is documented in the Fish and Wildlife Mitigation Plan (FWMP) and the Grand County Mitigation and Enhancement Coordination Plan (GCMECP). Because the response is not dependent on project operation, it may serve as an enhancement measure during the years of prior to project operation and as mitigation once the project is operational.

If the 250 AF available under the Temperature Mitigation Response has been bypassed, but temperature levels remain elevated, the Applicant has committed to bypass additional flows when the project is diverting[10]. Under

[10] The following definition is from the GCMECP: "After the Project is constructed, daily reservoir accounting will first credit the water diverted by Denver Water from the Williams Fork and Fraser basins to fill the existing, "Old Water" capacity of Gross Reservoir, which is 41,811 acre-feet. When the amount of Old Water in storage equals 41,811 acre-feet, the next increment of water put into storage at Gross

the heading of "Additional Actions for Elevated Stream Temperature" in the Final Report, the Applicant has committed to release up to 250 AF (at a rate of up to 4 cfs) when temperature action levels are reached at any of the specified locations in the Fraser basin. This commitment is documented in the GCMECP. In the sense that the Additional Actions bypass is tied to project operation, it would function as mitigation.

It is also possible that additional temperature mitigation can be accomplished with water dedicated for stream flows as described in the GCMECP[11]. However, these flows, which are a voluntary enhancement controlled through Learning by Doing, are not tied solely to temperature concerns. Consequently, there is no assurance that these flows will be available once the Temperature Mitigation Response and Additional Actions flows have been exhausted.

The Division recognizes that the Applicant's commitments for flow bypasses offer considerable potential for mitigation of temperature impact in the Fraser River Basin. Modeling work performed by the Applicant supports the argument for mitigation potential. However, it is not yet known if the mechanics of the response will yield successful mitigation in a real-life situation. One important step in that direction could be taken when the Applicant conducts a "Voluntary Pilot Project" (VPP), described in the GCMECP, to measure the effectiveness of flows bypassed in response to temperature triggers at different locations.

The Division's approach to conditions addressing temperature impacts is aimed at measures that will support and evaluate commitments the Applicant has made through the GCMECP. These conditions cover the locations and scope of monitoring, the capacity of bypass flows to alleviate temperature impacts, the relationship between temperature action levels and temperature standards, and the characterization of a *de minimis* temperature response to flow bypasses. In addition, the Applicant has agreed to conditions by which bypass flows are made available for VPPs that address temperature concerns and aid in development of a decision matrix.

Reservoir from the Williams Fork and Fraser basins will be counted as "Project Water." The Old Water is the first water stored in Gross Reservoir and the first water taken out of storage. Project Water does not include water stored from South Boulder Creek or flow-through water." "Flow-through water is water diverted and passed directly through Gross Reservoir to meet demand without being stored in the enlarged reservoir. Flow-through water is not considered Project Water because Denver Water could and would divert and pass through that water without the project."

[11] GCMECP II.3.C.a "LBD could coordinate use of the Fraser 1,000 acre-feet of bypasses ... if stream temperature monitoring in the Fraser Basin indicates a need for action ...."

Regarding South Boulder Creek, the concern is not about raising temperature, as was the case on the West Slope, but about significant alteration of the seasonal pattern of temperature. Consequently, impacts are related to the narrative standard[12] rather than a numeric standard. The current temperature regime at the Gross Reservoir outlet exhibits no diel variation and a greatly altered seasonal pattern of variation. The normal temperature patterns of South Boulder Creek have been altered since the reservoir was completed in 1954, and the existing alterations to the temperature pattern are not the responsibility of the project. Nevertheless, assessment of current conditions provides the basis for anticipating the additional impacts expected with operation of the project.

The Division has reviewed the available data regarding the current temperature regime and finds that there is non-attainment of the narrative temperature standard. The details of the analysis are presented in the attached Appendix A. In brief, the maximum mid-summer temperature with the current reservoir is about 10 degrees less than would be expected for an un-impounded stream at the elevation of South Boulder Creek below the Gross Reservoir outlet, and the annual maximum temperature occurs in October rather than late July. The altered pattern and reduced temperatures caused by the current reservoir result in a loss of degree-days[13] that would normally sustain growth of aquatic organisms during the summer.

The existing temperature pattern is altered because the existing outlet releases water from the bottom of the reservoir. In the summer, the bottom layer (the hypolimnion) contains cold water, but the supply of cold water is usually exhausted by the end of the summer under current conditions. The proposed enlargement of Gross Reservoir (including the Environmental Pool) will almost triple the volume of the reservoir, and will greatly increase the volume of the hypolimnion. After the reservoir is enlarged, the larger volume of cold water in the hypolimnion will extend the period of time in which cold water will be released during the summer.

The impact of the Gross Reservoir enlargement on temperature in South Boulder Creek is predicted based on modeling work performed for the U.S. Army Corps of Engineers during the EIS process. Model results predict that maximum summer temperatures with operation of the project will be about six degrees colder than the current maximum temperatures. The lower summer temperatures mean that degree-days, which are already much less than is normal, will be further reduced by about 30%. In addition, the seasonal

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[12] Regulation 31, Table 1, footnote 5: "Temperature shall maintain a normal pattern of diel and seasonal fluctuations and spatial diversity with no abrupt changes and shall have no increase in temperature of a magnitude, rate, and duration deleterious to the resident aquatic life."

[13] The area under a graph of temperature over time.

temperature ranges will be consistently suboptimal for fry and adults[14]. Further details of the analysis are contained in Appendix A. The proposed Environmental Pool was not included in the temperature modeling, but it is expected to augment the temperature impact because it will add up to 5,000 AF to the volume of the reservoir. The additional volume is likely to increase the capacity of the project to release cold water throughout the summer.

The Division concludes that operation of the project, with or without the Environmental Pool, will contribute to an existing impairment with respect to the narrative temperature standard. Since the impairment is caused by release of cold water from the bottom of the reservoir, mitigation of the project impact could be achieved by releasing instead the warmer water from the top layer of the reservoir. Selective withdrawal would allow for mixing water from the two layers to obtain a desired temperature range. Concepts for addressing problems caused by a too-cold release have been studied[15], and there is considerable literature describing options, including multi-level withdrawal[16].

The Applicant has modeled outlet temperatures with one design option for a multi-level outlet works (MLOW); see Appendix A for more detail. Although the modeling did not include the Environmental Pool, useful conclusions can still be drawn. According to model results, installation of the MLOW would fully mitigate the temperature impact predicted with operation of the project. In other words, the project would no longer be expected to contribute to an existing impairment of the narrative temperature standard. Furthermore, the MLOW would also serve as an enhancement measure because it would yield a gain in degree-days of approximately 30% above current conditions.

The literature describes many examples where selective withdrawal has been installed, and there are also examples in Colorado. However, the mitigation and enhancement benefits that may be achieved involve cost and risk. The Applicant has provided several reasons that a requirement for selective withdrawal would not be a reasonable way to address the temperature impact of the project[17]. The capital cost is at least $6.5M ($11.5M if operating costs and lost hydropower revenue are included), but cost alone does not make the

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[14] See Appendix B1 of the Applicant's Final Report

[15] See review by JD Olden & RJ Naiman. 2010. Incorporating thermal regimes into environmental flows assessments: modifying dam operations to restore freshwater ecosystem integrity. Freshwater Biology 55: 86-107.

[16] For recent overview, see Rheinheimer et al. 2014. Optimizing selective withdrawal from reservoirs.... Journal of Water Resources Planning and Management DOI: 10.1061/(ASCE)WR.1943-5452.0000447.

[17] "Engineering and Cost Overview of a Multi-Level Outlet Works Concept and Environmental Pool", prepared by Denver Water Engineering Division, 12/9/2015. "Multi-Level Outlet Works (MLOW) Practicability", prepared by Denver Water, 4/29/2016.

requirement unreasonable. Instead, the more persuasive arguments are related to operational constraints and expectations for net benefit.

The Applicant has investigated several engineering options for selective withdrawal. A spillway radial gate was evaluated, but rejected for reasons related to cost and the complexity and safety of operation. In addition, predicted reservoir levels in August and September would routinely be too low to maintain release of warmer water from the upper layer. Siphons were considered, but were found to be expensive and would be complex to operate. An auxiliary outlet tower also was evaluated, but was judged by the Applicant to be costly in part because of the need for underwater construction for installation of infrastructure.

Installation of the MLOW is feasible, but operation of the MLOW would interfere with hydropower generation. There are technical and safety considerations, as well as concerns about fish entrainment, that combine to make it impracticable for water from the upper layer of the lake to be routed through the existing penstock. According to the Applicant, operating the MLOW would result in the loss of approximately 7.9 million kilowatt-hours of power production, which would mean an annual revenue loss of about $450,000.

The potential for environmental benefit from the MLOW applies to a relatively short stream reach (about 5 miles in length), and recent data suggest that the water warms noticeably over that distance. Even full mitigation of the project effect would not restore a normal seasonal pattern of temperature below the reservoir. Furthermore, full mitigation may not be possible in years when reservoir levels are too low to release warmer water through gates in the MLOW. Therefore, a condition for monitoring will be imposed in order to document the longitudinal extent of impact from temperature to the aquatic communities in South Boulder Creek.

Condition 1: The Applicant will obtain temperature data from three real-time monitoring locations and two data logger sites in the Fraser basin, as described below. Monitoring at these sites will begin as soon as practicable, but no later than one year after the date of issuance for the 404 permit or the FERC license, whichever is later, and will continue for not less than five years after the project becomes fully operational. The data from each calendar year and a report documenting exceedances of the temperature standard will be submitted to the Division by April 1 following each calendar year of sampling. If the USGS ceases data collection at a real-time site, or GCWIN ceases collection at a data logger site, the Applicant will be responsible for establishing and maintaining data collection at the site. The condition for the Applicant to obtain the data at a site is satisfied at that site if the benefit from bypass flows is shown to be *de minimis*.

- Fraser River below Crooked Creek near Tabernash, CO (USGS gaging station 09033300). Real-time temperature data are currently available

from the USGS. If the USGS ceases data collection at this site, the Applicant will be responsible for establishing and maintaining real-time data collection at the site.

- Ranch Creek near Fraser, CO (USGS gaging station 09032000). Real-time temperature data are currently available from the USGS. The Applicant will be responsible for establishing and maintaining real-time data collection at this site. The commitment also is captured in existing agreements.
- Ranch Creek below Meadow Creek (USGS gage 09033100). Real-time temperature data are currently available from the USGS. If the USGS ceases data collection at this site, the Applicant will be responsible for establishing and maintaining real-time data collection at the site.
- Fraser River at Rendezvous Bridge (GCWIN site FR-Rendezvous). Data logger site maintained by GCWIN.
- St. Louis Creek above Fraser River confluence (GCWIN site ST-LC). Data logger site maintained by GCWIN.

Condition 2: The fixed values for temperature action levels[18] that are specified in existing agreements may or may not continue to match applicable regulatory standards, which are subject to revision. The action levels are hereby modified to correspond to the lesser of the action level in the GCMECP or the applicable standard for Cold Stream Tier 1. The Division expects that lower thresholds may be developed for triggering bypass flows as more is learned about tailoring responses to avoid exceedances.

Condition 3: The Applicant will conduct a Voluntary Pilot Project[19] (VPP) in the Fraser basin using up to 1000 AF/y of environmental water in each summer in which water supply conditions allow, beginning no later than the date of issuance for the 404 permit or FERC license amendment, whichever is later. The VPPs will be executed in the 15 July to 31 August time period that will be the focus of the temperature mitigation response defined in the FWMP. This condition applies in the Interim Period, which ends when the project "becomes operational"[20]. Based on the amount of water expected to be available[21] for the VPP, the Applicant will prepare and submit a plan to the Division by 1 June each year outlining the objectives for the VPP and describing plan components such as the target stream (Fraser River or Ranch Creek), the source(s) for bypass flows, monitoring locations, and assessment metrics. (See Appendix B for further explanation of plan components and expectations for the VPPs in

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[18] As given in the GCMECP, the temperature action levels for the Fraser basin gages are 21.2 °C for the daily maximum and 17.0 °C for the weekly average temperature.
[19] GCMECP II.B.1.c.1
[20] As per the CRCA: "The capacity of Gross Reservoir has been enlarged, and water has been diverted and stored in the enlarged portion of Gross Reservoir."
[21] Availability is determined by snowpack, system-wide reservoir storage, maintenance and operations schedules, and summer forecasts.

general.) The plan must be submitted by 1 June each year, and the Division will make comments and may recommend changes within 30 days. The Division recognizes that subsequent adjustments to the plan may be necessary during the summer in order to respond to actual stream flow conditions, or to accommodate operational or maintenance considerations.

At the conclusion of each VPP, the Applicant will prepare a report characterizing the mitigation measures employed and evaluating the effectiveness of those measures in terms of the distance over which a benefit to temperature could be detected. Each report is due by 1 February so that the conclusions will inform development of a VPP for the next year in which bypass water is available.

Condition 4: The Final Report includes a provision that defines the Applicant's responsibilities[22] in the case where flow bypasses (released pursuant to Additional Actions for Elevated Stream Temperature) are shown to "have a *de minimis* effect in reducing stream temperature below the temperature response triggers at USGS gages 09032000, 09033300 or 09033100 when the Moffat Project is diverting...." This condition broadens the consideration of *de minimis* effect to include the GCWIN site at Rendezvous Bridge, and it requires a finding of *de minimis* effect at all four sites. Although determination of *de minimis* effect is made through the Learning by Doing process, the Division expects that results of VPPs will inform the process by casting the magnitude of effects in terms of distance from diversion points. The analysis of effects leading to a *de minimis* conclusion must be documented in a report submitted to the Division, and the Division must agree with the conclusion before the Applicant can discontinue these bypass flows.

Condition 5: If temperature monitoring indicates an impairment at any of the monitoring locations identified in Condition 1, the Applicant will perform investigations to determine what contribution operation of the project has made. The impairment investigation report and all supporting information will be submitted to the Division within 12 months after the impairment has been detected. If, after diligently working on the impairment investigation, the Applicant requires more time to finish the impairment investigation the Applicant may request an extension from the Division. The Applicant must request the extension at least two months prior to the one year deadline and must explain the reason and need for the extension. The Division will review the request and determine whether to grant the extension.

If the Division concludes that operation of the project is primarily responsible for the impairment, the Division will require that the Applicant actively explore

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[22] "Denver Water will contribute $1 million dollars to LBD for the exclusive purpose of designing and constructing projects to address stream temperature issues in the Fraser River Basin."

preparation of a Category 4b Plan that will define the actions necessary to bring water quality back to attainment of the standard. In doing so, the Applicant will be encouraged to work with other significant contributors to the impairment, if applicable.

A Category 4b Plan must ensure attainment with all applicable water quality standards through agreed upon pollution control mechanisms within a reasonable time period, must be consistent with CRS 25-8-104, and must be submitted to the Division no more than two years after the Division's determination that the plan is applicable. If it becomes apparent that a Category 4b Plan cannot ensure attainment with all applicable water quality standards through agreed upon pollution control mechanisms within a reasonable time period, or if such plan is not accepted by the Division or EPA, or is precluded by or inconsistent with the water rights provisions in section CRS 25-8-104, then the Division anticipates a 303(d) listing and, in cooperation with the Applicant, preparation of a TMDL. The Applicant, at its discretion, may agree to remedial actions to restore water quality that are inconsistent with the water rights provisions of CRS 25-8-104. If, after diligently working on the Category 4b Plan, the Applicant requires more time to finish the Category 4b Plan the Applicant may request an extension from the Division. The Applicant must request the extension at least two months prior to the two year deadline and must explain the reason and need for the extension. The Division will review the request and determine whether to grant the extension.

Condition 6: The Applicant will monitor continuous stream temperature at four locations in South Boulder Creek, listed below. Monitoring at these sites will begin as soon as practicable, but no later than one year after the date of issuance for the 404 permit or the FERC license, whichever is later, and will continue for not less than five years after the project becomes fully operational. The data from each calendar year will be submitted to the Division by April 1 following each calendar year of sampling.

- South Boulder Creek at Pinecliffe (DW Station WS-RL-001)
- Gross Reservoir Outlet (FERC monitoring location)
- South Boulder Creek at a location between the reservoir outlet and the diversion point (to match the corresponding site for sampling benthic macroinvertebrates). The Applicant will submit a proposed location to the Division for approval before sampling begins.
- South Boulder Creek at Diversion Structure (DW Station WS-TL-002)

Nutrients

Reduction of flow in the Fraser River basin reduces the dilution of wastewater effluent, raising concerns about nutrient levels in the Fraser River, the Colorado River, and the Three Lakes system. According to the FEIS, total nitrogen concentrations at the mouth of the Fraser may increase by more than 40% due to cumulative impacts (including all RFFAs); however, the increase due

to the project alone is predicted to be less than 5%. Corresponding predictions for total phosphorus show a decrease in concentrations due to cumulative impacts and an increase of about 5% due to the project alone. Predictions are sensitive to assumptions about wastewater effluent concentrations, which are likely to be reduced significantly in the future as facilities respond to requirements mandated by Regulation 85.

Modeling for the certification process adds consideration of assimilative capacity as required for the AD review. A significant impact is predicted for phosphorus concentrations through reduction of assimilative capacity in the Fraser River below Vasquez Creek. A similar issue may exist for nitrogen, but the potential cannot be assessed with modeling at this time due to insufficient data.

The Applicant has made monetary commitments that are available for, but not required to be used for, reducing the contribution of nutrients from wastewater treatment facilities. In the CRCA, the Applicant committed to "provide $2 million [to Grand County] to pay for measures to address water quality, including but not limited to improvements to the capacity of wastewater treatment plants."[23] However, because there is no firm commitment to invest in reduction of nutrient loads, the monetary commitment cannot be considered in the significance determination.

The Division regards nutrient reduction in wastewater effluent as one of the few opportunities for direct mitigation of predicted water quality impacts related to loss of assimilative capacity for nutrients. Furthermore, targeting wastewater treatment benefits water quality throughout the year, with or without operation of the project (i.e., it is both mitigation and enhancement). Reduction of nutrient loads from wastewater treatment facilities upstream of the Vasquez Creek confluence would be a logical target for addressing the predicted loss of assimilative capacity. However, WWTPs in the Fraser basin will soon need to comply with effluent nutrient limits set in Regulation 85, and the necessary improvements may even be completed before the project becomes fully operational. Consequently, the Division concludes that a condition to develop a plan for nutrient reduction is appropriate and useful for the purpose of accelerating the process that Regulation 85 has initiated.

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[23] Grand County, in the GCMECP, interprets the $2 million as a flexible resource for voluntary enhancement of water quality. The CRCA also contains a provision for $1 million to go into a "wastewater treatment plant fund" that would be administered by Summit County for permitted wastewater dischargers in Summit County. Although the monetary commitments are relatively large, there is no specificity with regard to the location or the expected amount of improvements to nutrient concentrations.

Condition 7: The Applicant will undertake a study of alternatives for the Winter Park WSD to meet the Regulation 85 nutrient limits and develop conceptual level costs consistent with requirements for a Project Needs Assessment[24] (PNA). Developing a PNA for early implementation of the Regulation 85 limits for nutrients at the Winter Park WSD wastewater treatment plant will set the stage for decreasing nutrient loads in the Fraser River upstream of the confluence with Vasquez Creek and will assist with Winter Park WSD's efforts to fund treatment plant upgrades as needed. The plan must be prepared and submitted to the Division's Engineering Review Unit for approval within one year of the date of issuance of the 404 permit or the FERC license, whichever is later.

Condition 8: The Applicant will monitor nutrient concentrations monthly (total phosphorus and total nitrogen) at the following sites:

- Fraser River below Buck Creek at Winter Park (USGS 09023750)
- Fraser River at Winter Park (USGS 09024000)
- Fraser River below Vasquez Creek at Winter Park (USGS 09025010)
- Vasquez Creek at Winter Park (USGS 09025000)

Monitoring at these sites will begin no later than the date of issuance for the 404 permit or the FERC license, whichever is later, and will continue for not less than five years after the project becomes fully operational. The data will be submitted annually to the Division along with a report documenting exceedances of the nutrient standards; the report is due by April 1 following each calendar year of sampling.

Condition 9: If monitoring of total phosphorus or total nitrogen concentrations in the Fraser River indicates a potential impairment[25], the Applicant will perform investigations to determine what contribution operation of the project has made. The impairment investigation report and all supporting information will be submitted to the Division within 12 months after the impairment has been detected. If, after diligently working on the impairment investigation, the Applicant requires more time to finish the impairment investigation the Applicant may request an extension from the Division. The Applicant must request the extension at least two months prior to the one year deadline and must explain the reason and need for the extension. The Division will review the request and determine whether to grant the extension.

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[24] A PNA is required for the sources of federal funding for which the Winter Park WSD might be eligible to upgrade the Wastewater Treatment Plant to meet the Regulation 85 nutrients limits.

[25] Data are to be assessed against the appropriate interim numeric values in the event that numeric standards have not yet been adopted for the relevant segment(s).

If the Division concludes that operation of the project is primarily responsible for the impairment, the Division will require that the Applicant actively explore preparation of a Category 4b Plan that will define the actions necessary to bring water quality back to attainment of the standard. In doing so, the Applicant will be encouraged to work with other significant contributors to the impairment, if applicable.

A Category 4b Plan must ensure attainment with all applicable water quality standards through agreed upon pollution control mechanisms within a reasonable time period, must be consistent with CRS 25-8-104, and must be submitted to the Division no more than two years after the Division's determination that the plan is applicable. If it becomes apparent that a Category 4b Plan cannot ensure attainment with all applicable water quality standards through agreed upon pollution control mechanisms within a reasonable time period, or if such plan is not accepted by the Division or EPA, or is precluded by or inconsistent with the water rights provisions in section CRS 25-8-104, then the Division anticipates a 303(d) listing and, in cooperation with the Applicant, preparation of a TMDL. The Applicant, at its discretion, may agree to remedial actions to restore water quality that are inconsistent with the water rights provisions of CRS 25-8-104. If, after diligently working on the Category 4b Plan, the Applicant requires more time to finish the Category 4b Plan the Applicant may request an extension from the Division. The Applicant must request the extension at least two months prior to the two year deadline and must explain the reason and need for the extension. The Division will review the request and determine whether to grant the extension.

Aquatic Life

There is no model for predicting a quantitative change in the Multimetric Index (MMI) score as a result of cumulative impacts of the project, but there is a logical basis for a qualitative prediction. It is the Division's view that the habitat loss and increased temperatures expected with flow reductions could adversely impact the aquatic macroinvertebrates unless mitigation measures are in place. The concern is particularly acute for those segments[26] in the project area where MMI scores indicate that problems are already occurring or are expected to occur.

There are five ways in which the Applicant has made commitments that may benefit aquatic communities - flushing flows, sediment control, bypass flows for temperature mitigation, habitat improvements, and creation of an Environmental Pool in Gross Reservoir. The first four measures are likely to

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[26] The Fraser River and Vasquez Creek in segment COUCUC10a are currently listed as impaired (303d List). The Blue River below Lake Dillon in segment COUCBL17 and the Colorado River in segment COUCUC03 between Windy Gap Reservoir and Derby Creek are currently on the Monitoring & Evaluation List.

contribute to net environmental benefit. For the Environmental Pool, the enforceability of conditions is problematic for reasons discussed below.

Flushing flows have potential to improve habitat for macroinvertebrates in two areas - the Fraser River and Vasquez Creek - where the aquatic life use is currently impaired. Because commitments for flushing flows in the upper Williams Fork basin and the Fraser River basin (including the Fraser River and Vasquez Creek) will be enforced by the Off-License Agreement with the US Forest Service and the GCMECP through the 404 Permit, no additional conditions are imposed here. These commitments are likely to contribute to net environmental benefit.

The Applicant has made a commitment through the Fraser River Nonpoint Source Pollution Intergovernmental Agreement[27] to maintain and operate the Fraser River Sediment Pond, which will reduce sediment load to the upper Fraser River basin from traction sand used on Berthoud Pass. In addition, the Applicant has committed, through the Off-License Agreement, to develop Road Maintenance Plans for the Williams Fork and Fraser basins to reduce erosion that is contributing sediment to stream channels. When the plans are implemented, these commitments have potential to contribute to net environmental benefit.

Bypass flows for temperature mitigation also have potential to benefit aquatic macroinvertebrates in the upper Fraser River basin. The primary benefit, which is derived from temperature mitigation, is described above. The Division included these measures in its analysis of the net environmental benefit.

The Applicant has made significant monetary commitments to support habitat improvements on various stream segments.[28] The proposed habitat modifications may benefit fish and the macroinvertebrate community. These monetary commitments have the potential to yield environmental benefits. However, because the Applicant has not proposed the what-where-and-when details for these habitat modifications (with the exception of the Upper Colorado River Habitat Project, which specifies general location), there is uncertainty about the magnitude and location of the benefit. There is no way to incorporate the monetary commitments (other than the Upper Colorado River Habitat Project) for unspecified projects in the calculation of net

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[27] Parties include Colorado Department of Transportation, County of Denver, Grand County, and Town of Winter Park; signed 8 June 2011.

[28] In the FWMP, the Applicant committed $72,500 for restoration of cutthroat trout habitat, $750,000 for stream habitat restoration in the Fraser and upper Williams Fork basins, and $1.5 million for stream habitat improvements in the North Fork South Platte and/or mainstem of the South Platte. The Applicant has also committed to provide $1.5 million for habitat improvements as part of the Upper Colorado River Habitat Project.

environmental benefit because the application did not include information that would allow the Division to measure the success of these proposed measures.

Through previous commitments, the Applicant helped fund habitat improvements in South Boulder Creek between the Moffat Tunnel and Gross Reservoir. Although the projects do not represent commitments made specifically for the Moffat Project, they have value because the improvements were designed to accommodate future flows in upper South Boulder Creek.

The Applicant has committed to create additional storage for an Environmental Pool as part of the enlargement of Gross Reservoir. The commitment is documented in an IGA with the cities of Boulder and Lafayette, and in the FWMP. The additional storage would be filled with water owned by the cities, and the cities would manage releases from the Environmental Pool to bolster low flows in South Boulder Creek. The intent is to improve conditions for aquatic communities, especially downstream of the diversion dam. Modeling for the City of Boulder predicts that the Environmental Pool will reduce the extent and frequency of dry-up in South Boulder Creek. According to the Applicant and the Cities, 5000 AF is sufficient volume to "eliminate dewatering ... to just downstream of East Boulder Ditch."

The Division recognizes that the Applicant and the cities have made significant financial commitments to the Environmental Pool and that CPW regards the Environmental Pool as an important mitigation and enhancement measure under its statute[29]. The loss of stream habitat, which will occur through construction of the dam and through inundation of stream channel when the enlarged reservoir is filled, is an impact in CPW's framework. The Environmental Pool provides compensatory mitigation by improving fish habitat with increased winter flows that are expected to reduce or eliminate dry-up points downstream.

The Division accepts CPW's position that the Environmental Pool can improve the flow regime of South Boulder Creek below the Applicant's diversion point. However, unlike CPW, the Division cannot consider this type of stream habitat loss to be an impact based on provisions in Regulation 82[30]. Therefore the Environmental Pool is not mitigation from the perspective of this certification, although it can be considered an enhancement. At the same time, the Division sees potential for the Environmental Pool to contribute to temperature impacts, as described previously. Consequently, the significance determination

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[29] CRS 37-60-122.2

[30] Section 82.12: "It is recognized that the construction and operation of water diversion, conveyance, and storage facilities may result in unavoidable and permanent changes in the water quality characteristics of any segment of a stream which is inundated by the facility. These regulations are not intended to apply to or regulate such impacts."

for the project must account for the impact to temperature as well as the enhancement to stream habitat.

The Applicant's responsibility for the Environmental Pool is limited to creating the additional storage. Other parties not subject to this certification are responsible for securing the water court decrees necessary to store water in the Environmental Pool and for managing the releases. In addition, the Applicant, or either of the cities, can terminate the IGA. Consequently, the Division is not including any conditions regarding the Environmental Pool because the Applicant alone cannot ensure that the Environmental Pool will be maintained and operated for the benefit of aquatic communities downstream.

The health of aquatic communities in South Boulder Creek between Gross Reservoir and the diversion point has not been well documented. Consequently, the current effect of cold summer temperatures on aquatic life is not known. It is important to document current conditions in preparation for assessing the impact, if any, of future changes in temperature that can be attributed to project operation. Conditions are imposed to facilitate that evaluation.

Condition 10: The Applicant will monitor the health of aquatic communities at four primary sites (see table below) chosen because of existing concerns due to low MMI scores. The health of the communities will be established by sampling benthic macroinvertebrates and calculating MMI scores. The macroinvertebrate sampling will be conducted using the Division's protocols[31], which are described in Policy Statement 10-1 Aquatic Life Use Attainment Methodology to Determine Use Attainment for Rivers and Streams (Policy 10-1). The Applicant will develop a Sampling Analysis Plan for the collection and preservation of benthic macroinvertebrates that will be reviewed by the Division prior to the start of macroinvertebrate sampling.

GCWIN Site	Description	Latitude	Longitude
FR-abvWPSD	Fraser above Winter Park SD	39.89445	-105.76821
FR-Rendezvous	Fraser at Rendezvous Bridge	39.93412	-105.7896
FR-CR83	Fraser at Tabernash below bridge on CR83	39.99053	-105.8299
VC-WP	Vasquez at Winter Park	39.9203	-105.78498

Sampling at the primary sites will be conducted in the fall of each year beginning after the issuance of the 404 permit or the FERC license, whichever is later, and continue for five years after the project becomes fully operational. A report assessing the data (raw data and MMI scores) and documenting any impairment of aquatic life will be submitted to the Division

[31] The Division is insistent on the prescribed methodology. Even if a different methodology is selected through the LBD process (as suggested in the GCMECP), compliance with these conditions requires use of the Division's methodology.

by June 1 following each calendar year of sampling. If there are concerns about the representativeness of conditions in a particular year (e.g., if there has been a flood or other natural disaster), alterations to the sampling may be accommodated upon prior approval by the Division.

Condition 11: If monitoring of aquatic life indicates an impairment, the Applicant will use available indices to identify the stressor, if possible. Stressor identification work will be limited to indices that have been incorporated in the Listing Methodology applicable at the time the impairment is detected. The Applicant is not responsible for development of stressor identification tools. If a stressor is identified, the Applicant also will determine what contribution operation of the project has made to the identified stressor, or, if the project is not yet operating, the Applicant will predict the potential for the project to contribute to future impairment associated with the identified stressor. The impairment investigation report and all supporting information will be submitted to the Division within 12 months after the impairment has been discovered. If, after diligently working on the impairment investigation, the Applicant requires more time to finish the impairment investigation the Applicant may request an extension from the Division. The Applicant must request the extension at least two months prior to the one year deadline and must explain the reason and need for the extension. The Division will review the request and determine whether to grant the extension.

The Division, in consultation with the Applicant, will decide if the Applicant will be required to develop a Category 4b plan for the identified stressor. If such plan is required, it must be submitted to the Division within two years. If a Category 4b Plan is precluded by CRS 25-8-104, the Division anticipates a 303(d) listing and, in cooperation with the Applicant, preparation of a TMDL to bring water quality back to attainment of the standard. If, after diligently working on the Category 4b Plan, the Applicant requires more time to finish the Category 4b Plan the Applicant may request an extension from the Division. The Applicant must request the extension at least two months prior to the two year deadline and must explain the reason and need for the extension. The Division will review the request and determine whether to grant the extension.

Condition 12: The Applicant will monitor the health of aquatic communities at three sites in South Boulder Creek below Gross Reservoir. The health of the communities will be established by sampling benthic macroinvertebrates and calculating MMI scores. The macroinvertebrate sampling will be conducted using the Division's protocols[32], which are described in Policy Statement 10-1 Aquatic Life Use Attainment Methodology to Determine Use Attainment for Rivers and Streams (Policy 10-1). The Applicant will develop a Sampling

[32] The Division is insistent on the prescribed methodology. Even if a different methodology is selected through the LBD process (as suggested in the GCMECP), compliance with these conditions requires use of the Division's methodology.

Analysis Plan, including specifics of the proposed sampling locations, for the collection and preservation of benthic macroinvertebrates that will be reviewed by the Division prior to the start of macroinvertebrate sampling.

- South Boulder Creek immediately below Gross Reservoir
- South Boulder Creek at a location between the reservoir outlet and the diversion point (to match the corresponding site for temperature monitoring).
- South Boulder Creek upstream of the diversion point and the lentic zone it creates.

Sampling at the primary sites will be conducted in the fall of each year beginning after the issuance of the 404 permit or the FERC license, whichever is later, and continue for five years after the project becomes fully operational. A report assessing the data (raw data and MMI scores) and documenting any impairment of aquatic life will be submitted to the Division by June 1 following each calendar year of sampling. If there are concerns about the representativeness of conditions in a particular year (e.g., if there has been a flood or other natural disaster), alterations to the sampling may be accommodated upon prior approval by the Division.

If monitoring of aquatic life demonstrates that the project is responsible for degradation of aquatic life (as indicated with the MMI), the Applicant will be required to develop a Category 4b plan. The plan must be submitted to the Division within two years. If, after diligently working on the Category 4b Plan, the Applicant requires more time to finish the Category 4b Plan the Applicant may request an extension from the Division. The Applicant must request the extension at least two months prior to the two year deadline and must explain the reason and need for the extension. The Division will review the request and determine whether to grant the extension.

Mercury

The potential impact of the Moffat Project on mercury in fish tissue in Gross Reservoir causes concern because mercury levels already are high enough to warrant a Fish Consumption Advisory (FCA). Although it is not yet possible to develop quantitative predictions for mercury in fish tissue in the enlarged reservoir, there are good reasons to expect problems based on recent scientific literature. Expectations are based on what is known about the biogeochemistry of mercury in reservoirs. The key process is methylation, which, under the proper conditions, yields an organic form of mercury. Methylated mercury then makes its way through the food chain over a period of several years[33].

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[33] Lucotte, M, et al., 1999. Mercury in the Biogeochemical Cycle: Natural Environments and Hydroelectric Reservoirs of Northern Quebec. Berlin: Springer.

Two aspects of the reservoir enlargement are likely to create conditions conducive to methylation of mercury. When the enlarged reservoir fills, decay of newly-inundated organic matter creates a low-oxygen environment that favors methylation. The Applicant has a commitment per the FERC license to "prepare a final tree removal plan to remove as much organic matter as practicable from the inundation area." However, it is not possible at this time to predict if these measures will preclude additional methylation or diminish the present level of methylation.

Once the project is fully operational, interannual variation in supply of, and demand for, water will cause reservoir level to fluctuate, probably to a greater degree than occurs now. Greater fluctuations in lake level in the future may increase opportunities for mercury methylation by increasing the area that is alternately exposed and re-wetted. In addition, when lake level falls, the volume of the hypolimnion is reduced causing volumetric oxygen demand to increase, which also favors methylation of mercury.

The existing concern about mercury in fish tissue in Gross Reservoir is sufficient to impose a condition on the Applicant. However, it is also important to acknowledge the limitations that have been encountered in dealing with the problem from a statewide perspective. The problem of mercury in fish tissue in Colorado lakes has been addressed chiefly through monitoring and posting FCAs, as appropriate. The Applicant will be required to support this approach in Gross Reservoir.

Limiting the Applicant's role to monitoring and posting is a practical necessity. The nature and scope of the mercury problems in Colorado are too broad in scale to be resolved in Gross Reservoir alone. The importance of atmospheric sources of mercury and the complexity of the biogeochemical processes that influence concentrations in fish tissue require a statewide strategy. Accordingly, the Division plans to develop a strategy to address the problem statewide. However, in the event that impairment is detected in Gross Reservoir, the Applicant's responsibility for monitoring in that reservoir will be extended. Data collected at Gross Reservoir will benefit the Division's effort to address mercury impairments statewide.

Condition 13: The Applicant will work with the Division and CPW to support a biennial program to monitor mercury in fish tissue in Gross Reservoir. Field work to collect the fish will be performed consistent with CPW requirements, the EPA's Guidance for Assessing Chemical Contaminant Data for Use in Fish Advisories, and the goal will be to obtain adequate representation of the important species as per the Water Quality Control Commission's Section 303(d) Listing Methodology. The sampling effort for Gross Reservoir will begin in the first field season after the enlarged reservoir has filled and will continue for five more years. The Applicant will submit a brief report summarizing the sampling completed during each field season; the report is due by April 1

following each calendar year of sampling. If mercury levels fall below the level of concern for the last three years, the monitoring obligation will end. In the event that there is impairment for mercury at the end of the five-year period, the obligation for monitoring will be extended for an additional five years, at which time the monitoring obligation will end.

If fish tissue analyses show that a FCA is required, the Applicant will work with the Technical Advisory Team (TAC)[34] of the Colorado Fish Consumption Advisory Committee to provide public education including the posting of signs with associated consumption advisories. The TAC will determine the design of the signs and the information to be included. The Applicant will incur the costs of the signs and be responsible for proper posting of such signs.

General Monitoring for Metals

The impacts with respect to metals are related to the way that flow alterations (reductions or additions) change mass balance contributions, because the project does not add pollutants. The antidegradation (AD) review revealed concerns about erosion of assimilative capacity, as well as potential "cause-or-contribute" concerns. The importance of flow alterations is seen clearly in the AD analysis for the Fraser River below Vasquez Creek. Mass balance calculations predict a significant loss of assimilative capacity (i.e., higher concentrations) for dissolved iron, but a gain in assimilative capacity (i.e., lower concentrations) for dissolved copper and zinc.

Existing exceedances of standards, chiefly for copper, increase the level of concern about the potential for the project to have water quality impacts. Some exceedances[35] were identified during the AD review, but the geographic extent of the exceedances has been expanded during recent assessments by the Division. Recently adopted changes to Regulation 93 identify four segments with copper exceedances in the project area (see table below for dissolved copper listings). A similar, but less pervasive concern exists for dissolved iron in the Fraser River from Vasquez Creek to the mouth.

Regulation 93 Listings for Dissolved Copper in the Project Area		
Segment	**Segment Description**	**List**
COSPBO04a	Mainstem of South Boulder Creek, including all tributaries from the source to the outlet of Gross Reservoir	303d
COSPBO04b	Mainstem of South Boulder Creek, including all tributaries from the outlet of Gross Reservoir to South Boulder Road	303d

[34] Members include representative from CPW, the Division, and the Disease Control and Environmental Epidemiology Division of the Colorado Department of Public Health and Environment.

[35] Fraser below Vasquez, Williams Fork at Sugarloaf, and South Boulder Creek below Moffat Tunnel.

Regulation 93 Listings for Dissolved Copper in the Project Area		
Segment	**Segment Description**	**List**
COUCUC08	Williams Fork below Kinney Creek	M&E
COUCUC10a	Vasquez Creek	303d

In view of the pervasiveness of elevated concentrations of dissolved copper and iron, and in response to comments received during the public comment period, the Division concludes that additional monitoring is warranted for metals. At the very least, it is important to gain a better understanding of the way in which operation of the project will re-distribute these metals in the affected watersheds.

Condition 14: The Applicant will monitor concentrations of total recoverable metals[36], dissolved metals[37], and hardness at the following locations selected on the basis of historical data record or proximity to important hydrologic features:

- Williams Fork above bridge at Sugarloaf Campground (Site WS-WF-004)
- Vasquez Creek above Vasquez Tunnel outfall (Site WS-WF-001)
- Vasquez Creek at Winter Park (USGS 09025000)
- Fraser River below Buck Creek at Winter Park (USGS 09023750)
- Fraser River at Winter Park (USGS 09024000)
- Fraser River below Vasquez Creek (USGS 09025010)
- Fraser River above Ranch Creek (USGS 09027100)
- South Boulder Creek above Moffat Tunnel outfall (WS-RL-018)
- South Boulder Creek at Pinecliff (WS-RL-001)
- South Boulder Creek at Diversion Structure (WS-RL-002)

Samples will be taken monthly except where winter conditions prevent access. Monitoring at these sites will begin no later than the date of issuance for the 404 permit or the FERC license, whichever is later, and will continue for five years after the project becomes fully operational. The data will be submitted annually to the Division along with a report documenting exceedances of the nutrient standards; the report is due by April 1 following each calendar year of sampling.

Condition 15: If monitoring indicates an impairment, the Applicant will perform investigations to determine what contribution operation of the project has made. The impairment investigation report and all supporting information will be submitted to the Division within 12 months after the impairment has been detected. If, after diligently working on the impairment investigation, the Applicant requires more time to finish the impairment investigation the

[36] Iron, arsenic, and chromium

[37] Arsenic, boron, cadmium, chromium, copper, iron, lead, manganese, nickel, selenium, silver, uranium, and zinc

Applicant may request an extension from the Division. The Applicant must request the extension at least two months prior to the one year deadline and must explain the reason and need for the extension. The Division will review the request and determine whether to grant the extension.

If the Division concludes that operation of the project is primarily responsible for the impairment, the Division will require that the Applicant actively explore preparation of a Category 4b Plan that will define the actions necessary to bring water quality back to attainment of the standard. In doing so, the Applicant will be encouraged to work with other significant contributors to impairment, if applicable.

A Category 4b Plan must ensure attainment with all applicable water quality standards through agreed upon pollution control mechanisms within a reasonable time period, must be consistent with CRS 25-8-104, and must be submitted to the Division no more than two years after the Division's determination that the plan is applicable. If it becomes apparent that a Category 4b Plan cannot ensure attainment with all applicable water quality standards through agreed upon pollution control mechanisms within a reasonable time period, or if such plan is not accepted by the Division or EPA, or is precluded by or inconsistent with the water rights provisions in section CRS 25-8-104, then the Division anticipates a 303(d) listing and, in cooperation with the Applicant, preparation of a TMDL to bring water quality back to attainment of the standard. The Applicant, at its discretion, may agree to remedial actions to restore water quality that are inconsistent with the water rights provisions of CRS 25-8-104. If, after diligently working on the Category 4b Plan, the Applicant requires more time to finish the Category 4b Plan the Applicant may request an extension from the Division. The Applicant must request the extension at least two months prior to the two year deadline and must explain the reason and need for the extension. The Division will review the request and determine whether to grant the extension.

Monitoring in Gross Reservoir

Gross Reservoir will be enlarged and the additional storage filled before the project will be fully operational. It is reasonable to expect that water quality in the enlarged reservoir will be similar to current conditions. However, that assumption should be tested through monitoring. One potential concern involves dissolved oxygen, which may be affected by the increased residence time and the larger hypolimnetic volume. The Division will impose a condition requiring general monitoring of water quality in the new reservoir.

Condition 16: The Applicant will monitor water quality in Gross Reservoir. Monitoring will begin no later than the ice-free season following issuance of the 404 permit or the FERC license, whichever is later, and will continue for not less than five years after the project becomes fully operational. The data will

be submitted annually to the Division along with a report documenting any water quality impairments. The report is due by April 1 following each calendar year of sampling.

Samples will be taken monthly during the ice-free season at a site in deep water near the dam. Analysis will include general field parameters[38], nutrients and biological collections[39], major ions[40] and metals[41].

Significance Determination

The AD review process is guided by Regulation 31, Section 31.8(3), which describes what is required for the significance determination. The first step is to determine if there are likely to be significant impacts to water quality, as has been done in the preceding section of this document. Significant impacts are expected, but there are also commitments for mitigation and enhancement measures (i.e., offsets) that may reduce the impacts or otherwise improve water quality.

The next step is to decide if the balance of impacts and offsets results in net environmental benefit. In cases like the present application, where requirements for direct mitigation could interfere with normal exercise of water rights, the offsets become especially important. At the same time, evaluation of offsets presents a challenge in that it requires a measure of subjectivity; it is a comparison of apples and oranges.

The Division has evaluated the offsets with the following questions:

1) Does the action provide direct mitigation? In other words, where a significant impact is predicted for a particular water quality parameter, would the offset lessen the impact at the appropriate place and time?
2) In addition to lessening a significant impact, would the action also improve conditions at other times or places or for other uses within the project area?
3) Would the action result in a measurable improvement to water quality for a parameter that may have been degraded previously, but is not further degraded by the project?

After reviewing the mitigation and enhancements measures for which the Applicant has already made commitments, the Division finds three that are

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[38] Vertical profiles of temperature, DO, conductance, pH, turbidity, and secchi depth
[39] Total Kjeldahl nitrogen, ammonia-nitrogen, nitrite+nitrate-nitrogen, ortho-phosphorus, total phosphorus, dissolved organic carbon, and chlorophyll-a.
[40] Calcium, magnesium, chloride, potassium, sodium, and sulfate
[41] Total recoverable form: iron, arsenic, and chromium; Dissolved form: arsenic, boron, cadmium, chromium, copper, iron, lead, manganese, nickel, selenium, silver, uranium, and zinc

especially noteworthy. These include: Voluntary Pilot Projects, the Colorado River Habitat Project, and sediment transport controls. Each merits additional comment.

The Applicant's commitment to use VPPs for assessing the effect of bypass flows on stream temperature is noteworthy in several respects. It represents a significant commitment of water that the Division could not require unilaterally. By manipulating bypass flows and monitoring longitudinal changes in temperature, the Applicant can establish the technical basis for a decision matrix that can assist the LBD process in optimizing bypass flows in response to elevated temperatures. In addition, results of the VPPs can provide the technical framework for defining a *de minimis* effect in terms of distance from the bypass source.

The Applicant has committed to funding for habitat restoration work in the Colorado River below Windy Gap Reservoir. Although the location and nature of the work have not been identified precisely, enough is known to assure that the work will be in specific segment of the project area.

Commitments for erosion control, the Fraser River Sediment Pond, and flushing flows are expected to benefit aquatic organisms in the Fraser and Williams Fork river basins. Reductions in stream flow expected with project operation would likely have exacerbated sediment issues, but the proposed measures are important steps for addressing those issues.

Finally, as follow-up to water quality monitoring, if the Division concludes that operation of the project is primarily responsible for any impairment, the Division will require that the Applicant actively explore preparation of a Category 4b Plan that will define the actions necessary to bring water quality back to attainment of the standard. In doing so, the Applicant will be encouraged to work with other significant contributors to impairment, if applicable.

A Category 4b Plan must ensure attainment with all applicable water quality standards through agreed upon pollution control mechanisms within a reasonable time period, must be consistent with CRS 25-8-104, and must be submitted to the Division no more than two years after the Division's determination that the plan is applicable. If it becomes apparent that a Category 4b Plan cannot ensure attainment with all applicable water quality standards through agreed upon pollution control mechanisms within a reasonable time period, or if such plan is not accepted by the Division or EPA, or is precluded by or inconsistent with the water rights provisions in section CRS 25-8-104, then the Division anticipates a 303(d) listing and, in cooperation with the Applicant, preparation of a TMDL to bring water quality back to attainment of the standard. The Applicant, at its discretion, may agree to

remedial actions to restore water quality that are inconsistent with the water rights provisions of CRS 25-8-104.

A Category 4b Plan, or TMDL, is important because it establishes a pathway for water quality improvement where predictions may have over-estimated the benefit of proposed mitigation measures. In addition, even in the event that the impairment is not attributable to operation of the project, much of the exploratory work required to identify sources and causes will have been done and be available for future restoration planning efforts. Development of a Category 4b plan, or a TMDL, does not represent a mitigation measure per se, but it could be considered a component of net environmental benefit in the sense that it leads to improvement of water quality.

The Division concludes that the conditions imposed on the Applicant provide reasonable assurance that the commitments to mitigation and enhancement measures are sufficient to result in net environmental benefit. Therefore, the finding in regard to the significance determination is: no significant degradation.

Appendix A: Assessment of the Narrative Temperature Standard in South Boulder Creek below Gross Reservoir

Enlargement of Gross Reservoir is not expected to increase temperatures in South Boulder Creek below the reservoir. Consequently, the usual concerns about exceedance of the numeric temperature standards or loss of assimilative capacity do not apply. Instead, attention is focused on alteration of the "normal pattern" of temperature variation in a stream, which is covered by the narrative temperature standard. Assessing attainment of the narrative standard depends on having a definition for "normal pattern" of temperature variation in a stream, but no specific assessment protocol for the narrative standard is available in current listing methodology. These impediments, which have caused previous assessments to limit attention to the potential for impacts that can be evaluated with numeric standards, do not remove the Division's requirement to consider temperature impacts in terms of the narrative standard.

The assessment consists of three parts, beginning with a characterization of the normal pattern of seasonal temperature variation. This is followed by a characterization of the existing pattern of seasonal variation in South Boulder Creek and a comparison to the expected normal pattern. Finally, modeling is used to predict how operation of the project will change the seasonal temperature pattern and what might be accomplished with mitigation.

Normal Pattern

Assessment of the narrative depends first on establishing a frame of reference for the normal pattern of temperature. The Division has been reviewing temperature data throughout the state in preparation for a rulemaking hearing that will include consideration of temperature standards. That work has contributed to a better understanding of the seasonal patterns of temperature variation in streams. Some general characteristics are relevant and helpful for the purpose of explaining what is "normal".

Stream temperatures change seasonally in a sinusoidal manner with a maximum in late July. The pattern for streams mimics that of air temperature, and both are driven largely by solar radiation. For a pattern to be considered normal, stream temperatures should be warming from winter lows until July when the annual

maximum occurs; June should be warmer than May, and July should be warmer than June. Similarly, stream temperatures should be cooling after August; September should be cooler than August, and October should be cooler than September.

The shape of the normal seasonal pattern is common to most streams, but the maximum temperature reached in the summer varies with elevation. In addition, winter temperatures may be truncated at or near zero degrees. Not surprisingly, stream temperatures increase with decreasing elevation. At the elevation of South Boulder Creek immediately below Gross Reservoir (about 6975 ft), daily average temperatures of 18 to 20 degrees would be expected in late July.

Current Pattern

Impounding a stream has important implications for temperature in the stream below the reservoir. For large reservoirs that are deep enough to stratify in the summer, typical operation (i.e., bottom release) will release cold water for some portion of the summer months. How cold the release temperature will be and how long it will stay cold depend on the volume of the reservoir and the rate of release.

Cold summer temperatures at the outflow are the result of releasing water from the bottom of a stratified reservoir. Lakes of sufficient depth (greater than about 10 meters) usually form distinct layers in the summer; there is a warm layer on the top and a cold layer on the bottom. The layering begins shortly after ice-out and it effectively traps the cold water on the bottom. The water released from the bottom will remain cold until the volume of cold water is depleted or replaced with warmer inflows. In any case, the alteration to the normal pattern tends to be quite pronounced with large deep reservoirs.

Gross Reservoir was completed in 1954, and reservoir operation changed the seasonal temperature pattern in South Boulder Creek. The temperature of water at the outlet of Gross Reservoir is now measured routinely as part of a condition for the current FERC license. The water is cold early in the summer and the temperature increases gradually until reaching a maximum of about 11 °C in mid-October (Figure 1). The seasonal pattern is much different than what would be considered normal in terms of both the magnitude and the timing of the maximum. It is obvious that September is now warmer than August, and October is warmer than September. That the stream continues to warm for two months after August is clear evidence that the normal seasonal pattern is not maintained.

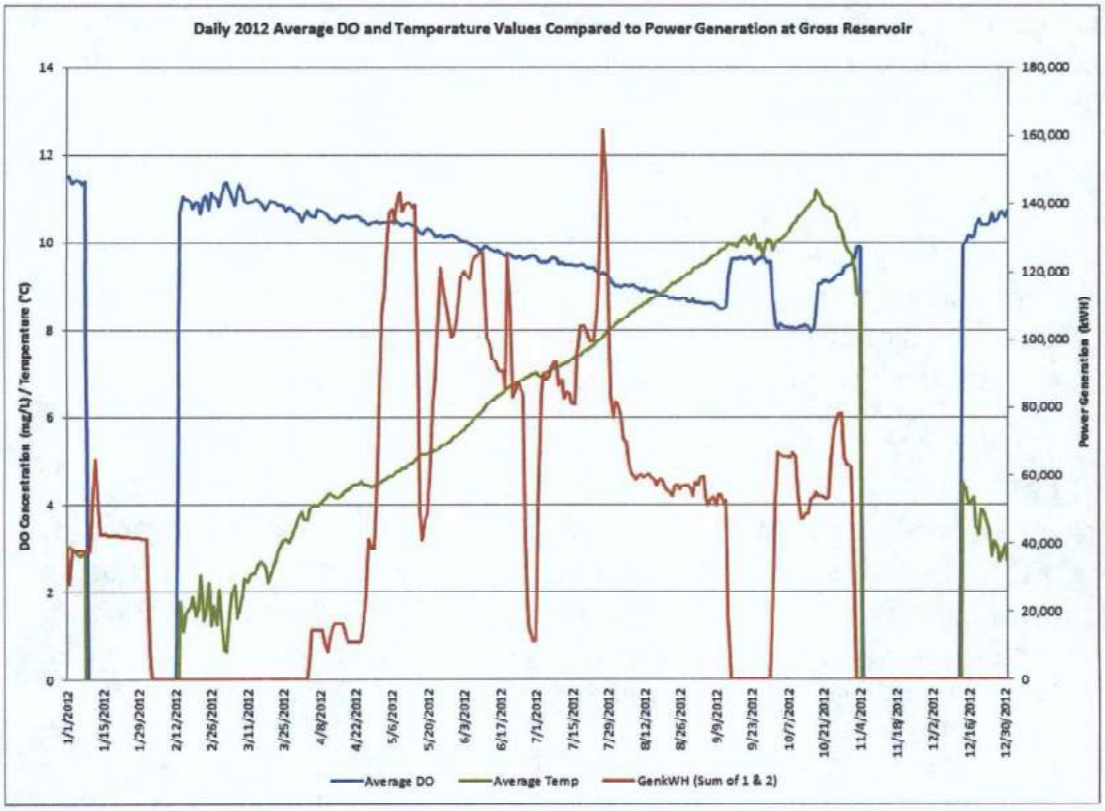


Figure 1. Temperature (green line) at the outlet of Gross Reservoir in 2012. Figure is taken from the 2012 annual report required by the FERC license.

A graphical comparison of temperatures in South Boulder Creek above and below Gross Reservoir would amplify the argument about alterations to the normal seasonal pattern, but adequate data are not available. An alternative is to use a surrogate stream at similar elevation where temperature data are available above and below a reservoir. Muddy Creek in Grand County is a reasonable choice for the comparison. It is impounded by Wolford Mountain Reservoir, and it is at an elevation similar to that of Gross Reservoir. In addition, real-time measurements of temperature are available above and below the reservoir (Figure 2). At the site above the reservoir, the seasonal pattern of temperature resembles a sine curve with a maximum in late July, which is the typical pattern for streams with minimal anthropogenic heat sources. Below the reservoir, however, the pattern bears little resemblance to the pattern observed above the reservoir. Summer temperatures below the reservoir can be 10 degrees cooler than they are upstream. Instead of the normal pattern where a maximum is reached in late July with temperatures decreasing after August, temperatures increase more or less linearly throughout the summer and into October. The maximum temperature below the reservoir occurs when stratification ends and the fully mixed lake is more or less isothermal. The effect of Gross Reservoir on temperature in South Boulder Creek is likely quite similar to the documented effect of Wolford Mountain

Reservoir on Muddy Creek.

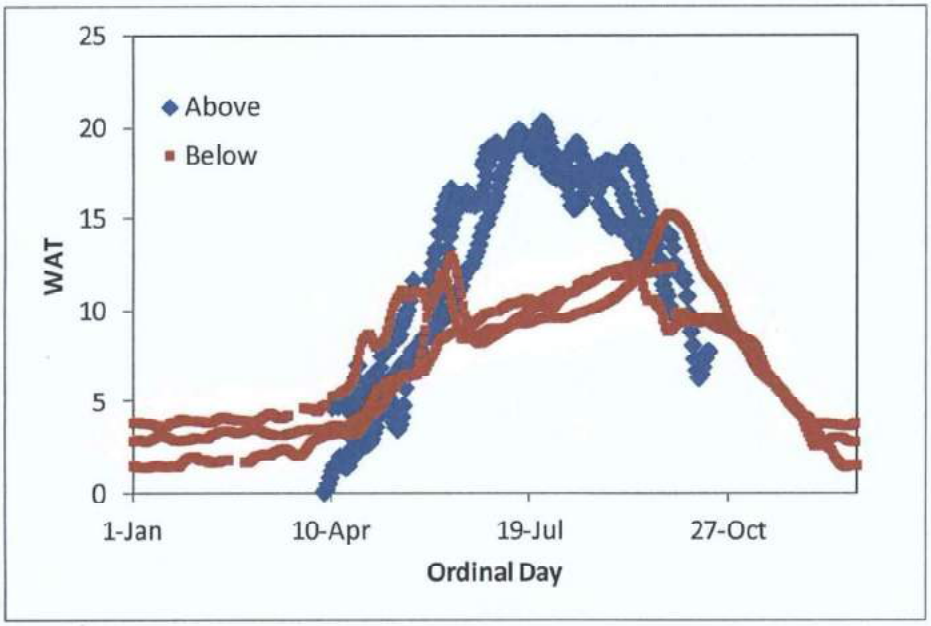


Figure 2. Weekly average temperatures in Muddy Creek above and below Wolford Mountain Reservoir. Data from WY2012-14 are plotted against ordinal day to highlight the seasonal pattern.

The Division concludes that construction of Gross Reservoir resulted in a significant alteration to the normal pattern of temperature variation in South Boulder Creek. The alteration is ecologically significant in that many degree days of warming have been lost in mid-summer, which would normally sustain growth of fish and other aquatic organisms. The alteration is sufficiently great to say that stream temperatures are no longer in attainment of the narrative standard. Although the existing impact of the reservoir is not the focus of the certification review, it is important for setting the stage for predicting the impact of the project.

Model Predictions

The Applicant has provided the Division with modeling results[1] that predict outlet temperatures before and after Gross Reservoir is enlarged. A comparison of modeled conditions with and without the project is the preferred basis for evaluating impacts because it is an apples-to-apples comparison that cannot be made with field data. Moreover, this type of comparison, which relies solely on modeled values, has been the principal basis for evaluating temperature impacts in the Fraser River.

[1] DRAFT Results of Preliminary Model Run of Selective Withdrawal in Gross Reservoir. Draft memo from Hydros Consulting, September 11, 2013.

When outlet temperatures are modeled for the base case (i.e., without the project), the maximum temperature is 13-15 degrees, and it occurs in late September (Figure 3). In contrast, the normal seasonal pattern for a stream at that elevation would likely reach a maximum in late July, and the maximum temperature that would approach 20 degrees. When the same scenario (hydrology and meteorology) is modeled with the project (Alt 1A), summer temperatures remain relatively constant at 7 or 8 degrees. In other words, the alteration of the pattern is sufficiently extreme that South Boulder Creek below the reservoir is likely to be in attainment the winter numeric standard throughout the year. That offers little opportunity for fish growth and would suppress productivity of the benthic invertebrates, which are an important food resource for the fish. The loss can be quantified in terms of degree-days, which is a metric frequently used for characterizing the thermal requirements for different life history stages. The model predicts a loss of about 260 degree-days with 1971 hydrology and 315 degree-days with 1972 hydrology. Operation of the project would reduce by about 30% the degree-days currently available for fish growth.

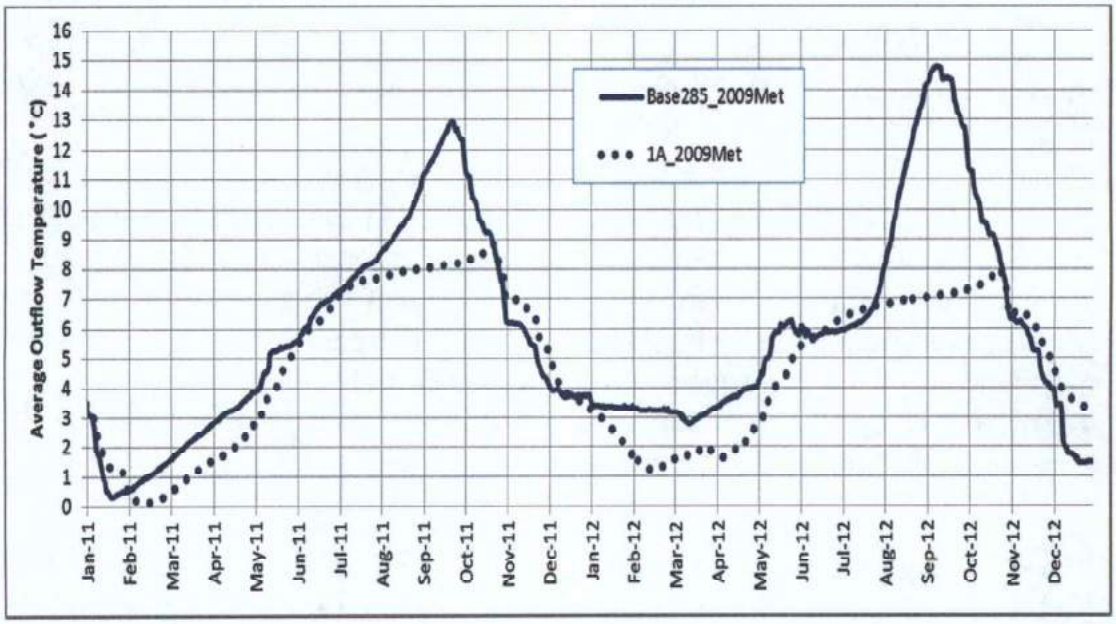


Figure 3. Simulated Outflow Temperatures from Gross Reservoir for Base285 and Alt1a, 1971 - 1972, 2009 Meteorological Inputs. From 2013 Hydros Draft Memo: "DRAFT Results of Preliminary Model Run of Selective Withdrawal in Gross Reservoir"

Operation of the project would essentially eliminate the small amount of warming that now occurs in late summer. By reducing summer temperatures and delaying the annual maximum compared to current conditions, operation of the project would further erode the seasonal pattern of temperature variation. The predicted impact is significant because it would contribute to an existing impairment. The impact could

be greater with the Environmental Pool[2] because it would increase the volume of the reservoir. The Environmental Pool was not included in the modeling.

The Applicant has evaluated several engineering mitigation options based on a selective withdrawal concept, as discussed in the Division's Rationale document. One design scenario involving installation of a multi-level outlet works (MLOW) was selected for modeling. Results of the modeling show that the MLOW could fully mitigate the temperature impact predicted for the project (Figure 4). In addition, release temperatures with the MLOW would get warmer sooner and stay warm for more days than is the case today.

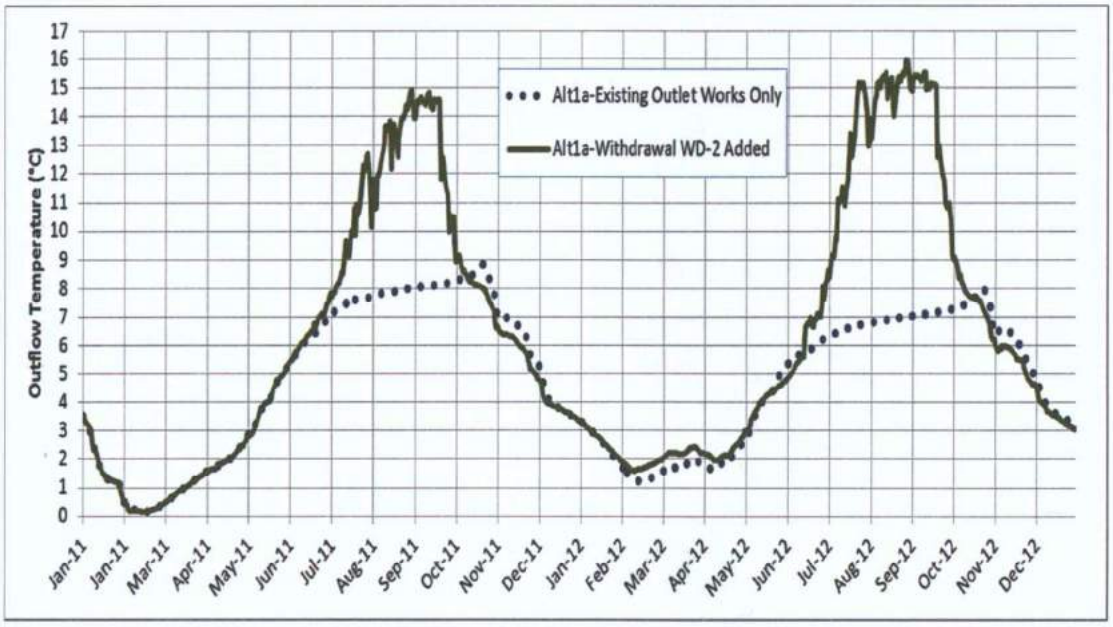


Figure 4. Simulated Gross Reservoir Outflow Temperatures for Alt1a With and Without Selective Withdrawal. From 2013 Hydros Draft Memo: "DRAFT Results of Preliminary Model Run of Selective Withdrawal in Gross Reservoir"

The comparison of current conditions (before) to future conditions with a multi-level outlet (after) can be sharpened by modifying[3] the original figures, as shown in the following two graphs. The first graph shows before-and-after with 1971 (Figure 5); Alt-1A is included for reference. The second graph shows the same comparison for 1972 (Figure 6). The two graphs suggest that the multi-level outlet could serve as both direct mitigation and enhancement, at least when hydrologic conditions are similar to those of 1971 and 1972. Maximum temperatures would be warmer than current conditions and would extend the time of warmer temperatures, although in neither case would a pre-impoundment temperature regime be restored. Operation of

[2] See the Rationale for a description of the Environmental Pool

[3] The original graphs had slight differences in time and temperature scales that were adjusted by re-sizing the figures.

the project with the MLOW would increase the degree-days by 176 in the 1971 scenario and 400 in 1972.

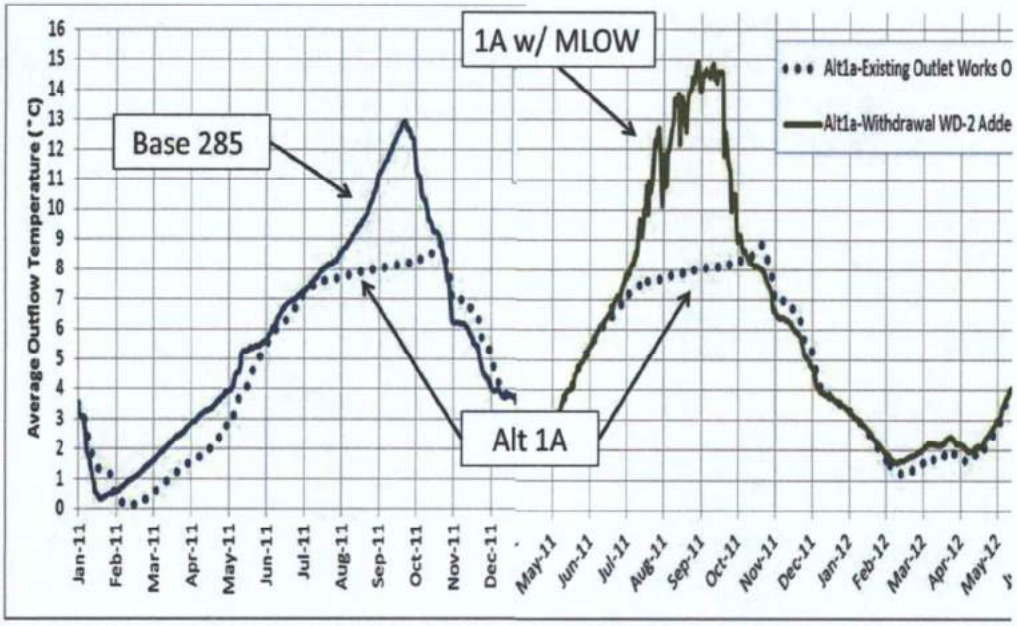


Figure 5. Comparison of outflow temperatures modeled with 1971 hydrology for current conditions (Base 285; left panel of graph) and project (Alt-1A w/MLOW; right panel of graph) plus multi-level outlet. Predictions without the MLOW are shown as dashed line on both panels. Composite of Figure 3 and Figure 4.

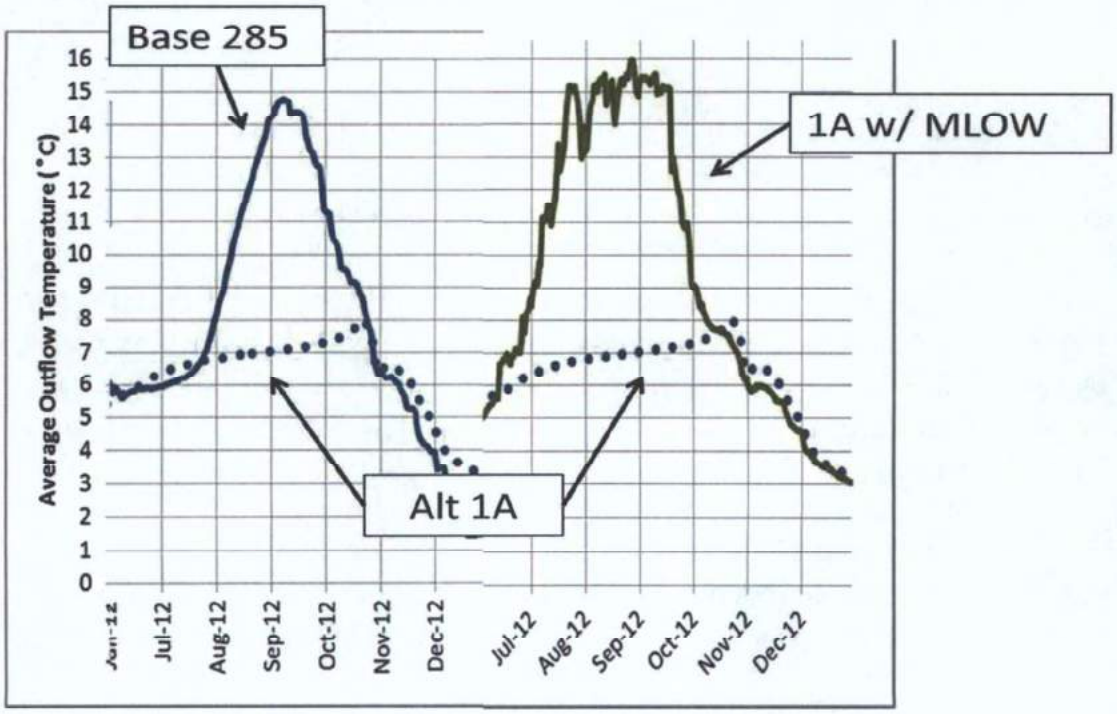


Figure 6. Comparison of outflow temperatures modeled with 1972 hydrology for current conditions (Base 285; left panel of graph) and project (Alt-1A w/MLOW; right panel of graph) plus multi-level outlet. Predictions without the MLOW are shown

as dashed line on both panels. Composite of Figure 3 and Figure 4.

Summary

With respect to the narrative standard, it is clear that temperature in South Boulder Creek below Gross Reservoir no longer shows a normal seasonal pattern, and operation of the project will further erode that pattern. However, this is only part of the information required to decide how this issue affects certification. Conclusions about conditions and the significance determination are presented in the Rationale document.

APPENDIX B: Guidance for Voluntary Pilot Projects

The Applicant has agreed to make bypass flows available for Voluntary Pilot Projects (VPPs) during the Interim Period. The Interim Period begins "upon issuance and acceptance by Denver Water of permits necessary for the Moffat Project" and continues until the project "becomes operational"[1]. VPPs conducted during the Interim Period will be devoted to evaluating the temperature benefit from bypass flows and for developing a decision matrix to guide subsequent bypass actions.

During the Interim Period, the amount of water available for VPPs is not fixed, but depends on snowpack, reservoir storage, summer forecasts, and maintenance or operational constraints on movement of water. A reasonable estimate of availability should be possible by May each year, which is ample time to establish a framework for the VPP to be conducted during the summer.

At least three locations offer potential for VPPs: Ranch Creek, Fraser mainstem, and St Louis Creek. Ranch Creek is especially important in view of the present magnitude and frequency of temperature exceedances; direct mitigation would be highly desirable. However, Ranch Creek is also a complicated location for a VPP because of diversions and the potential importance of the many beaver dams. The Fraser mainstem offers the best opportunity for investigating the longitudinal persistence of benefit from bypass flows because of the cold temperatures and availability of water in Vasquez Creek. However, temperature problems are not common in the mainstem above Granby.

The Applicant will submit a study plan by June 1st in each year for which bypass flows are available. The study plan will describe the objectives, monitoring locations, collection of ancillary data (e.g., air temperature, flows, travel times), and strategy for manipulating bypass flows. The plan should also explain circumstances where options for monitoring locations, and thus also for study design, are constrained by access to private land. The Division will review the plan and recommend any changes within 30 days.

Study Design

Each study will have general objectives related to evaluating the benefits of bypass flows. These objectives specify the stream to be evaluated (e.g., Ranch Creek), the strategy for manipulating bypass flows (amount, source, and scheduling), and the basis for detecting the benefit as the bypass water moves downstream. Although the

[1] As per the CRCA: "The capacity of Gross Reservoir has been enlarged, and water has been diverted and stored in the enlarged portion of Gross Reservoir."

time window for the studies is relatively brief (July 15 - August 31), there may sufficient time to evaluate multiple objectives with each VPP.

Ranch Creek and the Fraser River mainstem are well suited for study in the sense that both have real-time monitoring stations. Ranch Creek is more complicated in terms of options for bypass flows and by virtue of the numerous beaver dams along the reach of interest. One general approach would be to focus first on the Fraser River in order to test temperature metrics and develop a preliminary basis for estimating the longitudinal persistence of benefits from bypass flows.

The beaver dams along Ranch Creek pose special problems because they affect travel time and temperature in ways that must be considered in developing a study plan. Each beaver dam extends the residence time of water in the reach, and it warms the water more than would occur without the dam. Both factors are likely to affect the longitudinal persistence of benefits from bypass flows. The role of these factors could be evaluated initially without regard to bypass flows.

The VPPs are handicapped in a way because it is not possible to set up parallel streams - one with and one without bypass flows - that would facilitate a side-by-side comparison. Instead, it is necessary to vary bypass flows over short periods of time when weather conditions are expected to be relatively stable. For example, flow could be bypassed for three or four days followed by a similar period of time when there is no bypass. Alternation of flow regimes will make it easier to isolate the benefit of the bypass flows. In addition, the amount of each bypass can be varied according to the amount of water that is available, although it is important to begin with the maximum amount to make sure benefit can be detected.

There are several locations in the basin where bypass flows are available, and this offers options for mitigating elevated temperatures. However, for initial trials, it makes sense to manipulate the sources where bypass flows are likely to be largest. Having a single source, or closely spaced sources, makes it easier to determine the longitudinal extent of the benefit that bypass flows can provide. Smaller sources can be added later after a firm basis has been established for estimating the longitudinal extent of the benefit.

Scheduling bypass flows depends in part on travel times; how long does it take for the leading edge of bypass flows to reach the terminus of the study reach and how long does it take for the trailing edge to reach the terminus after the bypass flows are stopped. For example, if the travel time through the reach is approximately one day, then bypass flows should be scheduled for three or four days in order to get two or three days of stable conditions for data collection. Similar reasoning applies to the interval after bypass ceases.

Travel time determinations are an important element of scheduling decisions. Channel geometry along the Fraser mainstem may be sufficient to support these estimate, but that is unlikely to be the case in Ranch Creek due to the beaver dams. Dye tracer studies, or something comparable, are needed to provide an empirical

basis for travel times. These studies will also help determine the spacing for data loggers.

Real-time data for air temperature would be a significant addition to the studies. It would make it possible to validate that before and after bypass comparisons of stream temperature are made at times when air temperature is relatively stable.

Longitudinal Studies

For each VPP, data loggers must be closely spaced downstream of the bypass location; the real-time monitoring locations are also important, but do not provide adequate spatial resolution for assessing benefit. Ideally, the spacing should make it possible to measure the same parcel of water several times in a day. For example, if a parcel in lower Ranch Creek moves about 6 miles a day[2], placing loggers about 1 mile apart would result in a transit time of approximately 4 hours between adjacent loggers. As an initial trial, loggers could be deployed to cover a distance approximating a travel time of one day. Spacing or distance could then be adjusted as more is learned. The data loggers would be deployed only for the duration of the VPP and should be set to record at 15-min intervals, or more frequently.

The advantage of data from the data loggers, compared to sole reliance on the real-time sites, is that it is possible to frame benefit questions in terms of distance rather than just a yes or no answer. It is likely that the distance over which the benefit persists depends not only on the amount of the bypass, but also on the path it takes. In other words, we might predict that the benefit will travel farther in the Fraser River than in Ranch Creek due to factors that affect velocity (e.g., beaver dams and low gradient).

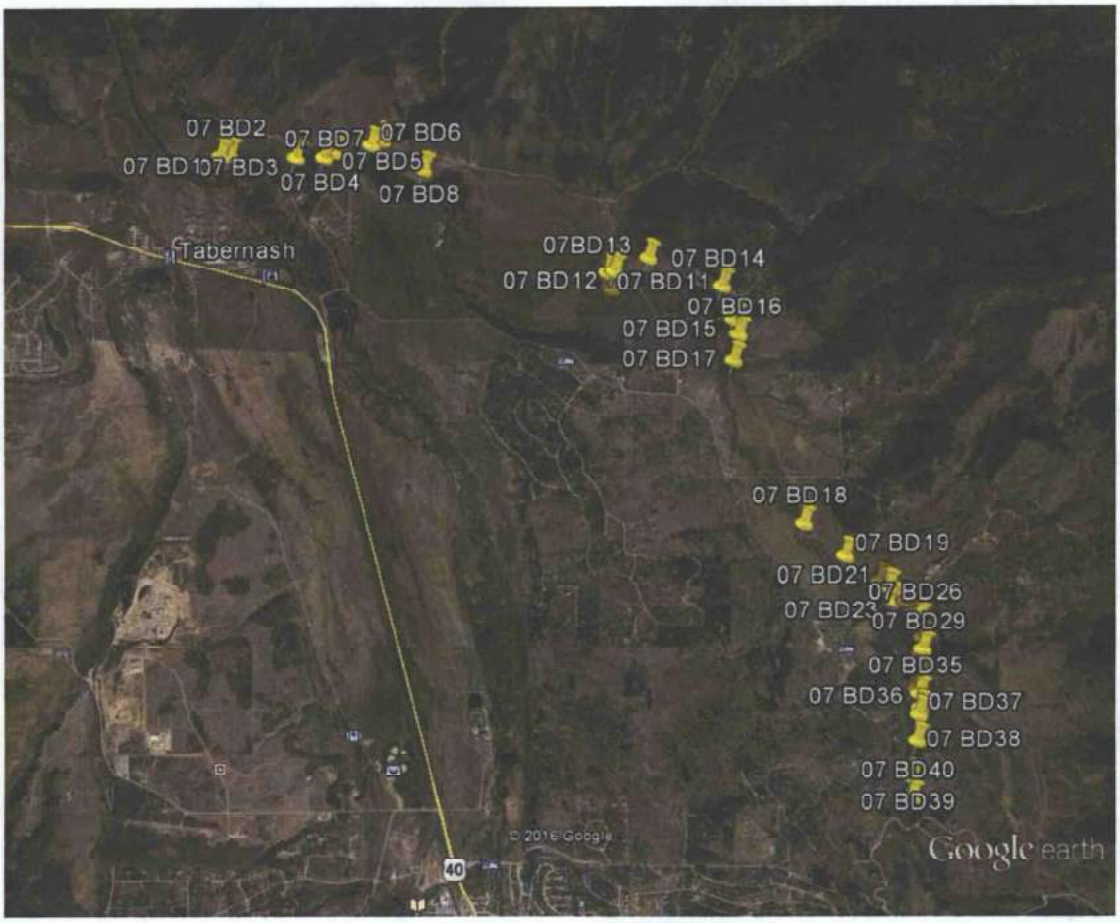
Beaver Dams

For Ranch Creek specifically, there is a need to understand more about the influence of beaver dams on stream temperature. Each beaver dam functions like a small low-head dam that creates a pool where width and depth are relatively insensitive to small variations in flow (i.e., the changes anticipated with bypass flows). Consequently, the beaver dams may result in more rapid attenuation of the benefit from bypass flows than would be expected in the absence of the dams. That information may prove valuable for developing the decision matrix and for reaching conclusions about *de minimis* benefit.

The Applicant has supplied information showing that there are almost 50 beaver dams between their diversion point and the mouth of Ranch Creek (see Figure below). The effect of beaver dams on stream temperature has been studied in other settings, and results of those studies yield some conclusions that can guide study design in Ranch Creek. Each beaver dam slows the velocity of the stream, and the longer residence

[2] Velocity is less than 1 fps at flows below 10 cfs based on field measurements at the two gages on Ranch Creek. The choice of 6 mi/d is approximate and simplifies calculations.

time warms the stream compared to what would happen in the absence of the dam. The dams also increase water depth, which tends to reduce the daily amplitude of temperature variation.



Concurrent measurement of temperatures above and below several of the ponds may yield important information about attenuation of bypass effects; this information may lead to conclusions about benefit on the basis of the number of beaver dams downstream of the bypass location. If beaver dams are found to strongly attenuate the bypass effect, bypass flows may yield little benefit in Ranch Creek. This type of study can be run concurrently with a longitudinal series of sites in Ranch Creek or the Fraser.

Data Analysis

The daily temperature data from streams generally conform to a sinusoidal time-series[3]. By fitting such a model to the data, several important characteristics can be determined at each site for each day or for a period of several days. Useful

[3] See, for example, G McRae & CJ Edwards. 1994. Thermal characteristics of Wisconsin headwater streams occupied by beaver: Implications for brook trout habitat. Transactions of the American Fisheries Society 123: 641-656.

characteristics include the minimum, maximum, amplitude, and time of maximum (phase shift); time above an arbitrary threshold or heating rate at a specific time of day3 might also be useful. Daily characteristics are used to define changes in temperature caused by transit through a reach or a beaver pond.

Bypass flows are turned on for a period of days and then turned off for a comparable period. The appropriate number of days depends on travel time through the reach, as explained previously. Daily temperature characteristics and the changes observed across reaches or the beaver ponds can then be segregated into groups according to whether flows were bypassed or not. The statistical approach for analyzing the data will depend on how much these characteristics change at individual sites over the course of the VPP, but could be as simple as a t-test. Results of the statistical test will help determine the longitudinal persistence of the bypass effect on stream temperature.

It is reasonable to expect that the daily amplitude and the daily maximum will be decreased when flow is bypassed; increasing the flow increases water depth, which means that heat transfers are occurring in a larger volume. The effect of bypass flows on stream temperature will dissipate over time whether the water is flowing in Ranch Creek or the Fraser River.

ATTACHMENT B
PROGRAMMATIC AGREEMENT

Programmatic Agreement

Among the

U.S. Army Corps of Engineers, Omaha District;

Colorado State Historic Preservation Officer;

U.S. Forest Service; and Denver Water

Regarding Compliance with the National Historic Preservation Act for Construction and Operation of the Proposed Enlargement of Gross Reservoir, Boulder County, Colorado

WHEREAS, the City and County of Denver, acting by and through its Board of Water Commissioners (Denver Water), has submitted a Section 404 Clean Water Act Permit application to the U.S. Army Corps of Engineers (Corps) for the proposed enlargement of Gross Reservoir (Project or the undertaking); and

WHEREAS, the Corps considers the authorization for the Project an undertaking subject to review in accordance with Section 106 of the National Historic Preservation Act (NHPA), 54 United States Code (USC) 306108, and its implementing regulations, 36 Code of Federal Regulations (CFR) Part 800; and

WHEREAS, the Corps has determined that the undertaking may have direct, indirect, and cumulative effects on cultural resources included in, or eligible for inclusion in, the National Register of Historic Places (NRHP), hereafter called historic properties [36 CFR 800.16(l)(1)]; and

WHEREAS, the Corps, in consultation with the Colorado State Historic Preservation Officer (SHPO), has defined the area of potential effects (APE) to include all staging areas, borrow areas, access roads, inundation, and other infrastructure associated with the undertaking, to account for direct, indirect and cumulative effects to historic properties (see attached map); and

WHEREAS, public involvement was implemented by the Corps through the Draft and Final Moffat Collection System Project Environmental Impact Statement (EIS) process that included scoping meetings, newsletters, website announcements, public hearings, cooperating agency meetings, news releases, and publication of Federal Register (FR) notices. Historic property impacts were evaluated for all alternatives in the Draft EIS (October 2009) and the Final EIS (April 2014). A draft version of this Programmatic Agreement (Agreement) was included as Appendix L in the Draft and Final EISs; and

WHEREAS, the Corps has notified the Advisory Council on Historic Preservation (ACHP), pursuant to 36 CFR 800.6(a)(1), and the ACHP responded to the Corps' December 18, 2014 letter on January 14, 2015, that they do not wish to participate unless requested to do so in the future; and

WHEREAS, the Corps has consulted with Native Americans pursuant to 36 CFR 800.14(b)(2)(i) and 36 CFR 800.2(c)(2) including the Northern Arapaho Tribe, Northern Cheyenne Tribe, Cheyenne-Arapaho Tribes of Oklahoma, the Southern Ute Indian Tribe, Ute Mountain Ute Tribe, and their associated Tribal Historic Preservation Officers (THPOs) are invited to be Concurring parties to this Agreement; and

WHEREAS, the Corps has consulted with the Boulder County Historic Preservation Advisory Board and has invited it to be a Concurring Party to this Agreement; and

WHEREAS, the Corps has consulted with the U.S. Department of Agriculture Forest Service, Arapaho & Roosevelt National Forests (USFS), which has management jurisdiction over all lands reserved as National Forest System Land, and therefore has the responsibility for cultural resources management within the Project boundary, and has invited it to be a Signatory to this Agreement; and

WHEREAS, the Corps has consulted with the Federal Energy Regulatory Commission (FERC), which is responsible for a hydropower license amendment process, inviting them to participate, and the FERC declined in an e-mail/conversation on December 6, 2012; and

WHEREAS Denver Water, which has participated in this consultation and is a Signatory to this Agreement, will be financially responsible for carrying out the terms of this Agreement;

NOW THEREFORE, the Signatories to this Agreement agree that the proposed undertaking, if permitted, shall be administered in accordance with the following stipulations to ensure compliance with Section 106 of NHPA.

STIPULATIONS

The Corps shall ensure that the following measures are carried out:

1. Area of Potential Effects

    a. The Corps, in consultation with the SHPO, has defined and documented the APE based on direct, indirect, and cumulative effects of the undertaking. The APE applies to federal, tribal, state, and private lands that may be affected by construction of the Project, to include staging areas, access roads, borrow areas, inundated areas, and other related infrastructure for this undertaking. The Corps may modify the APE in accordance with Stipulation 1. e. of this Agreement. The APE is defined as the geographic area or areas within which an undertaking may directly or indirectly cause alterations in the character or use of historic properties, if any such properties exist. The APE is influenced by the scale and nature of an undertaking and may be different for different kinds of effects caused by the undertaking [36 CFR 800.16(d)].

    b. Direct Effects – The Moffat Collection System Project (Moffat Project) Final EIS evaluated direct effects for all alternatives. The APE for the undertaking is the area of potential ground disturbance around Gross Dam and Gross Reservoir (see attached map), to include staging areas, borrow areas, access roads, inundation, and other infrastructure within the construction easement associated with the dam raise (Moffat Project Final EIS p. 3-555). In summary, direct effects were found to be major and permanent (for example, the proposed expansion of the dam itself, and changes to portions of the Resumption Flume would be permanent) (Moffat Project Final EIS p. 5-480). Appropriate mitigation of these effects would be required before construction begins.

    c. Indirect Effects – The Moffat Project Final EIS evaluated indirect effects for all alternatives and considered visual, atmospheric, and audible elements as well as vibration during construction that could diminish the integrity of the human and built environment (Moffat Project Final EIS p. 5-480). The indirect effects of the undertaking were found to be

temporary and minor. However, if construction is found to have more severe indirect effects on NRHP-eligible properties, the Corps will notify Signatory and Concurring parties and will consult on appropriate mitigation. For purposes of this Agreement, the APE for indirect effects is the same as that for direct effects.

d. Cumulative Effects – The Moffat Project Final EIS evaluated cumulative effects, to include reasonably foreseeable future effects caused by the undertaking, that may occur later in time, be farther removed in distance, or be cumulative [36 CFR 800.5(a)(1)]. The Moffat Project Final EIS evaluated cumulative effects for the undertaking, and impacts to cultural resources were found to be minor (Moffat Project Final EIS p. 4-575). For purposes of this Agreement, the APE for cumulative effects is the same as that for direct and indirect effects.

e. Modifying the APE – The APE, as currently defined, encompasses an area sufficient to accommodate all of the undertaking components under consideration as of the date of the execution of this Agreement. The APE may be modified by the Corps in consultation with the SHPO, and the USFS (if effects occur on National Forest System Land), when additional field research or literature review, consultation with Signatories or Concurring parties, or other factors indicate that the qualities and values of historic properties that lie outside the boundary of the currently defined APE may be affected directly, indirectly, or cumulatively. Agreement to modify the APE will not require an amendment to the Agreement; however, Signatory and Concurring parties and affected land-management agencies will be notified. Updated maps or figures with the accepted date of modification will be appended to this Agreement following consultation as described above (see Attachment A).

2. Notification and Coordination

a. As the lead federal agency, the Corps (as opposed to Denver Water, the permit applicant) will notify and coordinate with the Signatory and Concurring parties to this Agreement.

3. Historic Property Identification

a. The Corps, in coordination with Denver Water, shall ensure that intensive-level (or Class III) cultural resource inventories, as outlined within SHPO's *Colorado Cultural Resource Survey Manual Guidelines for Identification: History and Archaeology* (2007), are conducted within the APE (see attached map). These inventories will be conducted by the Corps or any contractor authorized by the Corps prior to any ground-disturbing activities. The inventories will be conducted in a manner consistent with the Secretary of the Interior's *Standards and Guidelines for Identification* (48 FR) 44720-23) and is consistent with ACHP's guidance on archaeology and all applicable National Park Service guidance for evaluating cultural resources for listing in the NRHP.

b. The Corps shall ensure that the inventories are conducted in consultation with the Signatory and Concurring parties. Inventory reports and site forms will conform to SHPO's survey manual guidelines. Identification on lands managed by the USFS will follow Forest Service Manual (FSM) 2360. Site forms will only be prepared when cultural resources are found within the APE. Draft inventory report and site forms will be submitted by the Corps to the Signatory and Concurring parties for a 30 calendar day review and comment period.

As appropriate, comments received by the Corps will be resolved. If the Signatory and Concurring parties do not respond to the Corps within 30 calendar days from receipt of the submittal, the Corps shall assume no comment on the Corps' findings and recommendations as detailed in the submittal, in accordance with 36 CFR 800.3(c)(4) and 36 CFR 800.4(d)(1)(i). A Final Inventory Report, including site forms, will be distributed by the Corps to the Signatory and Concurring parties.

c. Information gathered during inventory shall be adequate to allow assessment of cultural resources' eligibility for the NRHP. The Corps shall evaluate all cultural resources identified within the APE in accordance with 36 CFR 800.4(c). The Corps will consult with the SHPO to determine the eligibility of identified cultural resources pursuant to 36 CFR 800.4(c) and National Register Criteria for Evaluation, 36 CFR 60.4. If the inventory results in the identification of properties that are eligible for the NRHP, the Corps shall apply the criteria of adverse effect within the APE (36 CFR 800.5).

d. The Corps will ensure that any subsurface evaluative testing is limited to defining the nature, density, and distribution of materials in potential historic properties, and provides adequate data to make evaluations of NRHP eligibility.

4. Treatment Plan to Resolve Adverse Effects

a. The Corps shall apply the criteria of adverse effects to historic properties identified in the APE, in accordance with 36 CFR 800.5, and require appropriate mitigation wherever adverse effects are found. The Corps shall work with Denver Water to avoid or minimize adverse effects to historic properties, to the extent practicable, through design of Project facilities, relocation of Project facilities, or by other means. If effects occur on National Forest Service Land, the Corps will involve the USFS in avoidance and minimization efforts.

b. Where the Corps determines that avoidance or minimization is not feasible or prudent, the Corps shall ensure that Denver Water develops a treatment plan designed to mitigate adverse effects to the historic properties. Denver Water will prepare a treatment plan, in consultation with the Corps, SHPO, and the USFS (if effects occur on National Forest System Land), which considers effects to eligible cultural resources where avoidance is not feasible. The plan shall consider the full range of cultural resource types (i.e., historic and prehistoric site types) and the kind of information that each type could be expected to produce. The plan shall consider the Project context (i.e., reservoir basin, reservoir shoreline, facilities, etc.) and the type of effects that could occur within these contexts (i.e., inundation, wave action, blading, etc.). Appropriate data recovery methods and/or *in situ* conservation practices will be proposed accordingly. Provisions for unanticipated discoveries and for a pre-work meeting with the Project contractor in order to provide information on the identification of buried cultural resources shall be included within the treatment plan. Denver Water shall submit the draft treatment plan to the Corps. The Corps will distribute the draft treatment plan to the Signatory and Concurring parties for their comments. As appropriate, comments received by the Corps will be resolved. If no comments are received within 30 calendar days, the Corps shall assume concurrence with the draft treatment plan. For properties eligible under Criterion D (36 CFR 60.4), alternative forms of mitigation may be negotiated with the appropriate parties to this Agreement in lieu of, or in addition to, data recovery (e.g., monitoring, *in situ* protection,

archival research, etc.). The final treatment plan will be appended to this Agreement as Attachment B.

c. When archaeological data recovery is the preferred option for a historic property, the Corps shall ensure that Denver Water develops a plan for the recovery of significant archaeological data based on an appropriate research design. The research design shall be developed after all appropriate cultural resource inventory and evaluation work is completed. Data recovery plans shall be consistent with the Secretary of the Interior's *Standards and Guidelines for Archaeology and Historic Preservation* (48 FR 44716-37) and shall be implemented prior to any ground disturbance in the vicinity of the historic property. The Corps shall reach agreement with private landowners and will document the final disposition of artifacts prior to commencing work on private land. After reviewing Denver Water's data recovery plan for adequacy, the Corps shall submit the data recovery plan to the Signatory and Concurring parties for review and comments. As appropriate, comments received by the Corps will be resolved. If the Signatory and Concurring parties do not respond to the Corps within 30 calendar days of receipt of the submittal, the Corps shall assume concurrence with the Corps' findings and recommendations as detailed in the submittal. The final data recovery plan(s) will be appended to this Agreement as Attachment C.

d. If any of the Signatory or Concurring parties object to all or part of the proposed treatment or data recovery plan, the Corps shall attempt to resolve the objection pursuant to Stipulation 10 and shall make the final decision regarding such dispute. Upon completion of the dispute resolution process, the Corps shall ensure that the treatment or data recovery plan and any modifications to it resulting from the resolution effort are implemented.

5. Unanticipated Discoveries

a. When cultural resources not previously identified are discovered during the conduct of ground-disturbing activities, or when a previously identified historic property is affected in an unanticipated (accidental) manner, all activities within 100 feet of the discovery shall cease immediately, the site will be secured, and Denver Water shall notify either the Corps' Denver Regulatory Office or the Corps' Omaha District Office. The Corps will ensure that the discovery is evaluated and recorded by a qualified archaeologist, as defined in Stipulation 8.

b. The Corps will notify the Signatory and Concurring parties within 48 hours of the discovery. The Corps shall consult with the parties to seek initial comments regarding the discovery and determine whether testing is needed to evaluate significance.

c. If the Corps determines, in consultation with the Signatory and Concurring parties, that testing is needed to determine significance, the Corps shall notify the ACHP and will provide the proposed mitigation measures to the Signatory and Concurring parties, and request comments regarding the adequacy of the proposed effort to be provided within a timely fashion. As appropriate, comments received by the Corps will be resolved. If the Signatory and Concurring parties do not respond to the Corps within 7 calendar days of receipt of the submittal, the Corps shall assume concurrence with the Corps' findings and recommendations as detailed in the submittal. Upon receipt of and in consideration of their comments, the Corps shall notify the Signatory and Concurring parties of action necessary prior to resumption of construction.

d. In the event that the Signatory and Concurring parties object to the actions proposed for treating a discovery, the Corps shall work to resolve the objection in accordance with Stipulation 10.

e. Construction activities in the vicinity of the discovery shall not resume until Denver Water has been notified by the Corps that discovery mitigation is complete and activities can resume.

6. Inadvertent Discovery of Human Remains

a. Protocols for human remains discovered on federal lands differ from the protocols for human remains discovered on state or private lands. For discoveries on federal land, protocols outlined in FSM 2361.3 and 2364.1 will be followed. Colorado Revised Statute (CRS) 24-80-1301-1305, Unmarked Human Graves, provides procedures regarding the discovery of human remains on any state or private land.

b. Should such a discovery take place, Denver Water will contact the county coroner, sheriff, or land managing agency official (see below for contact information), who will determine whether the remains are of forensic value. If the coroner determines that the remains are not of forensic value, the State Archaeologist will be notified and will take the appropriate steps to determine whether the remains are over 100 years old and if they are Native American. If found to be Native American, the State Archaeologist will contact the Colorado Commission of Indian Affairs, who in turn will contact interested Tribes in the region before removal. The State Archaeologist shall submit a notice in the FR as soon as possible. The Corps will approach the landowner(s) with a letter of consent, allowing for the respectful and dignified treatment of any Native American skeletal materials in consultation with any interested Tribes. The letter will also request that any such remains be briefly examined by a qualified archaeologist and physical anthropologist. Should any remains be determined through available evidence to not include Native American skeletal elements, the remains shall be treated in accordance with Colorado State Law.

c. In the case of an inadvertent discovery of human remains, all activities within 100 feet of the discovery shall cease immediately, the site will be secured, and Denver Water shall notify either the Corps' Denver Regulatory Office or the Corps' Omaha District Office. Should the remains be determined by a qualified archaeologist to include Native American skeletal materials and any associated funerary objects, the Corps and the USFS if appropriate, will comply with the Native American Graves Protection and Repatriation Act (NAGPRA), Colorado State law, and Section 106 of the NHPA. The Corps and the USFS, if appropriate, will notify the appropriate Tribes and offer opportunities to visit the discovery site. Those Tribes who express an interest in the remains will be consulted. Appropriate treatment and/or repatriation options will be discussed. All potential claims and disputes with regard to the remains will be considered in accordance with NAGPRA and Colorado State law.

d. Ground-disturbing activities at the scene will not recommence without express written permission of the Corps' Denver Regulatory Office or the Corps' Omaha District Office. This permission will not be issued until the completion of site-specific consultation with the SHPO and appropriate Tribes.

BOULDER COUNTY	
Coroner	**Sheriff**
Coroner Emma R. Hall (or current Coroner) Justice Center 1777 6th Street, P.O. Box 471 Boulder, CO 80306 303-441-3535 or 303-441-4444 (24 hours) bouldercountycoroner@bouldercounty.org	**Sheriff Joe Pelle** (or current Sheriff) 5600 Flatiron Parkway Boulder, CO 80301 303-441-3600 or 303-441-4444 jpelle@bouldercounty.org
STATE ARCHAEOLOGIST	
Main Contact	**Alternate Contact**
Dr. Holly Norton (or current State Archaeologist) State Archaeologist/Deputy SHPO-Archaeology History Colorado 1200 Broadway Denver, CO 80203 303-866-2736 holly.norton@state.co.us	**Thomas Carr** (or current Staff Archaeologist) Senior Staff Archaeologist History Colorado 1200 Broadway Denver, CO 80203 303-866-3498 thomas.carr@state.co.us
ARAPAHO AND ROOSEVELT NATIONAL FORESTS	
Ron J. Archuleta (or current Forest Supervisor) Forest Supervisor Forest Supervisor's Office 2150 Centre Avenue, Building E Fort Collins, CO 80526 970-295-6600 rarchuleta@fs.fed.us	

e. The Corps shall ensure that any human remains are treated under the following terms, pursuant to CRS 24-80-1302:

i. The appropriate Corps' Denver Regulatory Project Manager or Omaha District Archeologist will be notified by Denver Water or the designated field archeologist of the location of the suspected human remains. This will be done within 24 hours of discovery. Appropriate notification may include voice mail or electronic mail for those instances when the Corps' offices are closed.

ii. Should there be ground-disturbing activities in progress in the general area, all work must cease immediately within 100 feet of the discovery location. Protective measures, such as covering the area with a tarp and fencing around the area, will be implemented as necessary to prevent deterioration of, or further damage to, the remains and the area associated with those remains.

iii. The Corps will notify law enforcement agencies, as appropriate, the State Archaeologist, Tribes, and the USFS. Law enforcement must be offered an opportunity to visit the scene and determine if they wish to conduct an investigation. Until law enforcement formally releases the scene, the discovery location shall be considered a crime scene under the direct supervision of said law enforcement personnel. The

Corps' Omaha District Archeologist or designated field archeologist can advise law enforcement personnel regarding protective measures and information collection techniques. Upon notification that law enforcement has no interest in the matter, the following procedures will be implemented:

1. The Corps will notify the State Archaeologist and, if appropriate, the USFS, of the release of the scene as a potential crime scene. The Corps shall request advice as to measures to protect the remains and proceed to do so, and will collect sufficient information to complete consultations.

2. The Corps will first assess whether human remains are indeed present. If law enforcement has been involved in the Project as per the above steps, it is likely that the remains have been identified as human. The Corps will consult with the State Archaeologist and Tribes to determine the appropriate steps, as necessary, to retrieve basic information with minimum disturbance to the remains, with particular focus on evidence of cultural affiliation or cultural patrimony. The intent will be to gain the necessary information in a non-destructive fashion.

7. Curation

   a. The Corps shall ensure that all records and materials resulting from identification and treatment efforts on public lands are curated consistent with 36 CFR 79 and the provisions of NAGPRA, if appropriate. Documentation of compliance with 36 CFR 79 or NAGPRA shall be provided by Denver Water to the Signatory and Concurring parties.

   b. The Corps will encourage private landowners through written communication to curate any collections from their lands associated with treatment and discovery in an appropriate facility prior to the commencement of any work. If any such collections are to be returned to the landowner(s), said collections will be maintained as per 36 CFR 79 or according to Colorado State standards until analyses are completed.

   c. The Corps shall ensure that all final reports resulting from actions pursuant to this Agreement are provided to the Signatory and Concurring parties, and submitted to the National Technical Information Service (http://www.ntis.gov/). The Corps shall ensure that all such reports are responsive to contemporary professional standards and to the Department of the Interior's *Formal Standards for Final Reports of Data Recovery Program* (48 FR 44716-40). Historic property information as outlined by 36 CFR 800.11(c) will not be made available to the general public.

8. Qualifications

   a. The Corps shall ensure that all historic, architectural, ethnographic, and archaeological work conducted pursuant to this Agreement is carried out by or under the direct supervision of persons meeting qualifications set forth in the Secretary of the Interior's *Professional Qualifications Standards* (36 CFR 61).

   b. The Corps shall ensure that if archaeological work happens on National Forest System Land, Denver Water obtains a USFS Rocky Mountain Region (Region 2) Special Use Permit for Archaeological Investigations prior to any field work.

c. Denver Water, in cooperation with the Corps, shall ensure that all of its personnel and all the personnel of its Project contractors are directed not to engage in collection of historic and prehistoric materials (e.g., old bottles and cans, projectile points, pottery, etc.) and to exercise caution to prevent inadvertent damage to cultural resources. All environmental inspectors will receive training by qualified cultural resources professionals prior to initiation of construction regarding cultural resources that could be discovered during the course of construction. All personnel involved in Project construction, construction zone rehabilitation, operation, and maintenance of the Project facilities will be instructed prior to initiation of construction on site avoidance and protection measures, including information on the statutes protecting cultural resources.

9. Annual Monitoring Reports and Final Report

a. The Signatory and Concurring parties may monitor actions carried out pursuant to this Agreement, and the ACHP shall review such actions when so requested. Denver Water shall submit an Annual Monitoring Report to Signatory and Concurring parties on or before December 31st of each calendar year once the Project has been authorized by the Corps, and a Special Use Permit has been issued to Denver Water by the USFS, if needed. This report will be designed to inform the parties to this Agreement of action taken during the previous year pursuant to this Agreement, and shall provide the basis for any amendments or other actions the parties may deem necessary for purposes of compliance with Section 106. The Monitoring Report will be submitted annually until Project construction is complete or upon expiration of the Agreement. The Final Monitoring Report will state that all Project construction has been completed. A meeting of the Signatories shall occur upon request of a Signatory to evaluate the implementation of the stipulations of this Agreement. Failure to submit the Annual Monitoring Report to the Signatory and Concurring parties each calendar year will result in the termination of this Agreement

b. A Final Summary Report of all inventories, treatment, discovery situations or other mitigative activities will be submitted by Denver Water to the Corps. The Corps will distribute this Final Summary Report to the Signatory and Concurring parties within 12 months after completion of the Project, unless otherwise agreed to among the parties to this Agreement.

10. Dispute Resolution

a. Should any Signatory or Concurring Party to this Agreement object in writing to the Corps regarding any action carried out or proposed with respect to the Project or implementation of this Agreement, the Corps shall consult with the objecting party to resolve the objection. If, after initiating such consultation, either party determines that the objection cannot be resolved through consultation, the Corps shall submit all relevant documentation to the ACHP, including the Corps' proposed response to the objection. Within 30 calendar days after receipt of all pertinent documentation, the ACHP shall exercise one of the following options:

i. Advise the Corps that the ACHP concurs with the Corps' proposed response to the objection, whereupon the Corps will respond to the objection accordingly;

ii. Provide the Corps with recommendations, which the Corps shall take into account in reaching a final decision regarding its response to the objection; or

iii. Notify the Corps that the objection will be referred for comment pursuant to 36 CFR 800.7(c) and proceed to refer the objection and comment. The resulting comment shall be taken into account by the Corps in accordance with 36 CFR 800.7(c)(4) and 110(1) of the NHPA.

b. Should the ACHP not exercise one of the above options within 30 calendar days after receipt of all pertinent documentation, the Corps may assume the ACHP's concurrence in its proposed response to the objection.

c. The Corps shall take into account any ACHP recommendation or comment provided in accordance with this stipulation with reference only to the subject of the objection; the Corps' responsibility to carry out all actions under this Agreement that are not the subject of the objection shall remain unchanged.

11. Amendment

a. Any Signatory to this Agreement may request that this Agreement be amended, whereupon the parties to this Agreement will consult in accordance with 36 CFR 800.14 to consider such amendment. Amendments to this Agreement will be in writing and signed by the parties.

12. Termination

a. Any Signatory to this Agreement may terminate this Agreement by providing 30-calendar-days' notice to the Concurring parties to this Agreement, provided that the parties will consult during the period prior to termination to seek agreement on amendments or other actions that would avoid termination. In the event of termination, the Corps will comply with 36 CFR 800.3 through 800.7 with regard to individual actions covered by this Agreement.

13. Execution

a. Execution and implementation of this Agreement evidences that the Corps has afforded the ACHP a reasonable opportunity to comment on the proposed Project and its effects on historic properties, and that the Corps has satisfied its Section 106 responsibilities for all individual actions associated with the proposed Project.

b. In the event that the Corps does not carry out the requirements of this Agreement, the Corps shall comply with 36 CFR 800.3 through 800.7 with regard to individual actions covered by this Agreement.

c. This Agreement shall become effective when the Signatories have all signed below, on the date of the last signature of those parties.

14. Sovereign Immunity

a. The Signatory parties do not waive their immunity by entering into this Agreement, and each fully retains all immunities and defenses provided by law with respect to any action based on or occurring as a result of this Agreement.

15. Expiration of Agreement

    a. This Agreement shall expire 10 years after execution of this document or upon completion of the proposed Project, whichever occurs first. If any Signatory wishes to extend this Agreement, a letter requesting that extension must be transmitted through the Corps to the other Signatories at least 90 calendar days prior to the expiration date. The Corps will then consult with the other Signatories to determine the outcome of such a request.

16. Antideficiency Act

    a. All Corps obligations under this Programmatic Agreement are subject to the availability of funds.

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SIGNATORIES

26OCT15

John W. Henderson
Colonel, Corps of Engineers
District Commander

Date

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SIGNATORIES

10/1/15

Edward C. Nichols — Date
Colorado State Historic Preservation Officer
HISTORY COLORADO

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SIGNATORIES

10/1/15

Ron J. Archuleta Date
Acting Forest Supervisor, Arapaho & Roosevelt National Forests
U.S. DEPARTMENT OF AGRICULTURE, FOREST SERVICE (USFS)

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SIGNATORIES

10/1/15

Jim Lochhead
CEO and Manager
BOARD OF WATER COMMISSIONERS (DENVER WATER)

Date

APPROVED AS TO FORM

LEGAL DIVISION

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CONCURRING PARTIES

Designated Representative Date
NORTHERN ARAPAHO TRIBE

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CONCURRING PARTIES

Designated Representative Date
NORTHERN CHEYENNE TRIBE

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CONCURRING PARTIES

Designated Representative Date
CHEYENNE-ARAPAHO TRIBES OF OKLAHOMA

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CONCURRING PARTIES

Designated Representative Date
SOUTHERN UTE INDIAN TRIBE

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CONCURRING PARTIES

Designated Representative Date
UTE MOUNTAIN UTE TRIBE

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CONCURRING PARTIES

Karen Hagler Date
Chair
BOULDER COUNTY HISTORIC PRESERVATION ADVISORY BOARD

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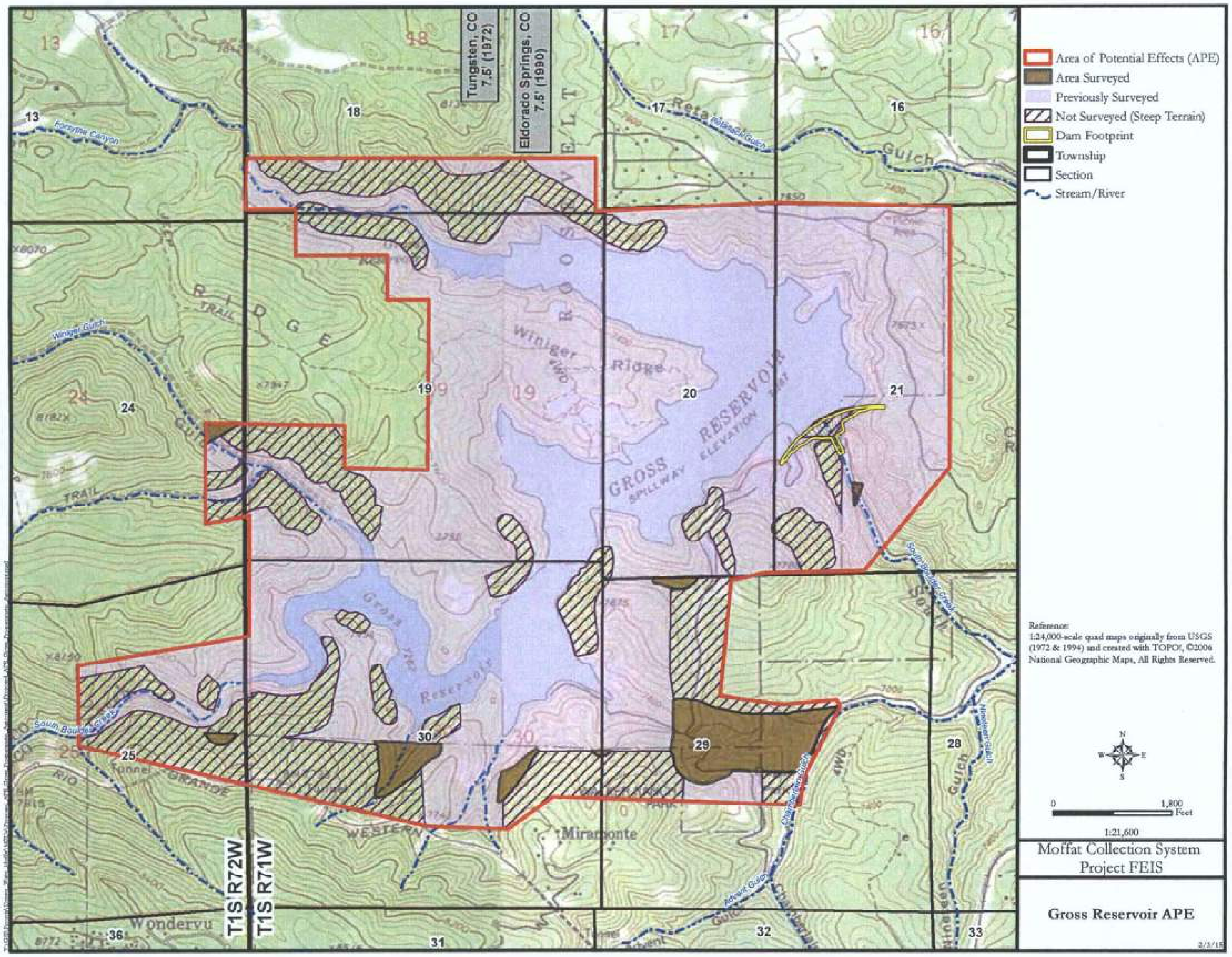
Area of Potential Effects (APE)
Area Surveyed
Previously Surveyed
Not Surveyed (Steep Terrain)
Dam Footprint
Township
Section
Stream/River
Reference:
1:24,000-scale quad maps originally from USGS (1972 & 1994) and created with TOPO!, ©2006 National Geographic Maps, All Rights Reserved.
1:21,600
Moffat Collection System Project FEIS
Gross Reservoir APE
Tungsten, CO 7.5' (1972)
Eldorado Springs, CO 7.5' (1990)
T1S R72W
T1S R71W
Gross Reservoir
Winiger Ridge
Miramonte
Wondervu
South Boulder Creek
Forsythe Canyon
Winiger Gulch

ATTACHMENT C
BIOLOGICAL OPINIONS

United States Department of the Interior

FISH AND WILDLIFE SERVICE
ECOLOGICAL SERVICES
COLORADO FIELD OFFICE
P.O. BOX 25486, DFC (MS 65412)
DENVER, COLORADO 80225-0486

IN REPLY REFER TO:
ES/CO: LK-6-CO-13-F-006
ES/CO: GJ-6-CO-99-F-033-CP126
TAILS: 06E24000-2012-F-0747

December 6, 2013

Mr. Kiel Downing
Denver Regulatory Office
U.S. Army Corps of Engineers
9307 S. Wadsworth Boulevard
Littleton, Colorado 80218-6901

Dear Mr. Downing:

This final biological opinion is provided in response to your August 14, 2012, and August 14, 2013, requests to reinitiate formal consultation pursuant to section 7(a)(2) of the Endangered Species Act of 1973, as amended (ESA). Your August 14, 2013, letter and revised Biological Assessment (BA) described the potential effects of the City and County of Denver's Moffat Collection System Project (Moffat Project or Project), U.S. Army Corps of Engineers (Corps) permit application number NWO-2002-80762-DEN, on federally listed species and designated critical habitat. This biological opinion replaces the opinion dated July 31, 2009 (BO# ES/LK-6-CO-09-F-021, TAILS 65412-2009-F-0520; ES/GJ-6-CO-99-F-033-CP101), that was issued for the Project.

The Federal action reviewed in this biological opinion is operation of the Moffat Project, which includes expansion of Gross Reservoir, located in Boulder County, and increased stream diversions in Summit, Grand, Park, Douglas, and Boulder counties, Colorado. In addition to full use of its existing water collection system, the Applicant - the City and County of Denver, acting by and through its Board of Water Commissioners (Denver Water), would enlarge the existing Gross Reservoir to a storage capacity of 113,811 acre-feet. This would be accomplished by raising the reservoir's concrete gravity arch dam. Denver Water also proposes to create an additional 5,000 acre-feet of storage in Gross Reservoir (for a grand storage total of 118,811 acre-feet) for the cities of Boulder and Lafayette by raising the dam an additional 6 feet. Water depletions associated with Boulder and Lafayette's proposed, additional water storage in Gross Reservoir will be addressed in a separate Section 7 consultation.

Whereas the July 31, 2009, opinion only addressed additional future depletions associated with the Project, this biological opinion will address past, existing, and future diversions for Denver Water's *entire system*, which includes Gross Reservoir. This opinion will cover all of Denver

Water's existing and future depletions up to an average annual demand of 363, 000acre-feet per year from the upper Colorado River and South Platte River basins.

The U.S. Fish and Wildlife Service (Service) has reviewed the information contained in the letter and revised BA submitted by your office on August 14, 2013.

The Service is working with your office to separately address water depletions associated with Boulder and Lafayette's proposed 5,000 acre-foot "environmental pool" in Gross Reservoir. This additional storage would be filled with water provided by Boulder and Lafayette, and released to enhance aquatic habitat in South Boulder Creek downstream of Gross Reservoir. Water storage rights and other specifics on Boulder and Lafayette's use of their water stored in Gross Reservoir should be provided to the Service for this separate Section 7 consultation; including if necessary, formal consultation and a resulting biological opinion.

We concur with your determinations of "likely to adversely affect" for the endangered whooping crane (*Grus Americana)*, least tern (*Sterna antillarum)*, pallid sturgeon (*Scaphirynchus albus)*, the threatened northern great plains population of the piping plover (*Charadrius melodus)*, and the western prairie fringed orchid (*Platanthera praeclara*) in the central and lower Platte River in Nebraska. We also concur with your determination of "likely to adversely affect" for designated whooping crane critical habitat in Nebraska. We concur with your determination of "not likely to adversely affect" for the endangered American burying beetle (*Nicrophorus americanus*) in Nebraska.

The Service also concurs with your determinations of "likely to adversely affect" for the endangered Colorado pikeminnow (*Ptychocheilus lucius*), razorback sucker (*Xyrauchen texanus*), humpback chub (*Gila cypha*), bonytail chub (*Gila elegans*), and their designated critical habitat in the upper Colorado River basin.

We concur with your determination of "not likely to adversely affect" for the Preble's meadow jumping mouse (*Zapus hudsonius preblei*) in Colorado.

DESCRIPTION OF THE FEDERAL ACTION

The Federal action is Denver Water's need for a section 404 individual permit from the Corps for the Moffat Project, which includes expansion of Gross Reservoir, located approximately 35 miles northwest of Denver and 6 miles southwest of the City of Boulder in Boulder County. The purpose of the Moffat Project is to develop 18, 000acre-feet per year of new, annual firm yield to the Moffat Water Treatment Plant (WTP) and raw water customers upstream of the Moffat WTP pursuant to the Board of Water Commissioners' commitment to its customers. Denver Water's need for the Moffat Project is to address two major issues: 1) timeliness - the overall near-term water supply shortage; and 2) location - the imbalance in water storage and supply between the North and South systems.

Denver Water proposes to enlarge the existing 41,811 acre-foot Gross Reservoir by 72,000 acre-feet, for its use; a storage capacity of 113, 811 acre-feet. This would be accomplished by raising

the existing, concrete gravity arch dam by 125 feet, from 340 feet to 465 feet in height. Denver Water would also create an additional 5,000 acre-feet of storage in the reservoir for Boulder and Lafayette. To accommodate this additional storage, Denver Water would raise the dam an additional 6 feet beyond the proposed 125-foot rise, for a total dam height of 471 feet. The surface area of Gross Reservoir would expand from about 418 acres to 842 acres, which would inundate approximately 400 acres of surrounding shoreline. The grand total of water storage in Gross Reservoir under the proposed action would be 118,811 acre-feet (113,811 + 5,000). However, none of Denver Water's existing or future water supply would be stored in the 5,000-acre-foot environmental pool. ESA compliance for the additional 5,000 acre-feet of storage will be addressed separately as mentioned above.

Using existing collection infrastructure, water from the Fraser River, Williams Fork River, and South Boulder Creek would be diverted and delivered during average to wet years via the Moffat Tunnel and South Boulder Creek to Gross Reservoir. In order to provide the 18,000 acre-feet per year of new firm yield to meet an average annual demand of 363,000 acre-feet per year (345,000 acre-feet from full use of the existing system plus the Project), the additional 72,000 acre-feet of storage capacity at Gross Reservoir is necessary. Existing facilities, including the South Boulder Diversion Canal and Conduits 16/22, would be used to deliver water from the enlarged Gross Reservoir to the Moffat WTP and raw water customers. To meet future demands, in most years, Denver Water would continue to rely on supplies from its entire integrated collections system. In a drought or emergency, Denver Water would rely on the additional water it would have previously stored in the Moffat Collection System to provide the additional 18,000 acre-feet of yield.

The Moffat Project would result in a combination of existing and new depletions to the Platte River system. These depletions are associated with changes in operation of Denver Water's *entire* water collection system, including Gross Reservoir and numerous other east slope reservoirs located throughout the South Platte River basin. The average annual diversions from the South Platte River at the demand level of 363,000 acre-feet per year would be 184,428 acre-feet. Total South Platte River diversions were calculated as the difference between total customer demand (deliveries of treated, raw, and non-potable water) and the amount supplied by Denver Water's Colorado River diversions.

The majority of Denver Water's South Platte River supplies are diverted from the South Platte at Strontia Springs Reservoir or downstream at the Conduit 20 intake in Waterton Canyon. Some water is also diverted from facilities on Bear Creek, South Boulder Creek, Ralston Creek, and Cherry Creek. Under the proposed action, total South Platte River diversions, including reservoir evaporative losses, associated with Denver Water's past, existing, and future demand levels since implementation of the PRRIP, would be 48,767 acre-feet per year. The Moffat Project would result in additional average annual diversions of 3,460 acre-feet from the South Platte River; this includes 2,879 acre-feet per year of new diversions and 581 acre-feet per year of additional reservoir evaporation. The amount of diverted water would be much greater than the amount of actual depletions from the South Platte River basin because much of the additional diverted water would return to the river via return flows from wastewater treatment plants and lawn irrigation.

This consultation also addresses Denver Water's entire system of water diversions from the Colorado River basin. Under the Moffat Project, Denver Water's total average annual depletion from the Colorado River would be 188,497 acre-feet. The Colorado River system depletions would include 137,833 acre-feet of average annual depletions that occurred before the initiation of the Upper Colorado River Recovery Program and previous consultations addressing 33,288 acre-feet per year. Therefore, the total of 188,497 acre-feet includes 17,376 acre-feet of new depletions and 171,121 acre-feet (137,833 + 33,288) of historic depletions that have already been consulted on. Increased diversions would decrease flows in the Colorado River primarily during the summer months, especially June and July.

PLATTE RIVER

BACKGROUND

On June 16, 2006, the Service issued a programmatic biological opinion (PBO) for the PRRIP and water-related activities[a] affecting flow volume and timing in the central and lower reaches of the Platte River in Nebraska. The action area for the PBO included the Platte River basin upstream of the confluence with the Loup River in Nebraska, and the mainstem of the Platte River downstream of the Loup River confluence.

The Federal action addressed by the PBO included the following:

1) funding and implementation of the PRRIP for 13 years, the anticipated first stage of the PRRIP; and

2) continued operation of existing and certain new water-related activities[b] including, but not limited to, Bureau of Reclamation (Reclamation) and Service projects that are (or may become) dependent on the PRRIP for ESA compliance during the first 13-year stage of the PRRIP for their effects on the target species[c], whooping crane critical habitat, and other federally listed species[d] that rely on central and lower Platte River habitats.

The PBO established a two-tiered consultation process for future Federal actions on existing and new water-related activities subject to section 7(a)(2) of the ESA, with issuance of the PBO being Tier 1 and all subsequent site-specific project analyses constituting Tier 2 consultations

[a] The term "water-related activities" means activities and aspects of activities which (1) occur in the Platte River basin upstream of the confluence of the Loup River with the Platte River; and (2) may affect Platte River flow quantity or timing, including, but not limited to, water diversion, storage and use activities, and land use activities. Changes in temperature and sediment transport will be considered impacts of a "water related activity" to the extent that such changes are caused by activities affecting flow quantity or timing. Impacts of "water related activities" do not include those components of land use activities or discharges of pollutants that do not affect flow quantity or timing.

[b] "Existing water related activities" include surface water or hydrologically connected groundwater activities implemented on or before July 1, 1997. "New water-related activities" include new surface water or hydrologically connected groundwater activities including both new projects and expansion of existing projects, both those subject to and not subject to section 7(a)(2) of the ESA, which may affect the quantity or timing of water reaching the associated habitats and which are implemented after July 1, 1997.

[c] The "target species" are the endangered whooping crane, the interior least tern, the pallid sturgeon, and the threatened northern Great Plains population of the piping plover.

[d] Other listed species present in the central and lower Platte River include the western prairie fringed orchid and American burying beetle.

covered by the PBO. Under this tiered consultation process, the Service will produce tiered biological opinions when it is determined that future federal actions are "likely to adversely affect" federally listed species and/or designated critical habitat in the PRRIP action area and the Project is covered by the PBO. If necessary, the biological opinions will also consider potential effects to other listed species and critical habitat affected by the Federal action that were not within the scope of the Tier 1 PBO (e.g., direct or indirect effects to listed species occurring outside of the PRRIP action area).

Although the water depletive effects of this Federal action to central and lower Platte River species have been addressed in the PBO, when "no effect" or "may affect but not likely to adversely affect" determinations are made on a site-specific basis for the target species in Nebraska, the Service will review these determinations and provide written concurrence where appropriate. Upon receipt of written concurrence, section 7(a)(2) consultation will be considered completed for those Federal actions.

Water-related activities requiring Federal approval will be reviewed by the Service to determine if: (1) those activities comply with the definition of existing water-related activities and/or (2) proposed new water-related activities are covered by the applicable states or the Federal depletions plan. The Service has determined that the Project meets the above criteria and, therefore, this Tier 2 biological opinion regarding the effects of the Project on the target species, whooping crane critical habitat, and the western prairie fringed orchid in the central and lower Platte River can tier from the June 16, 2006, PBO.

CONSULTATION HISTORY

Table II-1 of the PBO (pages 21-23) contains a list of species and critical habitat in the action area, their status, and the Service's determination of the effects of the Federal action analyzed in the PBO.

The Service determined in the Tier 1 PBO that the Federal action, including the continued operation of existing and certain new water-related activities, may adversely affect but would not likely 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, western prairie fringed orchid, and bald eagle (*Haliaeetus leucocephalus)* in the central and lower Platte River. Further, the Service determined that the Federal action, including the continued operation of existing and certain new water-related activities, was not likely to destroy or adversely modify designated critical habitat for the whooping crane. The bald eagle was subsequently removed from the Federal endangered species list on August 8, 2007. Bald eagles continue to be protected by the Bald and Golden Eagle Protection Act and the Migratory Bird Treaty Act. For more information on bald eagles, see the Service's webpage at: http://www.fws.gov/midwest/eagle/recovery/biologue.html

The Service also determined that the PBO Federal action would have no effect to the endangered Eskimo curlew. There has not been a confirmed sighting since 1926 and this species is believed to be extirpated in Nebraska. Lastly, the Service determined that the PBO Federal action,

including the continued operation of existing and certain new water-related activities, was not likely to adversely affect the endangered American burying beetle.

The effects of the continued operation of existing and certain new water-related activities on the remaining species and critical habitats listed in Table II-1 of the PBO were beyond the scope of the PBO and were not considered.

SCOPE OF THE TIER 2 BIOLOGICAL OPINION

The proposed Project is a component of "the continued operation of existing and certain new water-related activities" needing a Federal action evaluated in the Tier 1 PBO, and flow-related effects of the Federal action are consistent with the scope and the determination of effects in the June 16, 2006 PBO. Because Denver Water has elected to participate in the PRRIP, ESA compliance for flow-related effects to federally listed endangered and threatened species and designated critical habitat from the Project is provided to the extent described in the Tier 1 PBO.

This biological opinion applies to the Project's effects to listed endangered and threatened species and designated critical habitat as described in the PBO for the first thirteen years of the PRRIP (i.e., the anticipated duration of the first PRRIP increment).

STATUS OF THE SPECIES/CRITICAL HABITAT

Species descriptions, life histories, population dynamics, status and distributions are fully described in the PBO on pages 76-156 for the whooping crane, interior least tern, piping plover, pallid sturgeon and western prairie fringed orchid, and whooping crane critical habitat and are hereby incorporated by reference. Climate change is not explicitly identified in the Tier 1 PBO as a potential threat, except for whooping crane and whooping crane critical habitat.

The terms "climate" and "climate change" are defined by the Intergovernmental Panel on Climate Change (IPCC). "Climate" refers to the mean and variability of different types of weather conditions over time, with 30 years being a typical period for such measurements, although shorter or longer periods also may be used (IPCC 2007, p. 78). The term "climate change" thus refers to a change in the mean or variability of one or more measures of climate (e.g., temperature or precipitation) that persists for an extended period, typically decades or longer, whether the change is due to natural variability, human activity, or both (IPCC 2007, p. 78). Various types of changes in climate can have direct or indirect effects on species. These effects may be positive, neutral, or negative and they may change over time, depending on the species and other relevant considerations, such as the effects of interactions of climate with other variables (e.g., habitat fragmentation) (IPCC 2007, pp. 8–14, 18–19).

Changes in temperature and/or precipitation patters will influence the status of the Platte River system. These changes may contribute to threats that have already been identified and discussed for interior least tern, piping plover, pallid sturgeon and western prairie fringed orchid in the Tier 1 PBO.

Since issuance of the Service's PBO, there have been no substantial changes in the status of the target species/critical habitat other than the bald eagle delisting previously mentioned.

ENVIRONMENTAL BASELINE

The Environmental Baseline sections for the Platte River and for the whooping crane, interior least tern, piping plover, pallid sturgeon and western prairie fringed orchid, and whooping crane critical habitat are described on pages 157 to 219 of the Tier 1 PBO, and are hereby incorporated by reference. The status of the Platte River system includes a discussion on the impact of climate change. The Tier 1 BO concluded that although climate change has been identified as a contributor to the baseline, human activities are the biggest influence on the baseline. For the duration of this consultation (13 years), human activities are expected to continue to be the major influence on the functionality of the action area for listed species and critical habitat.

Since issuance of the Tier 1 PBO, there have been no substantial changes in the status of the target species/critical habitat in the action area other than the bald eagle delisting.

EFFECTS OF THE ACTION

The Tier 1 BO did not address climate change in the Effects of the Action section, as human activities (upstream storage, diversion, and distribution of the river's flow) are the most important drivers of change that adversely affect species habitat in the action area. Since issuance of the Tier 1 PBO, our analyses under the ESA include consideration of ongoing and projected changes in climate. In our analyses, we used our expert judgment to weigh relevant information, including uncertainty, in our consideration of various aspects of climate change. Actions that are undertaken to improve the river ecology and habitats for listed species not only address human activities, but also contribute to listed species and whooping crane critical habitat resiliency to climate change.

Based on our analysis of the information provided in your revised BA for the Project, the Service concludes that the proposed Federal action will result in a combination of existing and new depletions to the Platte River system above the Loup River confluence. These depletions are associated with changes in operation of Denver Water's *entire* water collection system. The total average annual South Platte River diversions at the demand level of 363,000 acre-feet per year would be 202,880 acre-feet; 184,428 acre-feet per year of river diversions and 18,452 acre-feet per year of evaporation from Denver Water's east slope reservoirs. The proposed Moffat Project would result in additional average annual diversions of 3,460 acre-feet from the South Platte River. This includes 2,879 acre-feet per year of new diversions and 581 acre-feet per year of additional reservoir evaporation. Overall, average annual South Platte River diversions and reservoir evaporation associated with Denver Water's past, existing, and future demand levels since implementation of the PRRIP would be 48,767 acre-feet. To meet the average annual demand of 363,000 acre-feet, Denver Water would use its entire South Platte collection system and associated water rights. The water is decreed for municipal and industrial purposes through multiple water right decrees (see Enclosure 1, Denver Water Tabulation of Water Rights).

Under the proposed action, the total average annual depletions to the South Platte River associated with an average annual demand of 363,000 acre-feet would be 113,969 acre-feet; 90,517 acre-feet per year from the South Platte, 18,452 acre-feet per year of evaporative losses from the east slope reservoirs, and 5,000 acre-feet per year from the "5K water deliveries", which is the amount of reusable water that Denver Water leases for municipal purposes with the Denver metropolitan area (the South Adams County Water and Sanitation District has contracted for this water). The average annual increase in South Platte River depletions associated with the Moffat Project would be 1,413 acre-feet; however, if evaporative losses are included, the amount would increase to 1,994 acre-feet per year. Overall, average annual depletions to the South Platte associated with Denver Water's past, existing, and future demand levels since implementation of the PRRIP would be 30,111 acre-feet.

As both an existing and new water-related activity, we have determined that the flow-related adverse effects of the Project are consistent with those evaluated in the Tier 1 PBO for the whooping crane, interior least tern, piping plover, pallid sturgeon, western prairie fringed orchid, and whooping crane critical habitat, and these effects on flows are being addressed in conformance with the Colorado plan for future depletions of the PRRIP.

CUMULATIVE EFFECTS

Cumulative effects include the effects of future state, local, or private (non-Federal) actions that are reasonably certain to occur in the action area considered in this biological opinion. A non-Federal action is "reasonably certain" to occur if the action requires the approval of a state or local resource or land-control agency, such agencies have approved the action, and the Project is ready to proceed. Other indicators which may also support such a "reasonably certain to occur" determination include whether: a) the Project sponsors provide assurance that the action will proceed; b) contracting has been initiated; c) state or local planning agencies indicate that grant of authority for the action is imminent; or d) where historic data have demonstrated an established trend, that trend may be forecast into the future as reasonably certain to occur. These indicators must show more than the possibility that the non-Federal project will occur; they must demonstrate with reasonable certainty that it will occur. Future Federal actions that are unrelated to the proposed action are not considered in this section because they require separate consultation pursuant to section 7 of the ESA and would be consulted on at a later time.

Cumulative effects are described on pages 194 to 300 of the Tier 1 PBO, and are hereby incorporated by reference. Since the Tier 1 PBO was issued, there have been no substantial changes in the status of cumulative effects.

CONCLUSION

The Service concludes that the proposed Moffat Collection System Project is consistent with the Tier 1 PBO for effects to listed species and critical habitat addressed in the Tier 1 PBO. After reviewing site specific information, including: 1) 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

their 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.

INCIDENTAL TAKE STATEMENT

Section 9 of the ESA and federal regulations pursuant to section 4(d) of the ESA prohibits the take of endangered and threatened species without special exemption. Take is defined as to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture or collect, or to attempt to engage in any such conduct, and applies to individual members of a listed species. Harm is further defined by the Service to include significant habitat modification or degradation that results in death or injury to listed wildlife by significantly impairing essential behavioral patterns, including breeding, feeding, or sheltering. Harass is defined by the Service as intentional or negligent actions that create the likelihood of injury to listed wildlife by annoying it to such an extent as to significantly disrupt normal behavior patterns which include, but are not limited to, breeding, feeding or sheltering. Incidental take is defined as take that is incidental to, and not the purpose of, the carrying out of an otherwise lawful activity. Under the terms of section 7(b)(4) and section 7(o)(2), taking that is incidental to and not intended as part of the agency action is not considered to be prohibited taking under ESA provided that such taking is in compliance with the terms and conditions of this incidental take statement.

Sections 7(b)(4) and 7(o)(2) of the ESA do not apply to the incidental take of federally listed plant species (e.g., Colorado butterfly plant (*Gaura neomexicana coloradensis*), Ute ladies'-tresses orchid, and western prairie fringed orchid). However, limited protection of listed plants from take is provided to the extent that ESA prohibits the removal and reduction to possession of federally listed endangered plants or the malicious damage of such plants on non-Federal areas in violation of state law or regulation or in the course of any violation of a state criminal trespass law. Such laws vary from state to state.

The Department of the Interior, acting through the Service and Reclamation, is implementing all pertinent reasonable and prudent measures and implementing terms and conditions stipulated in the Tier 1 PBO incidental take statement (pages 309-326 of the PBO) which will minimize the anticipated incidental take of federally listed species. In instances where the amount or extent of incidental take outlined in the Tier 1 PBO is exceeded, or the amount or extent of incidental take for other listed species is exceeded, the specific PRRIP action(s) causing such take shall be subject to reinitiation expeditiously.

CONSERVATION RECOMMENDATIONS

Section 7(a) (1) of ESA directs Federal agencies to utilize their authorities to further the purposes of ESA by carrying out conservation programs for the benefit of endangered and threatened

species. Conservation recommendations are discretionary agency activities to minimize or avoid adverse effects of an action on listed species or critical habitat, to help implement recovery plans, or to develop information. Conservation recommendations are provided in the PBO (pages 328-329) and are hereby incorporated by reference.

REINITIATION AND CLOSING STATEMENT

Any person or entity undertaking a water-related activity that receives Federal funding or a Federal authorization and which relies on the PRRIP as a component of its ESA compliance in section 7 consultation must agree: (1) to the inclusion in its Federal funding or authorization documents of reopening authority, including reopening authority to accommodate reinitiation upon the circumstances described in section IV.E. of the program document, which addresses program termination; and (2) to request appropriate amendments from the Federal action agency as needed to conform its funding or authorization to any PRRIP adjustments negotiated among the three states and the Department of the Interior, including specifically new requirements, if any, at the end of the first PRRIP increment and any subsequent PRRIP increments. The Service believes that the PRRIP should not provide ESA compliance for any water-related activity for which the funding or authorization document does not conform to any PRRIP adjustments (Program Document, section VI).

Reinitiation of consultation over the Moffat Collection System Project will not be required at the end of the first 13-years of the PRRIP provided a subsequent program increment or first increment program extension is adopted pursuant to appropriate ESA and NEPA compliance procedures, and, for a subsequent increment, the effects of the Project are covered under a Tier 1 PBO for that increment addressing continued operation of previously consulted-on water-related activities.

COLORADO RIVER

A Recovery Implementation Program for Endangered Fish Species in the Upper Colorado River Basin was initiated on January 22, 1988. The Recovery Program was intended to be the reasonable and prudent alternative to avoid jeopardy to the endangered fishes by depletions from the Upper Colorado River Basin. In order to further define and clarify the process in the Recovery Program, a section 7 agreement was implemented on October 15, 1993, by the Recovery Program participants. Incorporated into this agreement is a Recovery Implementation Program Recovery Action Plan (RIPRAP) which identifies actions currently believed to be required to recover the endangered fishes in the most expeditious manner.

On December 20, 1999, the Service issued the final programmatic biological opinion for Reclamation's Operations and Depletions, Other Depletions, and Funding and Implementation of Recovery Program actions in the Upper Colorado River above the Confluence with the Gunnison River (this document is available for viewing at the following internet address: coloradoriverrecovery.org/). The Service has determined that projects that fit under the umbrella of the Colorado River PBO would avoid the likelihood of jeopardy and/or adverse modification

of critical habitat for depletion impacts. The Service has determined that if the subject Project meets the following criteria, then it fits under the umbrella of the Colorado River PBO.

1. The Project depletes water from the Colorado River above the confluence with the Gunnison River.

2. The applicant signs the Recovery Agreement. The Service and Denver Water signed a Recovery Agreement on February 14, 2000 (copy enclosed). This Recovery Agreement was signed for a consultation with the Federal Energy Regulatory Commission on the relicense of the Gross Reservoir Hydroelectric Project, biological opinion number ES/GJ-6-CO-00-F-024, dated October 12, 2000.

3. The Moffat Collection System Project will deplete an additional 17,376 acre-feet of water from the upper Colorado River basin. In order to rely on the Recovery Program to offset the subject depletions, the Project sponsors will make a one-time monetary contribution for water depletions greater than 100 acre-feet to help fund their share of the costs of recovery actions. The one-time payment is calculated by multiplying the Project's average annual new depletion (17,376 acre-feet) by the water user's share of Recovery Program costs (the charge) in effect at the time payment is made. For Fiscal Year 2014 (October 1, 2013, to September 30,2014), the charge is $ $20.24 per acre-foot for the average annual depletion which equals a total contribution of $351,690.24 for this Project's share of the Recovery Program costs. This amount will be adjusted annually for inflation on October 1 of each year based on the Consumer Price Index. Ten percent of the total contribution($35,169.02), or total payment, will be provided to the Service's designated agent, the National Fish and Wildlife Foundation (Foundation), at the time of issuance of the Federal approvals from the Corps. The balance will be due at the time the construction commences. The payment will be included by the Corps as a permit stipulation. The funds will be used for acquisition of water rights (or directly-related activities) to meet the in stream flow needs of the endangered fishes; or to support other recovery activities for the endangered fishes described in the RIPRAP. All payments should be made to the Foundation.

National Fish and Wildlife Foundation
Donna McNamara, Finance Department
1133 15th Street, NW, Suite 1100
Washington, D.C. 20005

Each payment is to be accompanied by a cover letter that identifies the project and biological opinion number ES/GJ-6-CO-99-F-033-CP126 that requires the payment, the amount of payment enclosed, and check number. A copy of the cover letter and a copy of the payment check shall be sent to the Service office issuing this biological opinion. The cover letter also shall identify the name and address of the payor, the name and address of the Federal agency responsible for authorizing the project, and the address of the Service office conducting the section 7 consultation. This information will be used by the Foundation to notify the payor, the lead Federal agency, and the Service that payment has been received. The Foundation is to send notices of receipt to these entities within 5 working days of its receipt of payment.

4. The Service requests that the Corps retain discretionary Federal authority for the subject Project in case reinitiation of section 7 consultation is required.

REINITIATION NOTICE

This concludes formal consultation on the subject action. As provided in 50 CFR 402.16, reinitiation of formal consultation is required where discretionary Federal agency involvement or control over the action has been retained (or is authorized by law) and under the following conditions:

1. The amount or extent of take specified in the incidental take statement for the Colorado River PBO is exceeded. The Service has determined that no incidental take, including harm, is anticipated to occur as a result of the depletions contemplated in this opinion because of the implementation of recovery actions. The implementation of the recovery actions contained in the Colorado River PBO will further decrease the likelihood of any take caused by depletion impacts.

2. New information reveals effects of the action that may affect listed species or critical habitat in a manner or to an extent not considered in the Colorado River PBO. In preparing the Colorado River PBO, the Service describes the positive and negative effects of the action it anticipates and considered in the section of the opinion entitled "Effects of the Action." New information would include, but is not limited to, not achieving a "positive response" or a significant decline in population, as described in Appendix D of the Colorado River PBO. Significant decline shall mean a decline in excess of normal variations in population (Appendix D). The current population estimate of adult Colorado pikeminnow in the Colorado River is 600 individuals, with a confidence interval of ± 250. Therefore, with the criteria established in Appendix D, a negative population response would trigger reinitiation if the population declined to 350 adults. The Recovery Program has developed recovery goals for the four endangered fishes. If a population meets or exceeds the numeric goal for that species, it will be considered to exhibit a positive response. The Service retains the authority to determine whether a significant decline in population has occurred, but will consult with the Recovery Program's Biology Committee prior to making its determination. In the event of a significant population decline, the Service is to first rely on the Recovery Program to take actions to correct the decline. If nonflow recovery actions have not been implemented, the Service will assess the impacts of not completing these actions prior to reexamining any flow related issues.

New information would also include the lack of a positive population response by the year 2015 or when new depletions reach 50,000 acre-feet/year. According to the criteria outlined in Appendix D of the Colorado River PBO, a positive response would require the adult Colorado pikeminnow population estimate to be 1,100 individuals (±250) in the Colorado River (Rifle, Colorado to the confluence with the Green River). When the population estimate increases above 1,100, a new population baseline is established at the higher population level.

3. The Recovery Action Plan actions listed as part of the proposed action in the Colorado River PBO are not implemented within the required time frames. This would be considered a change in the action subject to consultation; section 7 regulations (50 CFR 402.16 (c)) state that reinitiation of consultation is required if the identified action is subsequently modified in a manner that causes an effect to the listed species or critical habitat that was not considered in the biological opinion. The Recovery Action Plan is an adaptive management plan because additional information, changing priorities, and the development of the States' entitlement may require modification of the Recovery Action Plan. Therefore, the Recovery Action Plan is reviewed annually and updated and changed when necessary and the required time frames include changes in timing approved by means of the normal procedures of the Recovery Program, as explained in the description of the proposed action. In 2003 and every 2 years thereafter, for the life of the Recovery Program, the Service and Recovery Program will review implementation of the Recovery Action Plan actions to determine timely compliance with applicable schedules.

4. The Service lists new species or designates new or additional critical habitat, where the level or pattern of depletions covered under the Colorado River PBO may have an adverse impact on the newly listed species or habitat. If the species or habitat may be adversely affected by depletions, the Service will reinitiate consultation on the Colorado River PBO as required by its section 7 regulations. The Service will first determine whether the Recovery Program can avoid such impact or can be amended to avoid the likelihood of jeopardy and/or adverse modification of critical habitat for such depletion impacts. If the Recovery Program can avoid the likelihood of jeopardy and/or adverse modification of critical habitat no additional recovery actions for individual projects would be required, if the avoidance actions are already included in the Recovery Action Plan. If the Recovery Program is not likely to avoid the likelihood of jeopardy and/or adverse modification of critical habitat then the Service will reinitiate consultation and develop reasonable and prudent alternatives.

For purposes of any future reinitiation of consultation, depletions have been divided into two categories:

CATEGORY 1

A. Existing depletions, both Federal and non-Federal as described in the project description, from the Upper Colorado River Basin above the confluence with the Gunnison River that had actually occurred on or before September 30, 1995 (average annual depletion of approximately 1 million acre-feet/year);

B. Depletions associated with the total 154,645 acre-feet/year volume of Green Mountain Reservoir, including power pool (which includes but is not limited to all of the 20,000 acre-feet contract pool and historic user's pool), the Colorado Big-Thompson replacement pool; and

C. Depletions associated with Ruedi Reservoir including Round I sales of 7,850 acre-feet, Round II sales of 6,135 acre-feet/year as discussed in the Service's biological opinion to Reclamation dated May 26, 1995, and as amended on January 6, 1999, and the Fryingpan

Arkansas Project replacement pool as governed by the operating principles for Ruedi Reservoir but excluding 21,650 acre-feet of the marketable yield.

Category 1 depletions shall remain as Category 1 depletions regardless of any subsequent change, exchange, or abandonment of the water rights resulting in such depletions. Category 1 depletions associated with existing facilities may be transferred to other facilities and remain in Category 1 so long as there is no increase in the amount of total depletions attributable to existing depletions. However, section 7 consultation is still required for Category 1 depletion projects when a new Federal action occurs which may affect endangered species except as provided by the criteria established for individual consultation under the umbrella of the Colorado River PBO. Reinitiation of this consultation will be required if the water users fail to provide 10,825 acre-feet/year on a permanent basis.

CATEGORY 2

Category 2 is defined as all new depletions up to 120,000 acre-feet/year, this includes all depletions not included in Category 1 that occur after 1995 regardless of whether section 7 consultation has been completed. This category is further divided into two 60,000 acre-feet/year blocks of depletions.

The recovery actions are intended to avoid the likelihood of jeopardy and/or adverse modification of critical habitat and to result in a positive response as described in Appendix D of the Colorado River PBO for both 60,000 acre-feet blocks of depletions in Category 2. However, prior to depletions occurring in the second block, the Service will review the Recovery Program's progress and adequacy of the species response to the Recovery Action Plan actions. According to the criteria outlined in Appendix D, a positive response would require the adult Colorado pikeminnow population estimate to be maintained at approximately 1,100 individuals in the Colorado River (Rifle, Colorado to the confluence with the Green River), unless the criteria in Appendix D is changed because of new information. If the adult Colorado pikeminnow population is maintained at approximately 1,100 adults or whatever is determined to be the recovery goal in the Colorado River, a new population baseline would be established to determine a positive or negative population response.

When population estimates for wild adult humpback chub are finalized, they will also be used to determine population response. As outlined in Appendix D, Colorado pikeminnow and humpback chub population estimates will serve as surrogates for razorback sucker and bonytail to assess the status of their populations for 10 years. Recovery goals for all four species were completed August 1, 2002. If a population meets or exceeds the numeric goal for that species, it will be considered to exhibit a positive response. However, short of reaching a specific recovery goal, trends in certain population indices provide an interim assessment of a species' progress toward recovery. This review will begin when actual depletion levels from the first depletion block reach 50,000 acre-feet/year or the year 2015, whichever comes first.

Calculation of actual depletions is to be accomplished using Cameo gage records and State Division of Water Resources data (Appendix B of the Colorado River PBO). The review will

include a determination if all the recovery actions have been satisfactorily completed, that all ongoing recovery actions are continuing, and the status of the endangered fish species. If it is determined that the recovery actions have all been completed and the status of all four endangered fish species has improved (based on criteria in Appendix D), then the Service intends that the Colorado River PBO would remain in effect for new depletions up to 120,000 acre-feet/year (total of both 60,000 acre-feet blocks of Category 2 depletions).

Monitoring, as explained in Appendix D, will be ongoing to determine if a population estimate of 1,100 (± one confidence interval) adult Colorado pikeminnow is maintained. If it is not maintained, this would be considered new information and section 7 would have to be reinitiated. Population baselines will be adjusted as population estimates change. If the adult Colorado pikeminnow population estimates increase, a new population baseline will be established to determine a positive or negative population response. If the population estimate for Colorado pikeminnow in the year 2015 is greater than 1,100 adults, then the higher number will be used to establish a new population baseline. These numeric values may be revised as new information becomes available. Revisions will be made to Appendix D as needed.

If the 50,000 acre-foot or 2015 review indicates that either the recovery actions have not been completed or the status of all four fish species has not sufficiently improved, the Service intends to reinitiate consultation on the Recovery Program to specify additional measures to be taken by the Recovery Program to avoid the likelihood of jeopardy and/or adverse modification of critical habitat for depletions associated with the second 60,000 acre-feet/year block. Any additional measures will be evaluated every 5 years. If other measures are determined by the Service or the Recovery Program to be needed for recovery prior to the review, they can be added to the Recovery Action Plan according to standard procedures, outlined in that plan. If the Recovery Program is unable to complete those actions which the Service has determined to be required for the second 60,000 acre-feet/year, consultation on projects with a Federal nexus may be reinitiated in accordance with Endangered Species Act regulations and this opinion's reinitiation requirements. The Service may also reinitiate consultation on the Recovery Program if fish populations do not improve according to the criteria in Appendix D or if any positive response achieved prior to the 50,000 acre-foot or the year 2015 is not maintained. Once a positive response is achieved, failure to maintain it will be considered a negative response.

If the Service reinitiates consultation, it will first provide information on the status of the species and recommendations for improving population numbers to the Recovery Program. The Service will reinitiate consultation with individual projects only if the Recovery Program does not implement recovery actions to improve the status of the listed fish species. The Service will reinitiate consultation first on Category 2 projects and second on Category 1 projects. The Service will only reinitiate consultations on Category 1 depletions if Category 2 depletion impacts are offset to the full extent of the capability of the covered projects as determined by the Service and the likelihood of jeopardy to the listed fishes and/or adverse modification of critical habitat still cannot be avoided. The Service intends to reinitiate consultations simultaneously on all depletions within the applicable category.

This concludes formal consultation on the actions outlined in the August 14, 2012, and August 14, 2013, requests from the Corps. As provided in 50 CFR § 402.16, reinitiation of formal consultation is required where discretionary Federal agency involvement or control over the action has been retained (or is authorized by law) and if: 1) the amount or extent of incidental take is exceeded; 2) new information reveals effects of the agency action that may affect listed species or critical habitat in a manner or to an extent not considered in this opinion; 3) the agency action is subsequently modified in a manner that causes an effect to the listed species or critical habitat not considered in this opinion; or 4) a new species is listed or critical habitat designated that may be affected by the action. In instances where the amount or extent of incidental take is exceeded, the specific action(s) causing such take shall be subject to reinitiation expeditiously.

Requests for reinitiation, or questions regarding reinitiation should be directed to the Service's Colorado Field Office at the above address. If you have any questions regarding this consultation, please contact this office at (303) 236-4773.

Sincerely,

Susan C. Linner
Colorado Field Supervisor

Enclosure 1: Denver Water Tabulation of Water Rights
Enclosure 2: [Colorado River] Recovery Agreement

cc: FWS/WTR, Denver (T. Econopouly)(w/Enclosure 1)
FWS/ES, Nebraska (M. Rabbe)
FWS/ES, Grand Junction (w/Enclosure 2)
FWS/UCREFRP, Denver (w/Enclosure 2)
FWS/ES, Lakewood (S. Vana-Miller)(w/Enclosure 1)

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Platte River Recovery Implementation Program document. 2006.

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U.S. Fish and Wildlife Service. 2006. Biological opinion on the Platte River Recovery Implementation Program.

Enclosure 1

Denver Water Tabulation of Water Rights

Division/District and Name of Structure or Water Right Name	Source	Appropriation Date	Decree Date	Amount	Case No.
Water Division No. 1					
Lawn Irrigation Return Flow Project	Reusable return flow	N/A	5/15/2012	200 cfs	2004CW121
District No. 2 Storage Rights					
Denver Water/South Adams County Reservoir Water Supply Project					
North Reservoir Complex - Fill and refill	South Platte River	12/28/2001	8/8/2011	17,747 AF	2001CW286
South Reservoir Complex - Fill and refill	South Platte River	12/28/2001	8/8/2011	2,400 AF	2001CW286
South Reservoir Complex - Enlargement	South Platte River	12/29/2009	Pending	1,129 AF	2009CW264
Lupton Lakes Storage Complex - Fill and refill	South Platte River	7/12/2006	Pending	11,400 AF	2007CW327
District No. 2 Direct Flow Rights					
DIA Wetlands	South Platte River inlb flow	4/1/2000	12/27/2006	22.15 AF	2003CW129
DIA Wetlands	Box Elder Creek	7/1/2000	1/14/2004	16.32 AF	2003CW386
Gravel Pit Exchange	South Platte River	8/31/2009	Pending	80 cfs	2009CW123
Recycling Plant Intake	South Platte River	12/28/2001	12/6/2011	70.0 cfs	2001CW287
Recycling Plant Intake exch. and subst.	South Platte River	12/28/2001	12/6/2011	70.0 cfs	2001CW287
SK Direct Flow Right	South Platte River	12/28/2001	10/25/2011	5,000 AF	2001CW285
Farmers and Gardeners Ditch	South Platte River	03/15/1863	9/29/2012	13.72 cfs ▪	2003CW84
1st Enlargement	South Platte River	04/01/1874	9/29/2012	10.28 cfs ▪	2003CW84
District No. 6 Storage Rights					
Gross Reservoir					
Storage Right	South Boulder Creek	5/10/1945	9/28/1953	113,078 AF ▫	C.A.12111
Refill Right	South Boulder Creek	5/10/1945	9/28/1953	113,078 AF ▫	C.A.12111
Ralston Creek Reservoir					
Priority 31 Storage Right	South Boulder Creek	1/1/1930	9/28/1953	11,000 AF	C.A.12111
Priority 31 Storage Right	South Boulder Creek	10/31/1939	9/28/1953	1,758 AF	C.A.12111
District No. 6 Direct Flow Rights					
South Boulder Diversion Conduit	South Boulder Creek	1/1/1930	9/28/1953	451 cfs	C.A.12111
District No. 7 Storage Rights					
Ralston Creek Reservoir	Ralston Creek	1/1/1930	10/18/1978	7,394 AF	W-7561
Ralston Creek Reservoir	Ralston Creek	1/1/1930	10/18/1978	3,382 AF ▫	W-7561
Long Lake No. 1 (Upper)	Ralston Creek	05/29/1873	10/04/1864	890 AF	Not given
Long Lake No. 1 (Upper)	Ralston Creek	6/6/1909	5/13/1936	567 AF	C.A. 60052
Long Lake No. 1 (Upper)	Ralston Creek	6/6/1909	5/13/1936	72 AF ▫	C.A. 60052
Long Lake No. 2 (Lower)	Ralston Creek	6/6/1909	5/13/1936	392 AF	C.A. 60052
District No. 7 Direct Flow Rights					
Ralston Creek Intake	Ralston Creek	1/1/1930	10/18/1978	212 cfs	W-7561
Ralston Creek Intake	Ralston Creek	1/1/1930	10/18/1978	148 cfs ▫	W-7561
District No. 8 Storage Rights					
Chatfield Reservoir					
Storage	South Platte River	12/28/1977	8/29/1984	27,428 AF ▫	W-8783-77
Exchange	South Platte River	12/28/1977	8/29/1984	27,428 AF ▫	W-8783-77

Division/District and Name of Structure or Water Right Name	Source	Appropriation Date	Decree Date	Amount	Case No.
Marston Reservoir	South Platte River	4/1/1911	6/16/1930	18,791 AF	C.A. 807
Platte Canyon Reservoir	South Platte River	6/3/1930	6/16/1930	905 AF	C.A. 807
Strontia Springs Reservoir	South Platte River	3/31/1953	12/19/1983	7,700 AF	80CW408
Refill Right	South Platte River	3/31/1952	2/28/1990	7,864 AF	87CW118
District No. 8 Direct Flow Rights					
Brown Ditch	South Platte River	11/30/1883	4/17/1900	8.75 cfs	86CW614
Cherry Creek Park Well No. 1	Cherry Creek Alluvium	7/25/1989	10/24/2008	98 gpm	89CW196
Cherry Creek Galleries (Well G)	Cherry Creek	05/01/1887	6/16/1930	14.00 cfs	C.A. 807
Cherry Creek Galleries (Well G) Aug. Plan	Cherry Creek	05/01/1887	10/5/2001	2.45 cfs	2003CW734
Exchange within Denver Water System	South Platte River	7/1/1971	6/18/1972	3,000 cfs o.e.	C.A. 3636
Four Mile House Well No. 1	Cherry Creek Alluvium	8/31/1948	6/29/1983	0.44 cfs	83CW950
Snell Ditch	Cherry Creek Alluvium	9/30/1871	10/30/1901	3.1 gpm	86CW335
Success Ditch	Cherry Creek Alluvium	4/30/1872	10/30/1901	180 gpm	86CW339
Garfield Park Well No. 1	Cherry Creek Alluvium	6/20/1991	3/7/2007	525 gpm	93CW110
Success Ditch	Cherry Creek Alluvium	4/30/1872	3/7/2007	325 gpm	86CW335
Glendale Wells No. 1, 2, 3, and 4	Cherry Creek Alluvium	3/6/1959	5/18/1972	8 cfs	C.A. 3635
Glendale Well No. 5	Cherry Creek Alluvium	7/15/1976	5/18/1972	1.1 cfs	C.A. 3635
Glendale LFH-1	Hornbl, Laramie F, Fox Hills Aquifer	NA	2/28/1990	141 AF	88CW14 49
Glendale Well UA-1	Hornbl, Upper Arapahoe Aquifer	NA	6/23/1991	32.41 AF	90CW117
Glendale Well LA-1	Hornbl, Lower Arapahoe Aquifer	NA	6/23/1991	17.34 AF	90CW117
Home Rights - Overfills at Conduit No. 20 Hicks and Strontia Springs Reservoir/Conduit No. 26 Foothills Tunnel and other points					
Transfer from Platte Canyon Ditch	South Platte River	01/20/1881	1/16/1984	4.70 cfs	80CW039
Transfer from Platte Canyon Ditch	South Platte River	12/30/1883	1/16/1984	24.50 cfs	80CW039
Transfer from Platte Canyon Ditch	South Platte River	12/30/1884	1/16/1984	17.30 cfs	80CW039
Transfer from Gordon Ditch	South Platte River	05/01/1868	1/16/1984	8.70 cfs	80CW039
City Right	South Platte River	12/20/1870	1/16/1984	3.00 cfs	80CW039
City Right	South Platte River	12/31/1874	1/16/1984	3.50 cfs	80CW039
Transfer from Wood Ditch	South Platte River	06/01/1875	1/16/1984	2.31 cfs	80CW039
City Right	South Platte River	09/15/1878	1/16/1984	13.32 cfs	80CW039
Transfer from Wood Ditch	South Platte River	06/01/1879	1/16/1984	3.66 cfs	80CW039
City Right	South Platte River	09/30/1880	1/16/1984	10.00 cfs	80CW039
Transfer from Love and Raynor Ditch	South Platte River	05/09/1881	1/16/1984	1.71 cfs	80CW039
Transfer from Little Channel Ditch	South Platte River	05/01/1882	1/16/1984	0.48 cfs	80CW039
Transfer from Bland Ditch	South Platte River	06/20/1885	1/16/1984	2.04 cfs	80CW039
City Right	South Platte River	10/01/1889	1/16/1984	12.38 cfs	80CW039
City Right	South Platte River	09/01/1892	1/16/1984	25.33 cfs	80CW039
City Right	South Platte River	05/01/1899	1/16/1984	38.08 cfs	80CW039
City Right	South Platte River	12/31/1910	1/16/1984	42.75 cfs	80CW039
Foothills Tunnel and Conduit No. 26	South Platte River	3/2/1982	12/19/1983	774 cfs o.e.	80CW408
John F. Kennedy Golf Course Wells and Plan for Augmentation					
John F. Kennedy Well 1 (51766-F)	Cherry Creek	1/13/1961	6/24/1985	1.23 cfs	81CW401
John F. Kennedy Well 2 (51768-F)	Cherry Creek	2/13/1961	6/24/1985	1.53 cfs	81CW401
John F. Kennedy Well 3 (42360-F)	Cherry Creek	3/27/1970	12/4/2008	700 gpm	93CW033
JFK Augmentation Plan	Cherry Creek	1/13/1961	6/20/1986	535 AF	81CW405
JFK Golf Course Expansion	Cherry Creek	3/27/1970	12/4/2008	371 AF	93CW033

Division/District and Name of Structure or Water Right Name	Source	Appropriation Date	Decree Date	Amount	Case No.
Last Chance Ditch No. 2					
Priority No. 14	South Platte River	12/30/1863	2/24/1903	1.14 cfs	92CW014
Priority No. 19	South Platte River	12/30/1865	2/24/1903	0.2 cfs	92CW014
Priority No. 39	South Platte River	03/03/1868	2/24/1903	8.54 cfs	92CW014
Nevada Ditch (Excludes amounts diverted at Farnell Lane Wells)					
Priority No. 4	South Platte River	08/30/1861	8/17/1993	13.06 cfs	92CW172
Priority No. 18	South Platte River	12/30/1865	8/17/1993	18.0 cfs	92CW172
Overland Golf Course Pumping Part and Plan for Augmentation					
Emerson Ditch	South Platte River	05/01/1860	4/26/1993	0.34 cfs	91CW028
Overland Golf Course Pumping Part	South Platte River	5/8/1968	2/17/1993	2.35 cfs	91CW028
Plan for Augmentation	South Platte River		5/24/1993	2.35 cfs	91CW028
District No. 9 Storage Rights					
Harriman Reservoir Priority No. 1 Original Cons.	Bear & Turkey Creeks	05/01/1873	02/04/1884	19.00 cfs	C.A. 8803
Harriman Reservoir Priority No. 2 1st Enlargement	Bear & Turkey Creeks	04/01/1915	02/04/1884	37.58 cfs	C.A. 8803
Weston Reservoir	Bear Creek	08/15/1892	8/24/1935	10,195 AF	C.A. 91471
Soda Lakes Reservoirs					
Priority No. 5 (Domestic)	Bear Creek	07/15/1893	8/24/1935	508 AF	C.A. 91471
District No. 9 Direct Flow Rights					
Harriman (Arnold) Ditch					
Priority No. 21	Turkey Creek	04/15/1908	5/13/1998	5.7 cfs	91CW103
Priority No. 23	Bear Creek	03/16/1909	5/13/1998	4.21 cfs	91CW103
Priority No. 25	Bear Creek	05/01/1871	5/13/1998	13.54 cfs	91CW103
Priority No. 30	Bear Creek	03/01/1882	5/13/1998	9.82 cfs	91CW103
Priority No. 67 Domestic (irrigation season)	Bear Creek	12/05/1889	8/24/1935	25.30 cfs	CA. 91471
Priority No. 68 Domestic (non-irrigation season)	Bear Creek	12/05/1889	8/24/1935	148.35 cfs	CA. 91471
Priority No. 69 Domestic (irrigation season)	Turkey Creek	02/01/1890	8/24/1935	4.605 cfs	CA. 91471
Priority No. 70 Domestic (non-irrigation season)	Turkey Creek	03/01/1890	8/24/1935	30.87 cfs	CA. 91471
Priority No. 77 Domestic (irrigation season)	Bear Creek	08/15/1892	8/24/1935	19.16 cfs	CA. 91471
Priority No. 78 Domestic (irrigation season)	Turkey Creek	08/15/1892	8/24/1935	4.50 cfs	CA. 91471
Priority No. 79 Domestic (non-irrigation season)	Bear Creek	08/15/1892	8/24/1935	78.66 cfs	CA. 91471
Priority No. 80 Domestic (non-irrigation season)	Turkey Creek	08/15/1892	8/24/1935	18.03 cfs	CA. 91471
Hodgson Ditch					
Priority No. 3	Bear Creek	04/01/1861	5/13/1998	1.55 cfs	91CW102
Priority No. 8	Bear Creek	05/01/1862	5/13/1998	0.30 cfs	91CW102
Parsee-Union Ditch					
Priority No. 5	Bear Creek	12/10/1861	5/13/1998	4.98 cfs	91CW100
Priority No. 11	Bear Creek	05/01/1862	5/13/1998	3.29 cfs	91CW100
Priority No. 15	Bear Creek	03/15/1865	5/13/1998	10.09 cfs	91CW100
Harriman Lateral Ditch	Bear Creek	10/01/1865	5/13/1998	6.98 cfs	91CW100
Emerson Ditch	Bear Creek	12/23/1860	5/13/1998	19.67 cfs	91CW100
Weitas Ditch					
Priority No. 4	Bear Creek	12/01/1861	5/13/1998	4.46 cfs	91CW109
Priority No. 8	Turkey Creek	04/16/1862	5/13/1998	1.03 cfs	91CW109
Priority No. 14	Bear Creek	10/31/1864	5/13/1998	9.21 cfs	91CW109
Priority No. 16	Bear Creek	04/01/1865	5/13/1998	4.15 cfs	91CW109

Division/District and Name of Structure or Water Right Name	Source	Appropriation Date	Decree Date	Amount	Case No.
District No. 23 Storage Rights					
Antero Reservoir	South Fork South Platte River	10/31/1907	3/31/1913	65,464 AF	C.A. 1678
Antero Reservoir Refill Right	South Fork South Platte River	12/31/1979	3/24/1953	20,046 AF	C.A. 3286
Antero Reservoir Exchange Right	South Fork South Platte River	4/1/1935	3/24/1953	20,046 AF	C.A. 3286
Eleven Mile Canon Reservoir	South Fork South Platte River	7/10/1979	3/24/1953	81,917 AF	C.A. 3286
1st Enlargement	South Fork South Platte River	10/7/1957	4/27/1972	13,862 AF	C.A. 3701
Refill Right	South Fork South Platte River	12/31/1979	3/24/1953	81,917 AF	C.A. 3286
Exchange Right	South Fork South Platte River	4/1/1935	3/24/1953	81,917 AF	C.A. 3286
Cheesman Reservoir	South Fork South Platte River	06/27/1883	3/22/1913	30,891 AF	C.A. 1634
1st Enlargement	South Fork South Platte River	09/24/1893	3/22/1913	48,373 AF	C.A. 1634
Refill Right	South Fork South Platte River	12/31/1979	3/24/1953	79,064 AF	C.A. 3286
Exchange Right	South Fork South Platte River	4/1/1935	3/24/1953	79,064 AF	C.A. 3286
District No. 23 Direct Flow Rights					
Beer's Ditch	Four Mile Creek, South Platte R.	09/15/1861	7/19/1979	1.0 cfs	W-7729-74
Four Mile No. 9 Ditch	Four Mile Creek, South Platte R.	08/01/1868	11/12/1969	7.00 cfs	80CW313
Water Division No. 5					
Exchange Rights from Williams Fork Reservoir to:					
Dillon Reservoir and Roberts Tunnel	Blue R. Snake R. Ten Mile Cr.	6/24/1946	3/10/1952	252,878 AF	Cons. 2182, 5016, 5017
Dillon Reservoir and Roberts Tunnel	Blue R. Snake R. Ten Mile Cr.	6/24/1946	6/30/1972	93,637 AF	C.A. 1430
Dillon Reservoir and Roberts Tunnel	Blue R. Snake R. Ten Mile Cr.	6/24/1946	11/10/1967	96,822 AF	86CW382
Fraser River Diversion Project	Fraser River and tributaries	11/10/1930	11/5/1937	93,637 AF	C.A. 657
Williams Fork Diversion Project	Williams Fork River & tributaries	11/10/1930	11/5/1937	93,637 AF	C.A. 657
Cabin Meadow Creek System	Cabin Meadow Creek and trib.	7/2/1932	10/22/1953	70 cfs/5,100 AF	Cons. 2182, 5016, 5017
District No. 36 Storage Rights					
Dillon Reservoir	Blue R. Snake R. Ten Mile Cr.	6/24/1946	3/10/1952	252,878 AF	C.A. 1806
Refill Right	Blue R. Snake R. Ten Mile Cr.	1/1/1965	6/23/1999	15,000 AF c/s	87CW376
District No. 36 Direct Flow Rights					
Blue River Diversion Project	Blue R. Snake R. Ten Mile Cr.	6/24/1946	3/10/1952	788 cfs c/s	Cons. 2182, 5016, 5017
District No. 51 Storage Rights					
Williams Fork Reservoir	Williams Fork River	11/10/1935	11/5/1937	93,637 AF	C.A. 657
Williams Fork Reservoir	Williams Fork River	10/31/1960	5/30/1972	93,637 AF	C.A. 1430
Meadow Creek Reservoir	Meadow Creek	7/2/1932	11/5/1937	5,100 AF	C.A. 657
Meadow Creek - Moffat Tunnel Collection Sys.	Meadow Creek	4/30/1953	5/30/1972	5,100 AF	C.A. 1430
Ribbon Mountain Reservoir	Muddy Creek	12/31/1987	12/30/1993	72,907 AF	87CW283
Enlargement	Muddy Creek	11/1/1992	12/30/1998	2,400 AF	95CW291
Substitution	Muddy Creek		3/31/1998	200 cfs	91CW253
Emergency Exchange	Muddy Creek	3/31/1987	3/31/1998	200 cfs	91CW253
District No. 51 Direct Flow Rights					
Fraser River Diversion Project	Fraser River & Tributaries	7/4/1921	11/5/1937	1280 c/s c	C.A. 657

Division/District and Name of Structure or Water Right Name	Source	Appropriation Date	Decree Date	Amount	Case No.
	Cabin - Meadow Creek System				
	Hamilton-Cabin Creek Ditch	Fraser River Tributaries	7/31/1933	11/30/1937	75 cfs	C.A. 657
	Extension and Enlargement Hamilton Ditch	Fraser River Tributaries	7/7/1933	11/30/1937	25 cfs	C.A. 657
	Moffat Tunnel Collection System	Fraser River & Tributaries	8/30/1903	5/30/1972	100.0 cfs	C.A. 1430
	Williams Fork Diversion Project	Williams Fork River & Trbs	7/4/1921	11/5/1937	245 cfs	C.A. 657

NOTE: The information contained in this Attachment A is for descriptive purposes only, and is not intended to represent an interpretation, admission or modification of any of the water right decrees.

A.Pending claim in Case No. 2006CW265 to make 654 cfs absolute.

B.Pending claim in Case No. 2007CW031 to make 245 cfs absolute. Conditional water rights associated with the enlargement and extension of the Williams Fork Diversion Project will be developed cooperatively with West Slope Entities pursuant to Article I.C.3.

C.Reuse of return flows generated by diversion and importation through the Moffat and Jones Pass Tunnels of this water right are subject to the ruling in Case No. 81CW405, Water Division No. 1 if the agreement or ruling is modified such that Denver Water is able to reuse these return flows, such return flows shall be subject to Articles I and II.

D.Water right is partially absolute and partially conditional.

E.Pending application in Case No. 2008CW125 to make 672 cfs absolute.

F.Pending application in Case No.2003CW039 to make 141,712 acre feet absolute. Under the decree in 87CW376, Denver may import through the Roberts Tunnel 150,000 af over any consecutive 10 year period.

G.By agreement dated July 21, 1992, Denver Water has 40% interest in Wolford Mountain Reservoir capacity and water right. Although Wolford Mountain Reservoir water is not physically used on the east slope, Denver Water operates an intergrated system and Wolford Mountain enables it to more fully use its Colorado River basin supplies.

H.Amount is for portion of conditional right, which when added to the amount absolute, equals the physical capacity of the facility.

I.Applies to only that portion of the water right needed to satisfy Denver Water's obligations under Articles I.A and I.B.

J.Water provided to Denver Water pursuant to the terms of paragraph 9 of the May 15, 2003 Memorandum of Agreement Regarding Colorado Springs Substitution Operations shall be used for the same uses and location as the rights listed on this Attachment A.

K.May be used to satisfy Denver Water's obligations stemming from the ruling in Case No. 81CW405 in addition to use under Articles I.A and I.B.

L.Denver Water's interests in this water right are the set forth in an agreement dated August 31, 1995 between Denver Water, City of Englewood and Climax Molib's Company

Enclosure 2

RECOVERY AGREEMENT

This RECOVERY AGREEMENT is entered into this 14th day of February, 2000, by and between the United States Fish and Wildlife Service (USFWS) and the City and County of Denver, acting by and through its Board of Water Commissioners (Denver).

WHEREAS, in 1988 the Secretary of Interior, the Governors of Wyoming, Colorado and Utah, and the Administrator of the Western Area Power Administration signed a Cooperative Agreement to implement the Recovery Implementation Program for Endangered Fish Species in the Upper Colorado River Basin (Recovery Program); and

WHEREAS, the Recovery Program is intended to recover the endangered fish while providing for water development in the Upper Basin to proceed in compliance with state law, interstate compacts and the Endangered Species Act; and

WHEREAS, the Colorado Water Congress has passed a resolution supporting the Recovery Program; and

WHEREAS, on December 20, 1999, USFWS issued a programmatic biological opinion (1999 Opinion) concluding that implementation of specified elements of the Recovery Action Plan (Recovery Elements), along with existing and a specified amount of new depletions, are not likely to jeopardize the continued existence of the endangered fish or adversely modify their critical habitat in the Colorado River subbasin within Colorado, exclusive of the Gunnison River subbasin; and

WHEREAS, the 1999 Opinion in the section entitled "Reinitiation Notice" divided depletions into Category 1 or Category 2 for reinitiation purposes; and

WHEREAS, Denver is the owner and operator of water diversion projects and facilities decreed for diversion from the Fraser, Williams Fork, Blue, Eagle and Colorado Rivers and their tributaries (Water Facilities). The operation of Denver's Water Facilities includes using water stored in Williams Fork and Wolford Mountain Reservoirs for substitution and in Williams Fork Reservoir for exchange purposes. Denver's Water Facilities cause or will cause depletions to the Colorado River subbasin within Colorado, exclusive of the Gunnison River subbasin; and

WHEREAS, Denver desires certainty that its depletions can occur consistent with Section 7 and Section 9 of the Endangered Species Act (ESA); and

WHEREAS, USFWS desires a commitment from Denver to the Recovery Program so that the Program can actually be implemented to recover the endangered fish and to carry out the Recovery Elements.

NOW THEREFORE, Denver and USFWS agree as follows:

1. USFWS agrees that implementation of the Recovery Elements specified in the 1999 Opinion will avoid the likelihood of jeopardy and adverse modification under Section 7 of the ESA, for depletion impacts caused by Denver's Water Facilities. Any consultations under Section 7 regarding Denver's Water Facilities' depletions are to be governed by the provisions of the 1999 Opinion. USFWS agrees that, except as provided in the 1999 Opinion, no other measure or action shall be required or imposed on Denver's Water Facilities to comply with Section 7 or Section 9 of the ESA with regard to its Water Facilities' depletion impacts or other impacts covered by the 1999 Opinion. Denver is entitled to rely on this Agreement in making the commitment described in paragraph 2.

2. Denver agrees not to take any action which would probably prevent the implementation of the Recovery Elements. To the extent implementing the Recovery Elements requires active cooperation by Denver, Denver agrees to take reasonable actions required to implement those Recovery Elements. Denver will not be required to take any action that would violate its decrees or the statutory authorization for its Water Facilities, or any applicable limits on Denver's legal authority. Denver will not be precluded from undertaking good faith negotiations over terms and conditions applicable to implementation of the Recovery Elements.

3. If USFWS believes that Denver has violated paragraph 2 of this Recovery Agreement, USFWS shall notify both Denver and the Management Committee of the Recovery Program. Denver and the Management Committee shall have a reasonable opportunity to comment to USFWS regarding the existence of a violation and to recommend remedies, if appropriate. USFWS will consider the comments of Denver and the comments and recommendations of the Management Committee, but retains the authority to determine the existence of a violation. If USFWS reasonably determines that a violation has occurred and will not be remedied by Denver despite an opportunity to do so, the USFWS may request reinitiation of consultation on Water Facilities without reinitiating other consultations as would otherwise be required by the "Reinitiation Notice" section of the 1999 Opinion. In that event the Water Facilities' depletions would be excluded from the depletions covered by 1999 Opinion and the protection provided by the Incidental Take Statement.

4. Nothing in this Recovery Agreement shall be deemed to affect the authorized purposes of Denver's Water Facilities or USFWS' statutory authority.

5. The signing of this Recovery Agreement does not constitute any admission by Denver regarding the application of the ESA to the depletions of Denver's Water Facilities. The signing of this Recovery Agreement does not constitute any agreement by either party as to whether the flow recommendations for the 15-Mile Reach described in the 1999 Opinion are biologically or hydrologically necessary to recover the endangered fish.

6. This Recovery Agreement shall be in effect until one of the following occurs:

a. USFWS removes the listed species in the Upper Colorado River Basin from the endangered or threatened species list and determines that the Recovery Elements are no longer needed to prevent the species from being relisted under the ESA; or

b. USFWS determines that the Recovery Elements are no longer needed to recover or offset the likelihood of jeopardy to the listed species in the Upper Colorado River Basin; or

c. USFWS declares that the endangered fish in the Upper Colorado River Basin are extinct; or

d. Federal legislation is passed or federal regulatory action is taken that negates the need for [or eliminates] the Recovery Program.

7. Denver may withdraw from this Recovery Agreement upon written notice to USFWS. If Denver withdraws, USFWS may request reinitiation of consultation on Water Facilities without reinitiating other consultations as would otherwise be required by the "Reinitiation Notice" section of the 1999 Opinion.

H. J. Barry, III
Manager, Denver Water

2/14/2000
Date

Regional Director, Region 6
U.S. Fish and Wildlife Service

2/14/00
Date

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Ecological Services
Colorado Field Office
P.O. Box 25486, DFC (65412)
Denver, Colorado 80225-0486

IN REPLY REFER TO:
TAILS: 06E24000-2015-F-0985

JAN 29 2016

Mr. Kiel Downing
Denver Regulatory Office
U.S. Army Corps of Engineers
9307 S. Wadsworth Boulevard
Littleton, Colorado 80218-6901

Dear Mr. Downing:

This final biological opinion is provided in response to your September 1, 2015, request to initiate formal consultation pursuant to section 7(a)(2) of the Endangered Species Act of 1973, as amended (ESA). Your Biological Assessment (BA) described the potential effects of the Gross Reservoir Environmental Pool Project (Project), Corps File No. NWO-2002-80762-DEN, on federally listed species and designated critical habitat associated with the Platte River in Nebraska. According to your September 1, 2015 letter, a separate BA is being prepared to address potential effects to greenback cutthroat trout (*Oncorhynchus clarkii stomias*) streams on the Western Slope affected by the proposed Gross Reservoir enlargement; therefore, this opinion will not address greenback cutthroat trout or any other listed species in Colorado.

The Federal Action reviewed in this biological opinion is the operation of the Gross Environment Pool (GEP) in Gross Reservoir, which is located on South Boulder Creek about five miles southwest of Boulder in Boulder County, Colorado. The proposed GEP is a mitigation and enhancement component of Denver Water's Gross Reservoir Enlargement Project. Two Intergovernmental Agreements (IGAs) between the cities of Boulder and Lafayette and the cities of Boulder, Denver, and Lafayette established the GEP as a dedicated 5,000 acre-foot "environmental pool" within an enlarged Gross Reservoir for permanent, year-round storage of Lafayette and Boulder's water supplies. Upon completion of the reservoir's enlargement and pursuant to the IGAs, Boulder and Lafayette, as co-applicants (or Applicants) for the Project, propose to jointly fill the GEP; up to 2,000 acre-feet (af) of water for Boulder and up to 3,000 af for Lafayette. The water would then be released, as needed, to provide year-round instream flows in South Boulder Creek downstream of Gross Reservoir. Evaporative losses from the GEP and any stream losses associated with instream flow releases would be absorbed by the Applicants' water rights stored in the GEP. Boulder and Lafayette are also applying jointly for a new junior water right on South Boulder Creek that would allow water diverted from the creek to be stored in the GEP.

BACKGROUND

On June 16, 2006, the U.S. Fish and Wildlife Service (Service) issued a programmatic biological opinion (PBO) for the Platte River Recovery Implementation Program (PRRIP) and water-related activities[1] affecting flow volume and timing in the central and lower reaches of the Platte River in Nebraska. The action area for the PBO included the Platte River basin upstream of the confluence with the Loup River in Nebraska, and the mainstem of the Platte River downstream of the Loup River confluence.

The Federal Action addressed by the PBO included the following:

> 1) funding and implementation of the PRRIP for 13 years, the anticipated first stage of the PRRIP; and
>
> 2) continued operation of existing and certain new water-related activities[2] including, but not limited to, Reclamation and Service projects that are (or may become) dependent on the PRRIP for ESA compliance during the first 13-year stage of the PRRIP for their effects on the target species[3], whooping crane critical habitat, and other federally listed species[4] that rely on central and lower Platte River habitats.

The PBO established a two-tiered consultation process for future federal actions on existing and new water-related activities subject to section 7(a)(2) of the ESA, with issuance of the PBO being Tier 1 and all subsequent site-specific project analyses constituting Tier 2 consultations covered by the PBO. Under this tiered consultation process, the Service will produce tiered biological opinions when it is determined that future federal actions are "likely to adversely affect" federally listed species and/or designated critical habitat in the PRRIP action area and the project is covered by the PBO. If necessary, the biological opinions will also consider potential effects to other listed species and critical habitat affected by the

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[1] The term "water-related activities" means activities and aspects of activities which (1) occur in the Platte River basin upstream of the confluence of the Loup River with the Platte River; and (2) may affect Platte River flow quantity or timing, including, but not limited to, water diversion, storage and use activities, and land use activities. Changes in temperature and sediment transport will be considered impacts of a "water related activity" to the extent that such changes are caused by activities affecting flow quantity or timing. Impacts of "water related activities" do not include those components of land use activities or discharges of pollutants that do not affect flow quantity or timing.

[2] "Existing water related activities" include surface water or hydrologically connected groundwater activities implemented on or before July 1, 1997. "New water-related activities" include new surface water or hydrologically connected groundwater activities including both new projects and expansion of existing projects, both those subject to and not subject to section 7(a)(2) of the ESA, which may affect the quantity or timing of water reaching the associated habitats and which are implemented after July 1, 1997.

[3] The "target species" are the endangered whooping crane (*Grus americana*), the interior least tern (*Sternula antillarum*), the pallid sturgeon (*Scaphirynchus albus*), and the threatened northern Great Plains population of the piping plover (*Charadrius melodus*).

[4] Other listed species present in the central and lower Platte River include the western prairie fringed orchid (*Platanthera praeclara*) and the American burying beetle (*Nicrophorus americanus*).

Federal Action that were not within the scope of the Tier 1 PBO (e.g., direct or indirect effects to listed species occurring outside of the PRRIP action area).

Although the water depletive effects of this Federal Action to central and lower Platte River species have been addressed in the PBO, when "no effect" or "may affect" but "not likely to adversely affect" determinations are made on a site-specific basis for the target species in Nebraska, the Service will review these determinations and provide written concurrence where appropriate. Upon receipt of written concurrence, section 7(a)(2) consultation will be considered completed for those federal actions.

Water-related activities requiring federal approval will be reviewed by the Service to determine if: (1) those activities comply with the definition of existing water-related activities and/or (2) proposed new water-related activities are covered by the applicable state's or the federal depletions plan. The Service has determined that the Project meets the above criteria and, therefore, this Tier 2 biological opinion regarding the effects of the Project on the target species, whooping crane critical habitat, and the western prairie fringed orchid in the central and lower Platte River can tier from the June 16, 2006 PBO.

CONSULTATION HISTORY

Table II-1 of the PBO (pages 21-23) contains a list of species and critical habitat in the action area, their status, and the Service's determination of the effects of the Federal Action analyzed in the PBO.

The Service determined in the Tier 1 PBO that the Federal Action, including the continued operation of existing and certain new water-related activities, may adversely affect but would not likely 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, western prairie fringed orchid, and bald eagle in the central and lower Platte River. Further, the Service determined that the Federal Action, including the continued operation of existing and certain new water-related activities, was not likely to destroy or adversely modify designated critical habitat for the whooping crane. The bald eagle was subsequently removed from the federal endangered species list on August 8, 2007. Bald eagles continue to be protected by the Bald and Golden Eagle Protection Act and the Migratory Bird Treaty Act. For more information on bald eagles, see the Service's webpage at: http://www.fws.gov/midwest/eagle/recovery/biologue.html

The Service also determined that the PBO Federal Action would have no effect to the endangered Eskimo curlew (*Numenius borealis*). There has not been a confirmed sighting since 1926 and this species is believed to be extirpated in Nebraska. Lastly, the Service determined that the PBO Federal Action, including the continued operation of existing and certain new water-related activities, was not likely to adversely affect the endangered American burying beetle.

The effects of the continued operation of existing and certain new water-related activities on the remaining species and critical habitats listed in Table II-1 of the PBO were beyond the scope of the PBO and were not considered.

The Service has reviewed the information contained in the BA, which was received in this office on September 2, 2015. Clarifying project information was requested and received in this office via email on January 13 and 15, 2016. Earlier, we reviewed a draft of the BA and Supplemental Worksheet, which were received in this office on August 25, 2015.

The Service issued a biological opinion on December 6, 2013 (BO# ES/LK- 6-CO-13-F-006, GJ-6-CO-99-F-033-CP126; TAILS# 06E24000-2012-F-0747), that addressed past, existing, and future diversions for Denver Water's entire system including Gross Reservoir; however, it did not address water depletions associated with the GEP. As described in the December 6, 2013, BO, Denver Water proposed raising Gross Reservoir's existing dam an additional 6 feet to create an additional 5,000 af of permanent, year-round storage for Boulder and Lafayette. This opinion will address water depletions associated with the cities' proposed joint filling of the GEP.

In your September 1, 2015, letter you also stated that a separate BA is being prepared to address potential effects to greenback cutthroat trout streams on the Western Slope affected by the Gross Reservoir enlargement because waters in the South Boulder Creek drainage are not considered recovery waters for the trout. Therefore, this opinion does not address the greenback cutthroat trout.

We concur with your determinations of "likely to adversely affect" for the endangered whooping crane, interior least tern, pallid sturgeon, the threatened northern Great Plains population of the piping plover, and the western prairie fringed orchid in the central and lower Platte River in Nebraska. We also concur with your determination of "likely to adversely affect" for designated whooping crane critical habitat in Nebraska.

The Service concurs with your determination of "not likely to adversely affect" for the endangered American burying beetle in Nebraska.

SCOPE OF THE TIER 2 BIOLOGICAL OPINION

The proposed Project is a component of "the continued operation of existing and certain new water-related activities" needing a Federal Action evaluated in the Tier 1 PBO, and flow-related effects of the Federal Action are consistent with the scope and the determination of effects in the June 16, 2006 PBO. Because Boulder and Lafayette have elected to participate in the PRRIP, ESA compliance for flow-related effects to federally listed endangered and threatened species and designated critical habitat from the Project is provided to the extent described in the Tier 1 PBO.

This biological opinion applies to the Project's effects to listed endangered and threatened species and designated critical habitat as described in the PBO for the first thirteen years of the PRRIP (i.e., the anticipated duration of the first PRRIP increment).

DESCRIPTION OF THE FEDERAL ACTION

The Federal Action is the Applicants' need for Section 404 authorization from the Corps to operate the GEP within Gross Reservoir, which is located on South Boulder Creek about five miles southwest of Boulder in Boulder County. The proposed GEP is a mitigation and enhancement component of Denver Water's Gross Reservoir Enlargement Project. Two IGAs between Boulder and Lafayette and Boulder, Denver, and Lafayette established the GEP as a dedicated 5,000 acre-foot "environmental pool" within an enlarged Gross Reservoir for permanent, year-round storage of Lafayette and Boulder's water supplies. Pursuant to the IGAs, Boulder is generally responsible for filling up to 2,000 af to meet instream flow targets, primarily during the summer season; and Lafayette is generally responsible for filling up to 3,000 af of the GEP to meet instream flow targets, primarily during the winter season. Upon completion of the reservoir's enlargement, the two cities would try to fill the GEP every year (all 5,000 af) and approximately 2,500 af would be left in storage for dry years. However, operation of the GEP would allow for carry-over storage; the average annual storage and release would be about 2,500 af, but in dry years less water would be stored and the GEP carryover storage would be drawn down. This is similar to how Gross Reservoir operates now and in the future; during wet and average years, water is stored for use during dry years.

The purpose of the GEP is to provide year-round instream flows in South Boulder Creek below the reservoir. Boulder and Lafayette's water would be released from the GEP only as needed to meet instream flow targets in two segments on South Boulder Creek: Gross Reservoir to South Boulder Road (Upper Segment) and South Boulder Road to the confluence with Boulder Creek (Lower Segment) (see Table 1 in the September 1, 2015, BA). After this first, non-consumptive instream flow use, the water would be recaptured or re-diverted for other decreed, beneficial purposes by the cities. More specifically, water released from the GEP by Lafayette could be re-diverted at Lafayette's existing diversion points on South Boulder Creek at South Boulder road and on Boulder Creek at 75th Street. Similarly, water released by Boulder from the GEP could be re-diverted for storage at Wittemyer Ponds, delivered to downstream irrigators and/or exchanged to Boulder's municipal points of diversion for either direct municipal use or for storage. The IGAs also allow for the release of water from the GEP in the event of an emergency with either Boulder or Lafayette's municipal water supply systems.

The GEP would be filled exclusively by the cities; no water rights owned by Denver Water would be used to fill the GEP. Current decreed uses under the cities' existing rights include, but are not limited to, municipal use, augmentation, irrigation, and return flow replacement. The GEP would be assessed evaporation based on its pro-rata share of total Gross Reservoir evaporation losses, amounting to an average of 25 af per year. Evaporative losses from the

GEP and any stream losses associated with instream flow releases would be absorbed by the Applicants' water rights stored in the GEP.

Both evaporation and the continuing consumptive use of water by the Applicants following instream flow use with the Project constitute existing depletions. Boulder and Lafayette are also applying jointly for a new junior water right on South Boulder Creek that would allow water diverted from the creek to be stored in the GEP. This biological opinion does not in any way authorize the Applicants to fill/store water in the GEP within Gross Reservoir.

STATUS OF THE SPECIES / CRITICAL HABITAT

Species descriptions, life histories, population dynamics, status and distributions are fully described in the PBO on pages 76-156 for the whooping crane, interior least tern, piping plover, pallid sturgeon and western prairie fringed orchid, and whooping crane critical habitat and are hereby incorporated by reference. Climate change is not explicitly identified in the Tier 1 PBO as a potential threat, except for whooping crane and whooping crane critical habitat.

The terms "climate" and "climate change" are defined by the Intergovernmental Panel on Climate Change (IPCC). "Climate" refers to the mean and variability of different types of weather conditions over time, with 30 years being a typical period for such measurements, although shorter or longer periods also may be used (IPCC 2007, p. 78). The term "climate change" thus refers to a change in the mean or variability of one or more measures of climate (e.g., temperature or precipitation) that persists for an extended period, typically decades or longer, whether the change is due to natural variability, human activity, or both (IPCC 2007, p. 78). Various types of changes in climate can have direct or indirect effects on species. These effects may be positive, neutral, or negative and they may change over time, depending on the species and other relevant considerations, such as the effects of interactions of climate with other variables (e.g., habitat fragmentation)(IPCC 2007, pp. 8–14, 18–19).

Changes in temperature and/or precipitation patterns will influence the status of the Platte River system. These changes may contribute to threats that have already been identified and discussed for interior least tern, piping plover, pallid sturgeon and western prairie fringed orchid in the Tier I PBO.

Since issuance of the Service's PBO, there have been no substantial changes in the status of the target species/critical habitat other than the bald eagle delisting previously mentioned.

ENVIRONMENTAL BASELINE

The Environmental Baseline sections for the Platte River and for the whooping crane, interior least tern, piping plover, pallid sturgeon and western prairie fringed orchid, and whooping crane critical habitat are described on pages 157 to 219 of the Tier 1 PBO, and are hereby incorporated by reference. The status of the Platte River system includes a discussion on the

impact of climate change. The Tier 1 BO concluded that although climate change has been identified as a contributor to the baseline, human activities are the biggest influence on the baseline. For the first 13-year stage of the PRRIP, human activities are expected to continue to be the major influence on the functionality of the action area for listed species and critical habitat.

Since issuance of the Tier 1 PBO, there have been no substantial changes in the status of the target species/critical habitat in the action area other than the bald eagle delisting.

EFFECTS OF THE ACTION

The Tier 1 BO did not address climate change in the Effects of the Action section, as human activities (upstream storage, diversion, and distribution of the river's flow) are the most important drivers of change that adversely affect species habitat in the action area. Since issuance of the Tier 1 PBO, our analyses under the ESA include consideration of ongoing and projected changes in climate. In our analyses, we used our expert judgment to weigh relevant information, including uncertainty, in our consideration of various aspects of climate change. Actions that are undertaken to improve the river ecology and habitats for listed species not only address human activities, but also contribute to listed species and whooping crane critical habitat resiliency to climate change.

Based on our analysis of the information provided in your BA for the Project, the Service concludes that the proposed Federal Action will result in a combination of existing and new depletions to the Platte River system above the Loup River confluence. These depletions are associated with average annual evaporative losses of 25 af from the GEP; up to 5,000 af of water to fill the pool every year; and approximately 2,500 af left in storage in the GEP for dry years. Thus, the typical annual storage and release will be 2,500 af in non-drought years. Boulder is responsible for filling up to 2,000 af and Lafayette is responsible for filling up to 3,000 af. The new joint water right on South Boulder Creek will allow water to be stored in the GEP.

As both an existing and new water-related activity, we have determined that the flow-related adverse effects of the Project are consistent with those evaluated in the Tier 1 PBO for the whooping crane, interior least tern, piping plover, pallid sturgeon, western prairie fringed orchid, and whooping crane critical habitat, and these effects on flows are being addressed in conformance with the Colorado Plan for Future Depletions of the PRRIP.

CUMULATIVE EFFECTS

Cumulative effects include the effects of future State, local, or private (non-federal) actions that are reasonably certain to occur in the action area considered in this biological opinion. A non-federal action is "reasonably certain" to occur if the action requires the approval of a State or local resource or land-control agency, such agencies have approved the action, and the project is ready to proceed. Other indicators which may also support such a "reasonably

certain to occur" determination include whether: a) the project sponsors provide assurance that the action will proceed; b) contracting has been initiated; c) State or local planning agencies indicate that grant of authority for the action is imminent; or d) where historic data have demonstrated an established trend, that trend may be forecast into the future as reasonably certain to occur. These indicators must show more than the possibility that the non-federal project will occur; they must demonstrate with reasonable certainty that it will occur. Future federal actions that are unrelated to the proposed action are not considered in this section because they require separate consultation pursuant to section 7 of the ESA and would be consulted on at a later time.

Cumulative effects are described on pages 194 to 300 of the Tier 1 PBO, and are hereby incorporated by reference. Since the Tier 1 PBO was issued, there have been no substantial changes in the status of cumulative effects.

CONCLUSION

The Service concludes that the proposed Gross Reservoir Environmental Pool Project is consistent with the Tier 1 PBO for effects to listed species and critical habitat addressed in the Tier 1 PBO. After reviewing site specific information, including: 1) 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 their 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. However, this opinion does not in any way authorize the Applicants to fill/store water in the GEP within Gross Reservoir.

INCIDENTAL TAKE STATEMENT

Section 9 of the ESA and federal regulations pursuant to section 4(d) of the ESA prohibit the take of endangered and threatened species without special exemption. Take is defined as to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture or collect, or to attempt to engage in any such conduct, and applies to individual members of a listed species. Harm is further defined by the Service to include significant habitat modification or degradation that results in death or injury to listed wildlife by significantly impairing essential behavioral patterns, including breeding, feeding, or sheltering. Harass is defined by the Service as intentional or negligent actions that create the likelihood of injury to listed wildlife by annoying it to such an extent as to significantly disrupt normal behavior patterns which include, but are not limited to, breeding, feeding or sheltering. Incidental take is defined as take that is incidental to, and not the purpose of, the carrying out of an otherwise lawful activity. Under the terms of

section 7(b)(4) and section 7(o)(2), taking that is incidental to and not intended as part of the agency action is not considered to be prohibited taking under ESA provided that such taking is in compliance with the terms and conditions of this incidental take statement.

Sections 7(b)(4) and 7(o)(2) of ESA do not apply to the incidental take of federally listed plant species (e.g., Colorado butterfly plant, Ute ladies'-tresses orchid, and western prairie fringed orchid). However, limited protection of listed plants from take is provided to the extent that ESA prohibits the removal and reduction to possession of federally listed endangered plants or the malicious damage of such plants on non-federal areas in violation of state law or regulation or in the course of any violation of a state criminal trespass law. Such laws vary from state to state.

The Department of the Interior, acting through the Service and Bureau of Reclamation, is implementing all pertinent Reasonable and Prudent Measures and implementing Terms and Conditions stipulated in the Tier 1 PBO Incidental Take Statement (pages 309-326 of the PBO) which will minimize the anticipated incidental take of federally listed species. In instances where the amount or extent of incidental take outlined in the Tier 1 PBO is exceeded, or the amount or extent of incidental take for other listed species is exceeded, the specific PRRIP action(s) causing such take shall be subject to reinitiation expeditiously.

CONSERVATION RECOMMENDATIONS

Section 7(a)(1) of ESA directs federal agencies to utilize their authorities to further the purposes of ESA by carrying out conservation programs for the benefit of endangered and threatened species. Conservation recommendations are discretionary agency activities to minimize or avoid adverse effects of an action on listed species or critical habitat, to help implement recovery plans, or to develop information. Conservation recommendations are provided in the PBO (pages 328-329) and are hereby incorporated by reference.

REINITIATION AND CLOSING STATEMENT

Any person or entity undertaking a water-related activity that receives federal funding or a federal authorization and which relies on the PRRIP as a component of its ESA compliance in section 7 consultation must agree: (1) to the inclusion in its federal funding or authorization documents of reopening authority, including reopening authority to accommodate reinitiation upon the circumstances described in Section IV.E. of the Program document, which addresses program termination; and (2) to request appropriate amendments from the Federal Action agency as needed to conform its funding or authorization to any PRRIP adjustments negotiated among the three states and the Department of the Interior, including specifically new requirements, if any, at the end of the first PRRIP increment and any subsequent PRRIP increments. The Service believes that the PRRIP should not provide ESA compliance for any water-related activity for which the funding or authorization document does not conform to any PRRIP adjustments (Program Document, section VI).

Reinitiation of consultation over the Gross Reservoir Environmental Pool Project will not be required at the end of the first 13-years of the PRRIP provided a subsequent Program increment or first increment Program extension is adopted pursuant to appropriate ESA and NEPA compliance procedures, and, for a subsequent increment, the effects of the Project are covered under a Tier 1 PBO for that increment addressing continued operation of previously consulted-on water-related activities.

This concludes formal consultation on the actions outlined in the September 1, 2015, request from the Corps. As provided in 50 CFR § 402.16, reinitiation of formal consultation is required where discretionary federal agency involvement or control over the action has been retained (or is authorized by law) and if: 1) the amount or extent of incidental take is exceeded; 2) new information reveals effects of the agency action that may affect listed species or critical habitat in a manner or to an extent not considered in this opinion; 3) the agency action is subsequently modified in a manner that causes an effect to the listed species or critical habitat not considered in this opinion; or 4) a new species is listed or critical habitat designated that may be affected by the action. In instances where the amount or extent of incidental take is exceeded, the specific action(s) causing such take shall be subject to reinitiation expeditiously.

Requests for reinitiation, or questions regarding reinitiation should be directed to the Service's Colorado Field Office at the above address. If you have any questions regarding this consultation, please contact Sandy Vana-Miller of my staff at (303) 236-4748.

Sincerely,

Drue L. DeBerry
Acting Colorado Field Supervisor

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United States Department of the Interior

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JUN 17 2016

Mr. Kiel Downing, Chief
Denver Regulatory Office
Corps of Engineers, Omaha District
9307 South Wadsworth Boulevard
Littleton, Colorado 80128-6901

Dear Mr. Downing,

This letter transmits the U.S. Fish and Wildlife Service's (Service or USFWS) biological opinion concerning the Corps of Engineers' (Corps) proposed issuance of a Clean Water Act Section 404 Individual Permit to Denver Water for the proposed Moffat Collection System Project (Moffat Project) in Boulder, Grand, Gilpin, and Clear Creek counties, Colorado, in accordance with section 7 of the Endangered Species Act of 1973 (ESA), as amended (16 U.S.C. 1531 et seq.).

The proposed project involves expansion of Gross Reservoir in Boulder County and increased stream diversions in the Colorado River and Platte River systems. The Applicant is the City and County of Denver, acting by and through its Board of Water Commissioners (Denver Water).

In this biological opinion, the USFWS finds that the proposed action will not jeopardize the continued existence of the green lineage cutthroat trout (*Onchorhynchus clarkii* spp). Critical habitat has not been designated for the green lineage cutthroat trout; therefore, none will be affected.

We base this biological opinion on the Corps' biological assessment (BA)(Corps 2015) for the green lineage cutthroat trout and request for reinitiation of consultation for the Moffat Collection System Project (Corps File NWO-2002-80762-DEN), which we received on December 3, 2015, as well as any subsequent clarifying correspondence, including electronic mail received from the Corps. This consultation addresses both the impacts of Denver Water's continuation of existing operations (Current Conditions) and future operations (Full Use and the Moffat Project).

Impacts relating to water depletions in the Colorado River and the Platte River were addressed through a separate section 7 consultation, in which a biological opinion was issued on December 6, 2013, that replaced the previous 2009 depletions biological opinion.

CONSULTATION HISTORY

The following is a summary of previous consultations for the Moffat Project, as provided in the BA (Corps 2015):

- **February 20, 2009** – Corps requested initiation of formal consultation for the Moffat Project and provided two BAs: one for federally-listed species in Nebraska, and one for all other federally listed species potentially affected by the Moffat Project.
- **July 31, 2009** – USFWS issued a biological opinion. The USFWS concurred with the determination of "not likely to adversely affect" the greenback cutthroat trout. This 2009 biological opinion was subsequently replaced by a biological opinion issued on December 6, 2013.
- ¼**October 30, 2009** – Corps issued the Draft EIS.
- ¼**February 16, 2010** – USFWS submitted a letter commenting on the Draft Environmental Impact Statement (DEIS) recommending re-initiation of consultation regarding a number of issues, including the Moffat Project's effects to greenback cutthroat trout.
- ¼**August 14, 2012** – Corps requested re-initiation of formal consultation for the Moffat Project and provided a supplemental BA for greenback cutthroat trout and Preble's meadow jumping mouse.
- ¼**November 20, 2012** – USFWS submitted a letter not concurring with the Corps' effects determination for greenback cutthroat trout. The USFWS stated that the Moffat Project will result in take of greenback cutthroat trout due to increased entrainment at the diversions and therefore reinitiated formal consultation.
- ¼**December 20, 2012** – USFWS sent an email to the Corps (Scott Franklin) indicating that the USFWS would provide two biological opinions for the Moffat Project: one to address depletions to the Platte and Colorado rivers and impacts to Preble's meadow jumping mouse, and a second to address impacts to greenback cutthroat trout.
- ¼**August 14, 2013** – Corps submitted a separate revised BA addressing depletions in the Colorado River and Platte River systems and Preble's meadow jumping mouse.
- ¼**December 6, 2013** – Colorado River and Platte River depletions biological opinion was issued by the USFWS, which replaced the 2009 biological opinion.
- ¼**April 25, 2014** – Corps issued the FEIS.
- ¼**September 1, 2015** – Corps submitted a Platte River depletions BA for the Gross Reservoir Environmental Pool. The Applicants are the cities of Boulder and Lafayette.
- ¼**January 29, 2016** – USFWS completed the biological opinion for the Gross Reservoir Environmental Pool.

BIOLOGICAL OPINION

DESCRIPTION OF THE PROPOSED ACTION

The proposed federal action is the Corps' issuance of a Clean Water Act Section 404 Individual Permit for the proposed Moffat Project, which involves the expansion of Gross Reservoir in Boulder County, Colorado, and increased stream diversions in the Colorado River and Platte River systems. This biological opinion only addresses the activities associated with the increased stream diversions in the Colorado River system; section 7 consultations for the other activities associated with the Section 404 Individual Permit have already been completed.

Project Purpose. The purpose of the Moffat Project is to develop 18,000 AF per year (AF/yr) of new, firm water yield to the Moffat Water Treatment Plant (WTP) and raw water customers upstream of the Moffat WTP pursuant to Denver Water's commitment to its customers. Denver Water's need for the proposed Moffat Project is to address two major issues: 1) timeliness– the overall near-term water supply shortage, and 2) location – an imbalance in water storage and supply between its North and South water collection systems. The increased water yield will result from increased water diversions in the Fraser and Upper Williams Fork River basins on the western slope of the Continental Divide.

Water System Infrastructure. Denver Water currently diverts water from 32 locations in the Fraser River Basin, of which two streams contain green lineage cutthroat trout populations (Hamilton and Little Vasquez creeks). Water collected from diversions in the Fraser River Basin are conveyed through the Moffat Tunnel under the Continental Divide, and delivered to South Boulder Creek on the East Slope. The water in South Boulder Creek is then stored in, or bypassed through Gross Reservoir, and eventually taken to the Moffat Water Treatment Plant in Lakewood or delivered to raw water customers. The Fraser River Collection System intercepts a drainage area of approximately 108.2 square miles.

Denver Water also diverts water from four locations in the Upper Williams Fork River Basin, of which two streams contain green lineage cutthroat trout populations (Bobtail and Steelman creeks). Denver Water's collection system in the Williams Fork River headwaters diverts from McQueary, Jones, Bobtail, and Steelman creeks, directing flow to the Gumlick Tunnel (Jones Pass Tunnel) for delivery into Vasquez Creek in the Fraser River Basin via the Vasquez Tunnel. Water in Vasquez Creek is then conveyed to the Moffat Tunnel for transfer to the East Slope. The Williams Fork Collection System intercepts a drainage area of approximately 14.2 square miles.

Project Hydrology. Using existing collection infrastructure, water from the Fraser River, Williams Fork River, and South Boulder Creek would be diverted and delivered during average to wet years via the Moffat Tunnel and South Boulder Creek to Gross Reservoir. In order to firm this water supply and provide 18,000 AF/yr of new firm yield, an additional 72,000 AF of storage capacity is necessary. Existing facilities, including the South Boulder Diversion Canal and Conduits 16 and 22, would be used to deliver water from the enlarged Gross Reservoir to the Moffat Water Treatment Plant and raw water customers. To meet future demands, in most years,

Denver Water would continue to rely on supplies from its entire integrated collection system. In a drought or emergency, Denver Water would rely on the additional water it would have previously stored in Gross Reservoir to provide the additional 18,000 AF/yr of firm yield.

Hydrologic effects directly or indirectly related to implementing the Moffat Project were analyzed in the Final EIS (FEIS) (Corps 2014). Denver Water's Platte and Colorado Simulation Model (PACSM), which is a water allocation computer model, was used as the tool to generate hydrologic information for the analysis of effects for three scenarios related to Denver Water's Current Conditions, Full Use, and the Moffat Project.

Hydrologic Scenarios. Consistent with the FEIS (Corps 2014), the scenarios are defined as follows:

> ***Current Conditions*** - This scenario reflects streamflow conditions associated with Denver Water's continuation of the existing system and an average demand of 285,000 AF/yr. This average annual demand includes all incremental changes to diversions in years past since the point at which the infrastructure was first introduced into the collection system. Average diversions through the Moffat Tunnel are 63,799 AF/yr.
>
> ***Full Use*** - This scenario reflects future streamflow conditions associated with Denver Water's existing system and water rights at an average annual demand of 345,000 AF/yr. Full Use means Denver Water would maximize the yield of its existing water supplies using its existing facilities and infrastructure, independent of a future Moffat Project. At this demand level, average diversions through the Moffat Tunnel would increase to 66,512 AF/yr. Full Use does not include the Moffat Project.
>
> ***Moffat Project*** - This scenario reflects future streamflow conditions associated with Denver Water's proposed enlargement of Gross Reservoir (Moffat Project) and a future average demand of 363,000 AF/yr. At this demand level, average diversions through the Moffat Tunnel would increase to 76,797 AF/yr. The only difference between Full Use and the Moffat Project is the proposed increase in reservoir storage and an increase in yield of 18,000 AF/yr.

Denver Water proposes to enlarge its existing 41,811 AF Gross Reservoir Dam by 72,000 AF to a total storage capacity of 113,811 AF. This increased storage would be accomplished by raising the existing concrete gravity arch dam by 125 feet, from 340 to 465 feet high. Denver Water is also proposing to create an additional 5,000 AF of storage (termed the Environmental Pool) in Gross Reservoir, as mitigation, to enhance aquatic habitat in South Boulder Creek downstream of the reservoir. This additional storage would be filled with water provided by the cities of Boulder and Lafayette, and released for environmental flows. None of Denver Water's existing or future water supply would be stored in this 5,000 AF Environmental Pool. To accommodate the Environmental Pool, Denver Water is proposing to raise the dam an additional 6 feet, beyond the proposed 125-foot raise, for a total dam height increase of 131 feet. The reservoir storage capacity will increase by a total of 77,000 AF to a total storage of 118,811 AF. The Corps submitted a separate BA and request for Section 7 consultation on the Environmental Pool in a letter to the Service dated September 1, 2015.

Existing and Future Operations and Maintenance. To operate and maintain its diversion structures and water collection system, Denver Water conducts the following activities: opening

and closing of diversion gates, opening and closing of sluice gates, operation of water delivery structures, operation of spillways, maintenance of diversion dams, removal of sediment by mechanical means above and below diversion dams, operation of minimum bypass facilities and channels, construction and operation of fish ladders (if built in the future), reconstruction of diversion dams and associated structures, maintenance and replacement of diversion canals, and transportation activities to diversion facilities. Denver Water currently implements Best Management Practices (BMPs) during construction activities to avoid or minimize sediment and erosion impacts; these are provided in Appendix A of this biological opinion.

Conservation Measures

Conservation measures are actions outlined in the project description that the project proponent will implement in order to reduce the environmental impacts of the action or promote the recovery of threatened and endangered species. The Service considers the beneficial effects of these conservation measures during the jeopardy and adverse modification analyses.

Conservation measures are part of the proposed action and their implementation is required under the terms of this consultation.

Overview - Denver Water will perform the following conservation measures, the design and intent of which are to fully mitigate for adverse effects to green lineage cutthroat trout incurred by continuation of Current Conditions, Full Use, and the Moffat Project. These conservation measures are designed to broadly address the:

a) Protection of existing green lineage cutthroat trout populations,

b) Habitat enhancement for these populations through brook trout eradication, and

c) Creation of new habitat and the expansion of occupied green lineage cutthroat trout habitat through re-introduction of the species in West Slope streams.

These conservation measures have been developed in concord with the USFWS's Greenback Cutthroat Trout Recovery Plan (USFWS 1988) and will promote the recovery of the species. These conservation measures provide complete and adequate mitigation for impacts of Current Conditions, Full Use, and the Moffat Project to the Fraser and Upper Williams Fork river basins by establishing a green lineage cutthroat trout conservation program in the same river basins in which the anticipated impacts will occur.

For the Upper Williams Fork River Basin, Denver Water will construct one fish migration barrier below each of its existing diversion structures on Steelman, Bobtail, and McQueary creeks. These three fish barriers will provide protection to the existing green lineage cutthroat trout populations on Bobtail and Steelman creeks, which are presently vulnerable to invasion by brook trout, and will also allow for the establishment of a new protected population of green lineage cutthroat trout on McQueary Creek. In all, approximately 9 miles of stream habitat will be permanently protected in the headwaters of Steelman (2.6 miles), Bobtail (3.7 miles), and McQueary (2.6 miles) creeks for green lineage cutthroat trout populations.

For the Fraser River Basin, Denver Water will ensure that its existing diversion structures and operation practices on Hamilton and Little Vasquez creeks continue to safeguard existing green lineage cutthroat trout populations in the headwaters by providing effective barriers to fish passage. This action will permanently protect approximately 10 miles of stream habitat for green lineage cutthroat trout (7.1 miles on Little Vasquez Creek and 2.7 miles on Hamilton Creek). Additionally, Denver Water will serve in a coordinating role for developing and implementing and will actively participate in a cooperative recovery program for green lineage cutthroat trout in St. Louis Creek with the USFWS, U.S. Forest Service (USFS), Colorado Parks and Wildlife (CPW) (formerly Colorado Division of Wildlife), and possibly others. This cooperative recovery program in St. Louis Creek would permanently protect up to approximately 15 miles of new green lineage cutthroat trout habitat.

Conservation Measure 1: Protection, Enhancement, and Recovery of Green Lineage Cutthroat Trout in the Upper Williams Fork River Basin

For the Upper Williams Fork River Basin, the existing diversion structures on Bobtail and Steelman creeks serve as an effective physical barrier to upstream fish passage when the sluice gates are closed; however, both brook trout and cutthroat trout have been identified above and below these diversions, indicating that brook trout are able to travel upstream of the diversions through the sluice gates. Presently, genetically pure green lineage cutthroat trout have not been identified in McQueary Creek. In an effort to protect the existing green lineage cutthroat trout populations above the diversion structures on Bobtail and Steelman creeks and to establish a new population through re-introduction of the species in McQueary Creek, the following actions will occur.

A. Denver Water will construct fish migration barriers below its diversion structures on Bobtail, Steelman, and McQueary creeks.

   i. Denver Water will be responsible for funding, acquiring the permit(s), design, construction, operation, and maintenance of three fish migration barriers downstream of its existing diversion structures on Bobtail, Steelman, and McQueary creeks.

      - Á Based on Denver Water's preliminary engineering evaluations, the fish migration barriers will require replacing the culverts on Bobtail and McQueary creeks below the existing diversion structures, and the construction of a sluice gate channel at the existing diversion on Steelman Creek. These upgraded structures will be designed to provide barriers to upstream fish migration. Denver Water will incorporate the following design goals in its construction of the barriers: a minimum of a 4-foot drop (more if possible) and a downward-sloping flat splash pad or rip rap (laid flat or rolled) to minimize pool development below the barrier.

   ii. Denver Water will enter into an Intergovernmental Agreement (IGA) with CPW to cost-share (50/50) the eradication of brook trout and re-introduction of green lineage cutthroat trout in Bobtail, Steelman, and McQueary creeks and McQueary Lake.

   iii. Á USFWS recognizes that Denver Water may remove the barriers in Conservation Measure 1(A)(i) if the following actions occur:

      - ÁA permanent fish barrier is constructed on the Williams Fork River below the confluence of Steelman Creek, and,

- Fish eradication has occurred in the Williams Fork River between the new barrier and Denver Water's existing diversions on Bobtail, Steelman, and McQueary creeks, and CPW has certified the removal effort.

Timeframe: Denver Water's commitment to construct three fish migration barriers in the Upper Williams Fork River Basin as outlined in Conservation Measure 1(A)(i) will be met prior to completing construction of the expansion of Gross Reservoir under the Moffat Project. Denver Water's commitment to complete an IGA with CPW as outlined in Conservation Measure 1(A)(ii) will be met within one year of the date of issuance of the Federal Energy Regulatory Commission (FERC) license amendment for Gross Reservoir (FERC No. 2035, also Moffat Project).

B. •Denver Water is committed to keeping the sluice gates at the Bobtail and Steelman diversions closed at all times except for draining of the diversions to allow mechanical removal of sediment, during times when maintenance is required, and during periods of high flow conditions that may cause damage to or jeopardize the integrity of the diversion structures. Denver Water will make a good faith effort to only partially open the sluice gates wide enough to safely release water past the diversions and maintain sufficient water velocities through the sluice gates to impede upstream fish migration. Keeping the sluice gates closed as much as possible will provide a second barrier towards upstream fish migration. Denver Water shall notify the USFS Sulphur District Ranger and the CPW Hot Sulphur Springs office in the event the sluice gates are opened during high flow conditions.

Timeframe: Denver Water's commitment to operate the sluice gates as outlined in Conservation Measure 1(B) will commence upon issuance of the FERC license amendment for the Moffat Project.

Conservation Measure 2: Protection of Green Lineage Cutthroat Trout in the Fraser River Basin

For the Fraser River Basin, Denver Water commits to maintaining its diversion structures and operating the structures on Hamilton and Little Vasquez creeks in a manner that safeguards the populations of green lineage cutthroat trout located above its diversions, which have been identified as genetically pure (core conservation populations). The following operative actions will be maintained to protect these existing green lineage cutthroat trout populations and to permanently protect the headwater habitat in these creeks for the benefit of green lineage cutthroat trout.

A. •In order to protect the green lineage cutthroat trout populations above its diversions, Denver Water will not modify the diversion structures or existing operations on Hamilton and Little Vasquez creeks. If new (replacement) diversion structures are constructed on Hamilton or Little Vasquez creeks, Denver Water will design the replacement structures to be barriers to upstream fish migration.

Timeframe: Denver Water's commitment to not modify its diversion structures or existing operations on Hamilton and Little Vasquez creeks as outlined in Conservation Measure 2(A) will become effective upon the date of issuance of the FERC license amendment for the Moffat Project.

Denver Water will serve in a coordinating role for developing and implementing and will actively participate in a cooperative recovery program for green lineage cutthroat trout in St. Louis Creek with USFS, CPW, USFWS, and possibly others.

B. ƒThe following actions will serve as Denver Water's conservation measures for the green lineage cutthroat trout recovery program in St. Louis Creek:

   i. Denver Water will ensure that its existing diversion structure on St. Louis Creek is a complete barrier to upstream fish migration.

   ii. Denver Water will coordinate a cooperative effort to identify partners, including USFS, CPW, USFWS, and possibly others. Denver Water's partners will identify and dedicate funding for developing the design and implementation of a fish eradication and green lineage cutthroat trout re-introduction program for St. Louis Creek and its tributaries above and below Denver Water's existing diversion. Denver Water will coordinate the development of an agreement between the partners, including Denver Water, to facilitate the fish eradication and re-introduction.

C. Denver Water will coordinate and participate in the following as part of the cooperative recovery program for the green lineage cutthroat trout in St. Louis Creek:

   i. Once a formal agreement is in place for the funding, design, and implementation of a plan to eradicate and then re-introduce green lineage cutthroat trout above and below Denver Water's diversion (Conservation Measure B(ii)), Denver Water will design, acquire the permit(s), and construct a second barrier on St. Louis Creek below Denver Water's diversion. Denver Water will contribute $1.2 million for the construction of this new barrier, the location of which will be selected in part based on this allocation. Should a location be selected where the construction costs exceed $1.2 million, Denver Water and the partners shall work cooperatively to secure the additional funding needed to complete the barrier and Denver Water shall not be obligated to contribute additional funding.

   ii. ƒOnce the second barrier has been constructed and green lineage cutthroat trout have been reintroduced, Denver Water will, upon the request of the USFS, design, acquire the permit(s), and construct and maintain a fish ladder (or a ladder alternative as described below) on its St. Louis Creek diversion to allow fish to move upstream when Denver Water is spilling water at this diversion.

      • ƒDuring the design phase, Denver Water will develop, in consultation with partners, a fish passage design for making use of the existing minimum bypass flows. The partners will then collaboratively determine which technique to use for fish passage. Should the construction cost of the alternative fish passage exceed $500,000, Denver Water and the partners shall identify the additional funding needed to complete the passage and Denver Water shall not be obligated to contribute additional funding.

      • ƒFollowing construction of the fish ladder, Denver Water will provide up to $5,000 to CPW for a Passive Integrated Transponder (PIT) tag study to conduct an evaluation, in consultation with USFS.

iii. | If the cooperating partners cannot identify and dedicate funding for Conservation Measure 2(B)(ii) within 15 years after the date of issuance of the FERC license amendment for the Moffat Project, Denver Water shall have no obligation to complete items in Conservation Measure 2(C) for the biological opinion under the Section 7 consultation.

Timeframe: Denver Water's commitments as outlined in Conservation Measures 2(A) and 2(B) will become effective upon the date of issuance of the FERC license amendment for the Moffat Project. Denver Water shall be responsible for the commitment under Conservation Measure 2(B)(ii) for the recovery program in St. Louis Creek for a period of 15 years after the date of issuance of the FERC license amendment for the Moffat Project. Once funding is dedicated, Denver Water will make its best effort to complete design, acquire permit(s), and construction within 10 years.

Project Monitoring and Operations Compliance

To demonstrate Denver Water's compliance with the above conservation measures for this biological opinion under Section 7 of the ESA, Denver Water will prepare an annual report for 15 years that will describe the following activities:

Conservation Measure 1

A (i). Summary of Denver Water's progress on constructing fish migration barriers on Bobtail, McQueary, and Steelman creeks.

A (ii). Denver Water will provide a copy of the executed IGA between Denver Water and CPW.

B. | Sluice gate operations – summary of dates and reasons the sluice gates on Steelman and Bobtail diversions were opened.

Conservation Measure 2

A. Statement that no modifications have been made to the Little Vasquez or Hamilton creek diversions that altered the effectiveness of the fish barrier.

B (i). Summary of Denver Water's efforts to ensure that the St. Louis Creek diversion is a complete fish barrier.

B (ii). Coordination and participation in cooperative recovery program – summary of dates, meeting notes, and task assignments from meetings of the cooperative partners (Conservation Measure 2(B)(ii)). Denver Water will be determined to be in compliance with Conservation Measure 2(B)(ii) if Denver Water attempts to hold an annual meeting with the cooperative partners to identify and dedicate funding for a period of 15 years after issuance of the FERC license amendment.

C. If the cooperating partners are able to identify and dedicate funding for this portion of the Moffat Project, Denver Water shall include a report on the construction of the lower barrier and the fish passage in the appropriate year's annual report.

ACTION AREA

The action area includes the immediate area involved in the action and also includes all areas to be affected directly or indirectly by the Federal action (50 CFR § 402.02). The action area is defined by measurable or detectable changes in land, air, and water or to other measurable factors that will result from the proposed action. In other words, the action area is not limited to the "footprint" of the action, but rather encompasses the biotic, chemical, and physical impacts to the environment resulting directly or indirectly from the action.

The action area for this consultation includes the Upper Fraser River Basin and the Upper Williams Fork Basin in Grand County, Colorado. The Fraser River basin boundary is formed by the Vasquez Mountains on the west, which separate it from the Williams Fork River Basin, and by the Continental Divide on the south and east. Major tributaries include Vasquez, St. Louis, Ranch, Crooked, and Strawberry creeks. The intercepted drainage area of the Fraser River collection system is 108.2 square miles. For the purposes of including potential downstream impacts, we consider the action area to include the Fraser River down to the Town of Tabernash. Elevations in this area range from 13,000 feet to approximately 9,000 ft.

The Williams Fork River Basin is formed by the Vasquez Mountains between Williams Fork River and the Fraser River to the east, and the Williams Fork Mountains form the western boundary shared by the Blue River Basin. The southern end is delimited by the Continental Divide, which separates the Williams Fork River Basin from Clear Creek. The Williams Fork River flows generally northwest, forming a relatively narrow basin approximately 8 miles wide by 30 miles long. The intercepted drainage area of the Williams Fork River collection system is 14.2 square miles. For the purposes of including potential downstream impacts, we consider the action area to include the Upper Williams Fork River down to where Middle Fork Williams Fork joins the Williams Fork River.

Although we recognize that the water collected from the Fraser River and Upper Williams Fork River basins is transported to the east side of the Continental Divide through the Moffat Tunnel, for the purposes of this consultation, we do not consider the action area to extend east beyond the entrance of the Moffat Tunnel in Grand County.

STATUS OF THE GREEN LINEAGE CUTTHROAT TROUT

The green lineage trout represents a newly identified lineage of cutthroat trout that was discovered during the 2012 Metcalf et al. genetic study. The green lineage trout currently receives interim protection under the ESA because several of its populations were previously identified as greenback cutthroat trout populations (*Oncorhynchus clarkii stomias*) (greenback), which is listed as a threatened species throughout Colorado. This interim protection will remain in effect while the Service conducts a status review to evaluate the need to list the green lineage cutthroat trout. The Service listed the greenback cutthroat trout as an endangered species in 1967 (32 FR 4001). The Service downlisted the greenback to a threatened status in 1978 because of recovery efforts that removed non-native trout from suitable habitat, established captive broodstocks, reintroduced greenbacks, developed stable populations, and initiated catch-and-release fisheries (43 FR 16343).

Studies have not been conducted specifically on the green lineage cutthroat trout. We consider much of the information on the status of the greenback cutthroat trout and the Colorado River cutthroat trout (*Oncorhynchus clarkii pleuriticus*) to be a surrogate for the status of the green lineage cutthroat trout.

Distribution

Until recently, delineations of subspecies of cutthroat trout in the southern Rocky Mountains were believed to follow geographic boundaries within several states, with greenback cutthroat trout on the east side of the Continental Divide and Colorado River cutthroat trout on the west side. Rio Grande cutthroat trout (*O. c. virginalis*) occur within the Rio Grande drainage; its range and genetic identity does not appear to be in question.

Through the recent genetic (Metcalf et al. 2012) and meristic (Bestgen et al. 2013) studies that identified the native ranges of cutthroat in Colorado, we now know that greenbacks are native only to the headwaters of the South Platte River drainage in Colorado and are not native to the Arkansas River drainage, as was previously believed. Another significant conclusion of the Metcalf et al. study (2012) is the identification of two distinct lineages of cutthroat trout on the West Slope of Colorado, one of which is the Colorado River cutthroat trout and the other is a newly identified lineage, which we temporarily refer to as the green lineage cutthroat trout, based on the map provided in the Metcalf et al. 2007 report in which these fish were shown in a green color. The common and scientific name will be described for the green lineage cutthroat trout in the future. Populations of the Colorado River cutthroats that are present on the east side of the Continental Divide are presumably due to stocking from West Slope sources in the past. Populations of the green lineage cutthroat trout are also present on the east side of the Continental Divide, although uncertainty remains of the origin of these fish.

Approximately 60 populations of green lineage cutthroat trout are known to exist at this time. The majority of these populations are present on the western slope of Colorado, primarily within the Colorado River Cutthroat Trout Geographical Management Units (GMUs) for Upper Colorado, Gunnison, and Dolores basins. Several populations are present on the eastern slope in both the South Platte River and Arkansas River drainages. One green lineage cutthroat trout population is also known to occur in eastern Utah.

The Colorado River cutthroat trout was previously evaluated for listing. The Service completed a 12-month Finding in 2007 (72 FR 32589) that determined that the Colorado River cutthroat trout was not warranted for listing as either threatened or endangered. This determination was challenged in court but the Service's position was upheld (Colorado River Cutthroat Trout et al. v. Salazar et al., Case Number 1:09-CV-02233-PLF). Therefore, the Colorado River cutthroat trout is not listed under the ESA.

Taxonomy

When the greenback was first listed, morphology and meristic analyses were a prominent genetic determinant for cutthroat trout subspecies, based on phenotypic expression that included spotting patterns, number of scales, coloration, number of basiobranchial teeth, etc. (Policky et al. 2003). Some of the first genetic analysis completed was University of Montana's electrophoresis work

(Kanda and Leary 1999a, 1999b, 1999c, 2000). More recently, techniques for genetic analysis have focused on mitochondrial DNA and nuclear DNA. With regard to taxonomy, Behnke (2004) has argued that genetics should not be the sole factor in determining taxonomic distinctions, and that morphological traits may sometimes be distinguishing factors.

In a 2007 study, Metcalf et al. used molecular markers from the mitochondrial and nuclear genomes to analyze individuals from greenback and Colorado River cutthroat trout. Phylogenetic analysis of the combined cytochrome oxidase I (COI) and nicotinamide adenine dinucleotide dehydrogenase 2 (ND2) mitochondrial gene sequences (n=1530 base pairs) revealed two divergent lineages within the ranges of greenback and Colorado River cutthroat trout consisting of 10 unique haplotypes. Metcalf et al. (2007) determined that these two lineages corresponded with the two described subspecies. However, the divergent evolutionary lineages defined by mitochondrial and nuclear DNA markers did not separate geographically on either side of the Continental Divide as expected. Results from that study identified five populations with what the authors believed were Colorado River cutthroat trout genetic markers on the east side of the Continental Divide and one population with what they believed were greenback genetic markers occurring on the West slope of Colorado in what should be Colorado River cutthroat habitat.

Additional research on this topic resulted in the recently published genetic study conducted by researchers from the University of Colorado - Boulder (Metcalf et al. 2012) that compared mitochondrial DNA of extant cutthroat trout populations from Colorado with cutthroat trout museum specimens collected in the late 1800s, thereby providing an understanding of the native ranges of cutthroat trout in Colorado prior to major fish stocking efforts. Several significant conclusions resulted from this study, namely that the greenback is native only to the South Platte River drainage and that a different subspecies was native to the Arkansas River drainage. This subspecies, the yellowfin cutthroat trout (*O. c. macdonaldi*), is considered to be extinct (Metcalf et al. 2012; Wiltzius 1985). As discussed above, another significant conclusion of the Metcalf et al. study (2012) is the identification of two distinct lineages of cutthroat trout on the West Slope of Colorado, one of which is the Colorado River cutthroat trout and the other is a newly identified lineage, which we temporarily refer to as the green lineage cutthroat trout. This study also identified an additional cutthroat lineage; this lineage was located in the San Juan River drainage and is considered to be extinct. Populations of the Colorado River cutthroats that are present on the east side of the Continental Divide are presumably due to stocking from West Slope sources in the past.

A concurrent meristic study of cutthroat trout in Colorado (Bestgen et al. 2013) complemented the 2012 genetic study. The meristic study was conducted by researchers at the Larval Fish Laboratory at Colorado State University, and included cutthroat trout specimens collected from all major drainages in Colorado, Wyoming, Utah, and New Mexico. Both meristic and genetic analyses were conducted on these specimens in a "double-blind" fashion in which neither group of researchers was aware of the origin of the specimens. The observed meristic differences supported the genetic study while also providing an even greater refinement of cutthroat trout groups than previously identified through the genetic study, including green lineage cutthroat trout on the Eastern Slope of Colorado.

Habitat

Cutthroat trout generally require clear, cold, well oxygenated water (McGrath 2004). In general, trout require different habitat types for different life stages: juvenile (protective cover and low velocity flow, such as side channels and small tributaries); spawning (riffles with clean gravels); over-winter (deep water with low velocity flow and protective cover); and adult (juxtaposition of slow water areas for resting and fast water areas for feeding, with protective cover from boulders, logs, overhanging vegetation or undercut banks) (Behnke 1992). Both water quality and quantity are important. High sediment loads, pollution, and diversion of streams for agricultural or municipal purposes can all adversely affect cutthroat trout habitat (see *Threats* section below).

Diet

Cutthroat trout are opportunistic feeders utilizing a wide range of prey organisms, including macroinvertebrates, but a large percentage of the diet can be also be terrestrial insects (McGrath 2004), which can comprise about half of the diet of trout populations (Saunders and Fausch 2007). Fausch and Cummings (1986) found that greenbacks in Hidden Valley Creek, Rocky Mountain National Park (8,825 ft elevation) fed opportunistically on a wide variety of organisms. Analysis of stomach contents revealed that terrestrial invertebrates comprised a relative constant proportion of the diet through September but the proportion of terrestrial invertebrates in the diet declined rapidly in October as temperatures declined. None of the stomachs contained young-of-the-year greenbacks (Fausch and Cummings 1986).

Reproduction

Cutthroat trout spawning is generally initiated in the spring when water temperatures reach 41-47° F. Field studies conducted on factors limiting cutthroat trout recruitment success into translocation streams in Rocky Mountain National Park, and several national forests, suggest that low water temperatures (averaging 46° F or below in July) may have an adverse effect on greenback fry (young fish) survival and recruitment (Coleman and Fausch 2007a, b). They also found that stream flows may influence recruitment and growth of cutthroat fry. Coleman and Fausch (2007a, b) found that streams that accumulate 1652-2192° F days cumulatively during the growing season afforded the best opportunity for cutthroat trout recruitment and translocation success. In the Big Thompson River (Forest Canyon), Rocky Mountain National Park at 10,498 ft, cutthroat fry were observed emerging on August 26 (USFWS 1998).

Harig and Fausch (2002) developed a model, based on a comparative field study, which predicted that cold summer water temperature, narrow stream width, and lack of deep pools limited translocation success of the greenback. Young and Guenther-Gloss (2004) evaluated the model developed by Harig and Fausch (2002), and found a positive correlation between the three model components and greenback abundance. High quality riparian habitat may allow them to spawn at lower elevation sites that would otherwise be too warm.

Threats to the Green Lineage Cutthroat Trout

As discussed earlier, at this time, we will consider the threats described for the greenback cutthroat trout and Colorado River cutthroat trout to be a surrogate for the threats to the green lineage cutthroat trout.

At the time of development of the 1998 Greenback Cutthroat Trout Recovery Plan, the main reasons cited for the subspecies' decline were hybridization, competition with non-native salmonids, and overharvest (USFWS 1998). New threats have arisen, or have become more prevalent, that were not thoroughly addressed in the 1998 Recovery Plan. These include the effects of fire and firefighting with chemical retardants; increased human population growth within the range of the subspecies along with potential for new water depletions; new introductions of non-native species; fragmentation and genetic isolation of small populations; and the effects of global climate change. Below we summarize threats to the greenback. Our most recent 5-year review for the greenback, published in the Federal Register on May 27, 2009, provides a more detailed analysis regarding threats.

Introduction of Non-native Fish Species. The number one reason for the historic decline of the greenback was the introduction of non-native salmonid fish species (Behnke 1992). The 1998 Recovery Plan states that, ". . . no action had more long-term impacts on the endemic trout subspecies than the introduction of non-native salmonids, which hybridized and competed with native fishes" (USFWS 1998). Non-native fish species also pose a predatory threat to greenback.

Brook trout *(Salmo trutta)* (a fall-spawning, cold hardy char) apparently outcompete the greenback for common food sources early in life in most stream habitats. Brook trout spawn in the fall, while greenbacks spawn in the late spring or early summer (McGrath 2004). Because brook trout spawn in the fall, they hatch earlier in the year than greenbacks, and the brook trout young are then larger and better able to compete for resources than the greenbacks that hatch later in the summer (USFWS 1998). An evaluation of greenback sites determined that non-native trout, most commonly brook trout, occurred within approximately 25 percent of greenback population sites examined by McGrath (2004). Peterson et al. (2004) found that age-0 Colorado River cutthroat trout survival was 13 times greater, and age-1 survival 1.5 times greater, when brook trout were removed. The mortality rates of young cutthroat trout exposed to brook trout are also often high enough to result in recruitment failure (Dunham et al. 2002a, Shepard et al. 2002, McGrath 2004, and M.K. Young, unpublished data, *in* Young 2009, p.34). However, it should be noted that McGrath and Lewis (2007) found that prey consumed by greenbacks and brook trout differed significantly at five of six sites where the species were sympatric.

Other non-native salmonids considered as threats to greenbacks include: rainbow trout, brown trout, and Yellowstone cutthroat trout. The greenback hybridizes with several introduced fish species, such as the rainbow trout, which also spawns in the spring. Rainbow and brook also prey on young greenbacks. Brown trout prey on all sizes of greenback. Adult brook trout also have been observed attacking and showing aggression toward greenbacks (McGrath 2004), but adult greenbacks and brook trout do coexist in some stream habitats where immigration of adult greenbacks occurs. McGrath and Lewis (2007) only found one greenback while investigating the stomach contents of 323 brook trout. Observational data suggest the competition dynamics appears to be different in lake habitats, and greenbacks may compete successfully with brook trout in some lake habitats under restricted harvest regulations.

Although non-native salmonid species continue to present a threat to cutthroat trout populations, management activities, such as maintenance and construction of stream barriers, have ensured that fewer populations co-exist with cutthroat populations.

Mining. Early mining and ore processing activities in Colorado for gold and other precious metals produced waste piles and mine tailings that contain heavy metals and acid-generating compounds. These piles were, and in many cases continue to be, leached by flowing water, resulting in increased acidity, decreased pH, and heavy metal concentrations downstream. Water draining from historic mine tunnels and adits (horizontal passages leading into mines) also may contain high concentrations of heavy metals and with a low pH value (acidic). Larval greenbacks have been shown to be more sensitive to low pH than eggs and embryos, with a pH of 5 being a threshold for larvae in the absence of aluminum (WNTI 2007). Such pollution can negatively affect fishes through asphyxiation, chronic toxicity resulting in reduced resistance to infection and other stresses, ecological impacts due to destruction of food organisms, and interference with behavioral patterns. In addition to impacts resulting from mining activities, some waters within the range of greenbacks are impacted by naturally high levels of heavy metals.

Today, mining activities are not as prevalent and are under environmental permitting and reclamation restrictions that minimize polluted runoff from mine sites. Progress has been made at managing mine waste, although the threat of accidental contamination through spills from abandoned mines remains. The Colorado DRMS estimates that, statewide, over 23,000 abandoned mines and 1,300 miles of streams impacted by past mining activities exist (Colorado DRMS 2009). While there may be some localized impacts to cutthroat trout due to past mining practices, there are many streams and lakes available for restoration.

Other Land Use Activities. Various types of land-use activities may negatively impact cutthroat trout habitat through the removal of riparian habitat that shades streams and maintains lower water temperatures, and through vegetation removal and trampling of streambanks, which causes bank erosion, producing stream sedimentation. Logging, grazing, road and trail construction and use, and recreational vehicle use near streams, for example, have the potential to cause a negative chain reaction by contributing to bank destabilization, which causes an increase in erosion, sediment deposition, and in turn, a threat of higher turbidity and elevated water temperatures in lower elevation habitats. In addition to the direct effects of vegetation removal and trampling, these types of land management activities also can reduce the input of terrestrial insects, which constitute an important part of the trout diet, into the aquatic environment (Saunders and Fausch 2007).

Erosion materials may form a new substratum inconsistent with that required for spawning by cutthroat trout, and may smother redds (the nests of salmonid species) after the eggs are laid, cutting off oxygen needed for the eggs to hatch. Additionally, erosion of material into streams can fill in deep water areas, thereby reducing the available over-winter habitat. Because sediment loads are greatest during spring runoff and thus have their greatest negative effect on reproduction of spring-spawning native trout, accelerated erosion can favor populations of fall-spawning non-native brook and brown trout (Behnke 1992).

In general, activities that could negatively impact cutthroat trout habitat, such as grazing, logging, and road/trail construction, etc., occur on federally managed lands that are subject to section 7 consultation under the ESA and, therefore, develop conservation measures to minimize those effects. Land management agencies participating in the recovery program also use their authorities to improve habitat conditions.

Water Depletions and Water Storage Facilities. Water management and water storage actions have occurred within the range of the cutthroat trout since the 1880s, and continue to the present day. Continued development is expected along Colorado's East Slope as the human population continues to grow. In theory, demand for water within the range of cutthroat trout habitat is expected to increase commensurate with population growth. As a result, potential water diversions or depletions may occur that reduce stream flow, fragment stream habitat, restrict cutthroat trout movement along stream corridors, and adversely impact water quality, aquatic food chains, and watershed conditions. Water diversions can also result in entrainment of fish at diversion sites that are not screened, generally resulting in the loss of the fish from the population. As an example of water management impacts, the 1982 failure of the Lawn Lake Dam within Rocky Mountain National Park (RMNP) resulted in impacts to over 6.2 miles of cutthroat stream habitat.

Most cutthroat trout populations occur in smaller tributaries at higher elevations, which are less likely for water development. Although many of the streams with greenback habitat do not have in-stream flow water rights or protections, waters within RMNP have in-stream flow protections or Federal reserved rights. The BLM also has established in-stream flow rights on some of its cutthroat streams, including those containing restored populations of cutthroats. Most requests for water diversions or depletions within the range of greenbacks would require section 7 consultation under the ESA, which would require measures to minimize impacts. Water depletions could become a greater threat in the future under expanded drought cycles and climate change.

Fragmentation. Artificial fish migration barriers have been constructed in many cutthroat trout streams in Colorado and have had positive results for maintaining cutthroat trout populations by excluding non-native fish. Section 2.42 of the Greenback Cutthroat Trout 1998 Recovery Plan recommends construction and improvement of artificial barriers as a management strategy to stop the invasion of downstream non-native fish. However, existing barriers provide a limitation to dispersal, resulting in most populations of greenback cutthroat trout being restricted to short, headwater stream segments. More than 90 percent of the stream segments occupied by cutthroat that were previously considered to be greenback are less than 3.1 miles in length, with an average length of 1.5 miles (Albeke 2008). Small, isolated populations and the lack of connectivity makes them vulnerable to stochastic events, such as drought, floods, fires and debris torrents and, in the long term, to loss of genetic variability through bottlenecking and the reduced potential for evolving in response to changing environmental conditions, such as climate change (Young 2009). Small stream populations that are tied to lake populations are likely less vulnerable to stochastic events due to the greater ability to repopulate disturbed areas.

Diseases – Whirling Disease. One of the primary diseases that threaten cutthroat trout is whirling disease, which is a parasitic infection caused by *Myxobolus cerebralis* that impacts

young trout. The disease was introduced to the United States in the 1950s, and has been present in Colorado since the 1990s. These parasites enter through the nerve endings on the skin, and feed upon cartilage in the head and spinal area of young fish, resulting in pressure on the nerves and equilibrium loss (Whirling Disease Foundation 2009). The nerve pressure causes the fish to 'whirl', making them susceptible to predators and starvation. Young greenbacks are highly susceptible to whirling disease. Greenbacks less than 1 year of age had a mortality rate of greater than 25 percent when lightly exposed to the disease (Markiw 1990).

The disease can be spread through hatcheries use and/or release of contaminated water, stocking of infected fish, by mud on angler equipment, and by birds eating infected fish. However, live infected fish appear to be the main vector for the spread of the disease. Controlling or managing the disease has proven to be a challenge for fishery managers. While elimination of whirling disease has not been possible, Federal and State agencies have successfully implemented regulations that prevent the spread of exotic diseases, such as whirling disease. Hatchery operations also have been improved to prevent the spread of whirling disease. For example, the Leadville National Fish Hatchery completed a cleanup of the hatchery and its water sources and was certified whirling disease free in 2007.

Since cutthroat populations exist in relatively unaltered habitats, and many of the higher/colder elevation streams have low numbers of the required intermediate host, whirling disease does not appear to be a high threat to current greenback cutthroat trout populations. Stream barriers can serve to protect native cutthroat populations from immigration by non-native trout that are whirling disease positive. However, the presence of the disease may limit future reproduction and reintroduction of salmonids in lower elevation lakes and streams. Additional information on whirling disease is provided in the greenback 5-year review (USFWS 2009).

Invasive Species. Several other invasive species in Colorado have the potential to affect cutthroat trout, including the New Zealand mud snail (NZMS) and the Zebra and quagga mussels. However neither of these invasive species is currently known to impact cutthroat trout in Colorado at this time, but it is possible they could be transferred to cutthroat trout lakes or streams in the future. The extent of their potential impacts on cutthroat trout populations, should they spread into occupied streams, is unknown. Additional information on these invasive species is provided in the greenback 5-year review (USFWS 2009).

Fire and Fire Management Activities. Wildfires are a natural component of the ecological region occupied by cutthroat trout. However, suppression of forest fires over the past 80 to 100 years in North America has resulted in many forest types with substantial fuel accumulations that are at risk of wildfires with greater intensity and severity than historically occurred. The added effects of drought and climate change add to the potential fire risk.

While managers do their best to control and or prevent wildland fires, unplanned fires do occur and can have negative impacts on aquatic species and their habitat. The direct effects of fire can be lethal to fish both from the increases in stream temperature, and from smoke and ash (both immediate ashfall and later erosional deposition) that can cause an increase in ammonia and respiratory distress, respectively. Minshall and Brock (1991) believe that increased water temperatures during the fire can kill fish in small (first and second order) streams but doubt that

larger streams get hot enough to kill organisms. Mortality in second and third order streams could be caused by smoke and ash (Minshall et al. 1989). Additionally, indirect adverse effects can result from the loss of streamside and forest vegetation and include erosion and loss of bank stabilization, causing increased turbidity and stream temperatures. Given the short length of many cutthroat streams in Colorado, large scale fires have the potential to extirpate individual cutthroat trout populations in these streams.

Fire retardant chemicals used for fire-fighting also present a threat to cutthroats because they are known to be toxic to aquatic wildlife. Lethal levels of fire retardants have been documented in studies on rainbow trout (Buhl and Hamilton 2000). Depending on the size of the retardant drop and the stream characteristics, ammonia concentrations from the retardant can remain lethal for at least 0.62 miles downstream of the retardant drop (Norris and Webb 1989). Larger, better-connected fish populations are more resilient (Rieman et al. 1995; Dunham et al. 2003) and in these cases, individuals from downstream may migrate back into the headwater system to spawn, re-establishing the population in that area. No known drops of fire retardant have occurred on greenback streams. However, given the smaller-sized streams that greenbacks typically occupy with their reduced potential for dilution of fire retardant, combined with the general inability to be naturally repopulated due to isolated populations and downstream barriers, the effects of a retardant drop on an individual greenback stream could be severe. Fish populations in lakes may be less impacted by retardants due to the volume of water in the lakes, and multiple water sources for some lakes.

An additional threat to cutthroat trout populations from fire management is the potential to introduce whirling disease into cutthroat trout streams by the aerial application of water during firefighting activities. Contamination could occur in this manner if the water was drafted from a stream or lake containing whirling disease. Interim guidelines have been developed for fire personnel to help them avoid the spread of whirling disease and other aquatic diseases (USFS 2007).

Since recovery efforts began in the 1970s, no known greenback population has been negatively impacted by fire activities. Many of the reintroduction sites are at high elevations with low fuel loads and minimal fire threats. Additional information on threats from fires and fire management is provided in the greenback 5-year review (USFWS 2009).

Contaminants. The Western Airborne Contaminants Assessment Project was completed by the National Park Service in 2008 (Landers et al. 2008). From 2002 to 2007, researchers conducted analysis of the concentrations and biological effects of airborne contaminants in air, snow, water, sediments, lichens, pine needles, and fish in eight national parks, including RMNP. The study found high levels of endosulfans and dacthal in snowpack depositions and also in fish samples in RMNP. Mercury levels in fish samples were fairly low, although mercury level increased with increasing age of fish. Poorly developed testes and or intersex trout were found in five of the nine lakes tested in RMNP, indicating that endocrine and reproductive disruption is occurring (Landers et al. 2008). As part of this study, a sample from a male greenback collected in Twin Lakes in the 1800s was also examined and found to be an intersex fish, showing that this is not a new phenomenon, and likely does not pose a significant threat to greenback recovery (USFWS 2009).

Utilization and Management. Unregulated fishing was a major cause in the historic reduction of greenback (USFWS 1998). Since the subspecies was reclassified as a threatened species in 1978, sport angling for the greenback has been regulated under section 4(d) of the ESA. The CPW regulates the taking of greenback for commercial, recreational, scientific, or educational purposes as long as it is consistent with State law and the 4(d) rule. The 4(d) rule allows sport angling under applicable State law. Zimmerman Lake, which was stocked by CPW with greenbacks in 2014, is open to catch and release fishing while Bear Creek has been closed by CPW to angling since January 1, 2008. Additional information on the management of greenbacks is provided in the greenback 5-year review (USFWS 2009). Green lineage cutthroat trout streams are generally open to angling, unless closed by CPW for a site-specific purpose.

Global Climate Change. According to the Intergovernmental Panel on Climate Change (IPCC 2007) "Warming of the climate system is unequivocal, as is now evident from observations of increases in global average air and ocean temperatures, widespread melting of snow and ice, and rising global average sea level." Average Northern Hemisphere temperatures during the second half of the 20th century were very likely higher than during any other 50-year period in the last 500 years and likely the highest in at least the past 1,300 years (IPCC 2007). It is very likely that over the past 50 years cold days, cold nights, and frosts have become less frequent over most land areas, and hot days and hot nights have become more frequent (IPCC 2007). It is likely that heat waves have become more frequent over most land areas, and the frequency of heavy precipitation events has increased over most areas (IPCC 2007).

The IPCC (2007) predicts that changes in the global climate system during the 21st century are very likely to be larger than those observed during the 20th century. For the next two decades, a warming of about 0.2°C per decade is projected (IPCC 2007). Afterwards, temperature projections increasingly depend on specific emission scenarios (IPCC 2007). Various emissions scenarios suggest that by the end of the 21st century, average global temperatures are expected to increase 0.6 to 4.0°C with the greatest warming expected over land (IPCC 2007). Localized projections suggest the southwest may experience the greatest temperature increase of any area in the lower 48 States (IPCC 2007). The IPCC predicts that it is very likely hot extremes, heat waves, and heavy precipitation will increase in frequency (IPCC 2007). There also is high confidence that many semi-arid areas like the western United States will suffer a decrease in water resources due to climate change (IPCC 2007). Milly et al. (2005) project a 10 to 30 percent decrease in precipitation in mid-latitude western North America by the year 2050 based on an ensemble of 12 climate models.

As a recently emerging issue, warming temperatures associated with current climate change theories were not specifically discussed in the Greenback Cutthroat Trout 1998 Recovery Plan, although the task of monitoring populations is generally outlined in Recovery Plan Tasks 1.1 and 2.6. As part of the monitoring protocol, one of eight study sites in the Service's Fishery Resources Status and Trends, Global Climate Change Component (1993) was in greenback habitat. The goal of this program was to determine the effects of global climate change on fishes in selected regions of the United States. As such, water temperatures and spawning dates for high elevation greenback populations were collected at eight sites as baseline data for this study

(USFWS 1993). Temperature monitoring has continued and has been expanded to many cutthroat populations within RMNP.

Coleman and Fausch (2007a) monitored six headwater streams containing what were previously considered to be greenback populations in RMNP and the Arapaho-Roosevelt National Forest. Their results showed that recruitment of native cutthroat trout in Colorado is limited by cold water temperatures that reduce growth and recruitment. Based on these results, we can hypothesize that, at least for the short term, an increase in water temperature could be beneficial for greenback reproduction and recruitment. The recovery program has a good baseline data set for water temperature and the potential to identify population changes within sub-alpine habitats in the future that should provide for the evaluation of the effects of changing water temperatures on cutthroat trout populations.

Studies have indicated that global warming has the potential to adversely affect river systems that support cutthroat trout (Defenders of Wildlife 2002; Ficke et al. 2007). In general, threats from climate change could affect fish populations through reduction of precipitation, increase in fire, and increase in stream temperature. Higher temperatures in lentic systems (lakes) also could increase evaporation and result in lowered lake levels (Ficke et al. 2007). Defenders of Wildlife and The Natural Resources Defense Council performed a 2002 study that modeled the effects of increased air and water temperatures in trout habitat. The report suggests that species of trout and salmon could lose 5 to 17 percent of their existing habitat by the year 2030, 14 to 34 percent by 2060, and 21 to 42 percent by 2090 (Defenders of Wildlife 2002). Although relative impacts to cutthroat trout are unknown, these studies suggest that native cutthroat trout may experience a significant decline in habitat within the next 25 years due to climate change, with highest concern for trout populations in southern and southwestern States. However, a slight increase in water temperature also could be beneficial in extending the growing season and increasing fish production in high elevation cutthroat trout streams where spawning and incubation are delayed due to current cold temperatures, as described by Coleman and Fausch (2005). While it appears reasonable to assume that cutthroats may be affected, we lack sufficient certainty to know how climate change will affect the subspecies. Additional information on climate change is provided in the greenback 5-year review (USFWS 2009).

Management Guidance

Until the status reviews and the rulemaking, if necessary, have been completed, the Service will not change the listing status of the greenback. Therefore, all protection that is currently afforded to cutthroat populations that have been identified as greenback, including green lineage cutthroat trout and Colorado River cutthroat populations on the eastern slope and green lineage cutthroat trout on the western slope of Colorado, will remain in place until rulemaking occurs, if necessary (USFWS 2012).

The identification of green lineage cutthroat trout in western Colorado and eastern Utah has raised concerns regarding whether there is a need for application of the Act in these areas. Although the greenback was listed rangewide, its distribution was designated only as Colorado. Thus, any green lineage cutthroat trout found in Utah or Wyoming would not currently receive any protection under the Act.

Colorado River Cutthroat Trout Conservation - The Colorado River Cutthroat Trout (CRCT) Conservation Team updated the Conservation Strategy and Agreement in March 2006. The purpose of the strategy is to provide a framework for the long-term conservation of the Colorado River cutthroat, and to reduce or eliminate the threats that warrant its status as a sensitive species or species of concern by federal and state resource agencies. The objectives of the strategy are to identify and characterize all CRCT core and conservation populations, secure and enhance conservation populations, restore populations, secure and enhance watershed conditions, public outreach, data sharing, and coordination. Signatories to the Agreement include the State wildlife agencies of Colorado, Utah, and Wyoming; the USFS, the Bureau of Land Management (BLM), and the Service (CRCT Conservation Team 2006). The three States, USFS, BLM, and the Service have committed to implement the strategy.

ENVIRONMENTAL BASELINE

The environmental baseline is the past and present effects of all Federal, State, or private actions and other human activities in the action area, the anticipated effects of all proposed Federal actions in the action area that have already undergone formal or early section 7 consultation, and the effects of State or private actions that are contemporaneous with the consultation in progress.

Existing Green Lineage Cutthroat Trout Streams within the Action Area

Four green lineage cutthroat trout streams are present within the action area. Bobtail Creek and Steelman Creek occur in the headwaters of the Upper Williams Fork River Drainage. Hamilton Creek and Little Vasquez Creek occur in the Fraser River Drainage.

Bobtail Creek
Bobtail Creek is approximately 4.6 miles in length, of which 3 miles are above the diversion and occupied by green lineage cutthroat trout. The diversion for this creek is located at an elevation of approximately 10,600 feet. Water from Bobtail diversion is transported into the Gumlick Tunnel where it eventually joins the Moffat Tunnel via Vasquez Tunnel, Creek, and Canal. The Bobtail Creek drainage area above the diversion is 5.0 square miles.

Steelman Creek
Steelman Creek is approximately 3.9 miles in length, of which approximately 2 miles are above the diversion and occupied by green lineage cutthroat trout. The diversion for this creek is located at an elevation of approximately 10,600 feet. Water from the Steelman diversion is transported into the Gumlick Tunnel where it eventually joins the Moffat Tunnel via Vasquez Tunnel, Creek, and Canal. The Steelman Creek drainage area above the diversion is 4.0 square miles.

Hamilton Creek
Hamilton Creek is approximately 5.5 miles in length, of which 2.5 miles are above the diversion and occupied by green lineage cutthroat trout. The Hamilton Creek diversion is located at an elevation of 9,600 feet. Water diverted from Hamilton Creek water is transported in the Meadow Creek Connection Structure until it reaches the Moffat Tunnel. The Hamilton Creek drainage

area above the diversion is 2.5 square miles. A bypass flow requirement is present on Hamilton Creek.

Little Vasquez
Little Vasquez Creek is approximately 4.3 miles in length, of which 3 miles are above the diversion and occupied by green lineage cutthroat trout. The Little Vasquez Creek diversion is located at an elevation of 9,400 feet. The Little Vasquez Creek diversion water joins with the Vasquez canal and eventually reaches the Moffat Tunnel. The Little Vasquez Creek drainage area above the diversion is 5.5 square miles.

Other Streams
Other streams that are noteworthy for this consultation include McQueary Creek/Lake and St. Louis Creek. McQueary Creek is important because it is in the headwaters of the Upper Williams Fork River near Bobtail Creek and its diversion canals are interconnected with those of Bobtail and Steelman creeks near the Gumlick Tunnel. McQueary is approximately 2.6 miles in length above its diversion structure. A stocked hybrid cutthroat population is currently present in McQueary Creek (K. Larkin, USFS, pers. comm.). St. Louis Creek is important because it is the potential future site of a green lineage cutthroat trout reintroduction. Currently, fish in St. Louis Creek include brook trout and sculpins (K. Larkin, USFS, pers. comm.).

Existing Fish Populations within the Action Area

The following provides a summary of sampling records on green lineage cutthroat trout in the Fraser and Williams Fork River basins and in Gross Reservoir, as provided in the Corps' BA (Corps 2015). Little Vasquez Creek, Hamilton Creek, and Bobtail Creek above the diversions were identified as genetically pure (core conservation populations), and Steelman Creek was identified as 90 to 99 percent unaltered (conservation population). Fishery surveys have also found cutthroat trout and brook trout below the diversions on these four creeks (Corps 2014).

Little Vasquez Creek
The diversion on Little Vasquez Creek acts as a barrier to upstream migration and protects an isolated population of green lineage cutthroat trout. Upstream of the diversion, the only fish species recorded during sampling in 1996, 1999, and 2006 was cutthroat trout. Three sites were sampled in 1996, with an average density of 27 fish per hectare (fish/ha), ranging from 17 to 44 fish/ha, with an average biomass of 12.1 kilograms per hectare (kg/ha), ranging from 5.5 to 21.5 kg/ha. Little Vasquez Creek was surveyed upstream of the diversion again in 1999, and the estimated cutthroat trout population was 108 plus or minus 51 fish/ha. However, high recruitment was observed in 2001, one year after a culvert was modified to allow fish access to spawning habitat. CPW surveyed multiple sites upstream of the diversion in 2006, and fish densities ranged from 109 to 509 fish/ha. Little Vasquez Creek usually contains low densities of fish; a CPW report estimates that the population ranges from 0 to 50 fish/mile (Hirsch *et al.* 2006).

Downstream of the Denver Water diversion, fish populations were sampled in 1982, 1983, 1985, 1997, and 2006. Average fish density was variable over time, ranging from 36 to 4,046 fish/ha. Biomass was not reported for all surveys, but values ranged up to 94 kg/ha. Brook trout and cutthroat trout were the only species present during the sampling period, and the proportion of each species in the sample exhibited large fluctuations over time. Only brook trout were recorded

in 1982 and 1985, and only cutthroat trout were recorded in 1983, 1997, and 2006. Population densities appear to have declined between the 1980s and 2006, although sampling has not been at regular intervals and there has been only one site sampled since 1997.

Hamilton Creek

The existing diversion on Hamilton Creek was modified to function as a barrier to upstream migration of brook trout, which serves to protect an isolated population of green lineage cutthroat trout above this diversion. Upstream of the diversion, a USFS population survey in 2000 resulted in a population estimate of 1,206 plus or minus 202 cutthroat trout for Hamilton Creek from Denver Water's diversion to the headwaters. In 2003, CPW sampled five stations along Hamilton Creek upstream of this diversion and collected only cutthroat trout at each site. At one site, 183 fish were captured in a single electrofishing pass, and at the other four sites, total densities ranged from 456 to 8,847 fish/ha. Biomass estimates were not made. Hamilton Creek was surveyed upstream of the diversion again in 2009, and density estimates ranged from 159 to 699 fish/ha. The genetic status of this cutthroat trout population is unaltered (Hirsch *et al.* 2006).

Downstream of the diversion, Chadwick Environmental Consultants conducted fish population sampling in 2005 and collected brook trout. The total density was 484 fish/ha, and the total biomass was 14.5 kg/ha (GEI 2013).

Bobtail Creek

Fish populations upstream of the Denver Water diversion in Bobtail Creek have been sampled periodically since 1978. Based on the studies described below, the findings indicate that the diversion on Bobtail Creek is an effective physical barrier to upstream movement of trout when the sluice gate is closed, but brook trout apparently have moved past the barrier during times when the sluice gates were open.

In 1978, three sites were sampled; two sites had no fish present, while five cutthroat trout were captured at a third site. In 1984 and 1985, two groups collected fish population data in Bobtail Creek; in 1984, Chadwick & Associates, Inc. (1985, 1986) reported a population dominated by cutthroat trout, with brook trout present in small proportions (Table 1). Total density was 186 fish/ha, and total biomass was 11.0 kg/ha. CPW collected 25 brook trout and 4 cutthroat trout in 1984 and 12 cutthroat trout in 1985, but did not estimate total fish density or biomass. From 1992 to 2003, brook trout dominated the fish populations with at least 57 percent of the total density. A 2000 USFS survey produced a population estimate of 791 plus or minus 165 cutthroat trout, but brook trout outnumbered cutthroat trout by a ratio of 4:3 (Fieke *et al.* 2003). At one site in 2001, an extremely high total density of 21,083 fish/ha was reported; this was likely due to large numbers of young fish, although no biomass estimates exist from that site to verify this assumption. At a different site the same year, total fish density was 663 fish/ha and total fish biomass was 50.4 kg/ha. In 2003, brook trout biomass was estimated at 22.4 kg/ha at one site. The cutthroat trout density estimate for Bobtail Creek was 0 to 50 fish/mile (Hirsch *et al.* 2006).

A brook trout removal was conducted in 2001 to alleviate competitive pressure on cutthroat trout, but the proportion of brook trout was similar in 2001 and 2003, indicating that the brook trout population quickly rebounded through recolonization, reproduction, or a combination of the two. Further brook trout removals were conducted in 2011 through 2014. Several hundred brook trout were removed each year by CPW. The portion of the sampled fish each year that

were cutthroat trout ranged from only 8 percent in 2012, up to approximately 25 percent in 2014. In 2014, 71 cutthroat trout were collected by CPW and returned to the stream. The cutthroat trout in Bobtail Creek are 90 to 99 percent genetically pure (Hirsch *et al.* 2006).

Table 1. Fish Population Data for Bobtail Creek Upstream of Denver Water Diversion (1984 to 2003) (Corps 2015).

Species/Date (Sampling Sites)	1984 (1)	1992 (1)	2001 (5)	2003 (2)
Brook Trout	7%	57%	65%	66%
Cutthroat Trout	93%	43%	35%	34%
Average Density (fish/ha)	*186*	*28 captured*[1]	*4,574*	*662*
Range	N/A	N/A	323 to 21,083	657 to 667
Average Biomass (kg/ha)	*11.0*	*N/R*	*N/R*	*N/R*
Range	N/A	N/A	N/R	N/R

Source: Chadwick & Associates, Inc. 1985; 1986; Ficke *et al.* 2003; CPW 2006 *in* Corps (2015).
Notes:
[1]Data from 1992 reflect the number captured, since insufficient data were included to calculate total density and biomass estimates.
The number of sample sites represented in each time period is shown in parentheses.
% = percent
fish/ha = fish per hectare
kg/ha = kilogram per hectare
N/A = not applicable
N/R = not reported

Downstream of the diversion, fish populations were sampled at two sites in 1984 and at one site in 2001. In all years, only brook trout and cutthroat trout were collected. In 1984, total fish density at one site was 978 fish/ha, with brook trout comprising 86 percent of the population; total fish biomass was 58.6 kg/ha. At a separate site, one brook trout and 12 cutthroat trout were captured, but total density or biomass estimates were not available. In 2001, total fish density was 653 fish/ha with brook trout comprising 86 percent of the population.

Steelman Creek

Upstream of the Denver Water diversion in Steelman Creek, fish populations were sampled in 1974, 1978, 1984, 2000, 2003, and 2004. Based on the studies described below, the findings indicate that the diversion on Steelman Creek is an effective barrier when the sluice gate is closed.

In 1974 and 1978, cutthroat trout was the only species collected but total fish densities and total fish biomass estimates were not reported. Cutthroat trout was also the only species collected in 1984. Total fish density was 492 fish/ha and total fish biomass was 24.3 kg/ha (Table 2). By 2000, brook trout began to comprise sizeable proportions of the population. Although a 2000 USFS survey produced a cutthroat trout population estimate of 908 plus or minus 532 fish, brook trout outnumbered the native fish by a ratio of 4:1 (Ficke *et al.* 2003). Eight consecutive sites were sampled in 2004; however, data from all eight sites were combined into one site in the CPW report (CPW 2006), and biomass estimates were not made. The most recent cutthroat trout density estimate is 151 to 400 fish/mile; these cutthroat trout are 90 to 99 percent genetically pure (Hirsch *et al.* 2006). In 2011, during brook trout removals by CPW, there were 85 cutthroat

trout returned to the stream and 166 brook trout removed. In 2013, there were 270 cutthroat trout returned to the stream, including many young fish, and 277 brook trout removed by CPW.

Table 2. Fish Population Data for Steelman Creek Upstream of Denver Water Diversion (1984 to 2004)(Corps 2015).

Species/Date (Sampling Sites)	1984 (1)	2000 (1)	2003 (2)	2004 (1)
Brook Trout	0%	80%	35%	47%
Cutthroat Trout	100%	20%	65%	53%
Average Density (fish/ha)	*492*	*908*	*933*	*647*
Range	N/A	N/A	925-941	N/A
Average Biomass (kg/ha)	*24.3*	*N/R*	*N/R*	*N/R*
Range	N/A	N/A	N/A	N/A

Source: Chadwick & Associates, Inc. 1985, 1986; CPW 2003, 2006 *in* Corps (2015).
Notes:
The number of sample sites represented in each time period is shown in parentheses.
% = percent N/A = not applicable
fish/ha = fish per hectare N/R = not reported
kg/ha = kilogram per hectare

Downstream of the diversion, fish populations were sampled in 1978 and 1984. In 1978, two cutthroat trout and one brook trout were collected. Density and biomass estimates were not reported. In 1984, brook trout dominated the community comprising 79 percent of the fish density and 83 percent of the fish biomass. Total fish density was 792 fish/ha, and total fish biomass was 57.1 kg/ha.

East Slope – Gross Reservoir

Impacts to green lineage cutthroat trout at Gross Reservoir were addressed in the 2009 BA and subsequent 2009 biological opinion, and no new information has been identified for green lineage cutthroat trout at Gross Reservoir. CPW stocked 61,000 greenback cutthroat trout in Gross Reservoir in 2002 (with an average size of 1.73 inches), and 77,027 in 2004 (with an average size of 2.8 inches) (Swigle 2008). Net sampling by CPW on June 1, 2007, did not find any greenback cutthroat trout, and they appear to be relatively rare if they are still present. After the 2002 and 2004 stocking events, problems were discovered with the genetic purity of a number of green lineage cutthroat trout populations (Metcalf *et al.* 2007), and the cutthroat trout stocked at Gross Reservoir are likely to have been hybrids of green lineage and Colorado River cutthroat trout (Swigle 2008). Gross Reservoir is not considered a recovery water for green lineage cutthroat trout (Young *et al.* 2002), and a number of other fish species and hybrids are regularly stocked at Gross Reservoir. Therefore, due to fact that the fish stocked into Gross Reservoir were a hybridized stock, this population is not considered a protected population under the ESA.

Existing Water Diversions within the Action Area

Diversion of water is currently occurring in all of the four green lineage cutthroat trout streams present within the action area. The discussion on current water diversions is provided in the

Effects Analysis section of this biological opinion because these effects were not previously consulted on and because the conservation measures have been specifically developed to address, in part, the impacts resulting from the existing water diversions.

Whirling Disease

Whirling disease is considered to be present within the action area and all watersheds have tested positive, although particular streams within these watersheds may still be negative for whirling disease (FEIS, Section 3.11.1.7). Fish surveys in the four green lineage cutthroat trout streams in the action area have not detected the presence of deformities in these fish (K. Larkin, USFS, pers. comm.). At this time, we do not know if whirling disease is currently present in Bobtail, Steelman, Hamilton, or Little Vasquez creeks.

EFFECTS OF THE PROPOSED ACTION

Diversion of water from streams within the action area, including the green lineage cutthroat trout streams, is believed to be resulting in entrainment of fish due to the lack of screens on the diversion structures. Fish that are entrained are considered to be lost from a given population. The proposed action is expected to continue to result in entrainment impacts to green lineage cutthroat trout at the current level under the current diversion conditions and, additionally, is expected to result in increased entrainment in the future as water diversion rates increase.

Invasion of non-native fish into cutthroat trout stream has been identified as a significant threat to cutthroat trout populations in the form of competition and predation. The diversion structures generally provide a barrier from invasion of non-native fish, although invasions can occur when sluice gates on the diversions are open. Project conservation measures have been designed to secure the four green lineage cutthroat trout streams from the threat of non-native fish invasions and are expected to significantly benefit the green lineage cutthroat trout populations by removing these threats. Project conservation measures also include the creation of new green lineage cutthroat trout populations in McQueary Creek/Lake (2.6 miles) and St. Louis Creek (4.8+ miles) through reintroduction of green lineage cutthroat trout.

Additional impacts to green lineage cutthroat trout are also expected as a result of Denver Water's operation and maintenance activities for the diversion system, primarily in the form of sedimentation and disturbance impacts.

Effects from Water Diversions under Current, Full Use, and Moffat Project Conditions

Entrainment under Current Conditions

Diversion structures within the action area do not have fish screens that would otherwise keep fish from entering diversion canals. Therefore, entrainment of fish is occurring, likely resulting in a loss of fish from the green lineage cutthroat trout populations in Bobtail, Steelman, Hamilton, and Little Vasquez creeks. Observations of cutthroat trout in canals downstream of the diversion structures (K. Larkin, USFS, pers. comm.) are consistent with this concern of

entrainment. However, the effects of the entrainment are difficult to assess and quantify without specific on-site entrainment studies. Because of the difficulty in assessing the number of fish lost from a population due to entrainment, we consider the amount of water diverted from a given stream to be a surrogate for fish lost from a stream due to entrainment.

Summary of Entrainment Study Provided in BA

A recent estimation of the effects of current entrainment was performed by GEI and included in the BA (Corps 2015). The estimate was conducted on Bobtail and Steelman creeks in the Williams Fork River Basin. The method of data collection by CPW on Bobtail and Steelman creeks allowed for the sampling reach to be subdivided into smaller sections to determine if fish density is different based on distance from the diversion dam. This type of CPW data was not available for Hamilton or Little Vasquez creeks. Entrainment estimates were evaluated using three different approaches that focused on the number of fish encountering the diversion. We are providing a summary of the entrainment study; the full description of the study is provided in Appendix B of this biological opinion:

> Quantitative studies that directly estimate the entrainment of fish into the diversions and the take of cutthroat trout (e.g., using a marking or netting method) have not been conducted in these two streams. Instead, CPW electrofished upstream of the diversions in Bobtail Creek in 2011, 2012, 2013, and 2014, and in Steelman Creek in 2011 and 2013, noting the location of each fish collected with geographical coordinates (except in 2014). Many individual fish in a population move short distances (sedentary trout), while the remainder moves much longer distances (mobile trout). Accounting for individual variability in movement rates, three modeling approaches were developed to estimate the entrainment of cutthroat trout in Denver Water diversions using the CPW data.
>
> The first approach takes into account the different movements between sedentary and mobile trout and the percentages that could be entrained. The second approach is similar but also incorporates specific data on cutthroat trout and takes into account the distances individual fish would move. The third approach simply assumes that the lack of fish near the diversion is entirely due to entrainment. Each approach is discussed briefly below.
>
> **Approach 1: Simple, Separate Estimates for Mobile and Sedentary Fish**
>
> For this approach, the fish population was separated into mobile (20%) and sedentary (80%) proportions. These proportions are typical for trout and other fishes (Heggenes et al. 1991; Rodriguez 2002; Schrank and Rahel 2006). Fish were assigned to one of two locations: 0 to 100 m upstream of the diversion (short distance), and greater than 100 m from the diversion (long distance). The frequency with which short distance fish encountered the diversion was estimated by a turnover rate, or the rate at which individuals leave and are replaced by others in a short reach. This number was divided by two to account for equal probability of upstream or downstream movement. The long distance fish that encountered the diversion were estimated by multiplying the number of fish more than 100 m upstream of the diversion by 10% (i.e., 20% mobile individuals with half moving downstream and half moving upstream). The number of individual cutthroat trout potentially encountering the diversion under this scenario would be

$$Total\ encounters = \left(^{0.69}/_{2} * n\right) + \left(^{0.20}/_{2} * x\right),$$

where n is the number of individuals within 100 m of the diversion, and x is the number of individuals more than 100 m upstream of the diversion. This accounts for both the short distance and long distance fish.

Approach 2: A Spatially Explicit Modeling Approach

This approach also uses the concept that the distribution of individual fish movements is leptokurtic in which a greater number of the fish move shorter distances and a smaller number of the fish move longer distances, but movements are modeled with a mathematical distribution built with cutthroat trout data. This more sophisticated approach allows calculation of cumulative risk of fish encountering the diversion from multiple starting locations.

The probability that each individual cutthroat trout encountered the diversion was calculated using its physical location (i.e., meters upstream of the diversion) and the exponential function. The encounter probability for each fish was divided by two (to account for the equal probability of upstream or downstream movement). Individual fish were placed in one of two categories: short distance (within 300 m of the diversion), and long distance (over 300 m upstream of the diversion), because only the mobile proportion of fish over 300 m upstream of the diversion would encounter it. The encounter probabilities of all of the individual fish were summed to estimate a proportion of each segment that encountered the diversion. This proportion was multiplied by the number present in that segment for a total number of encounters for the segment. The encounters from each segment were summed for a total number of encounters. This analysis was done separately for each year of data in each stream.

Approach 3: Assume Missing Trout Have Been 100% Lost to Entrainment

Because cutthroat trout were often absent near the diversions in Bobtail and Steelman creeks, we assumed that they would be more common if the diversions were not entraining fish. For the third approach, take estimates were developed for Bobtail and Steelman creeks based on this assumption. This approach differs from the other two in that no assumptions are made about fish movement and movement is not modeled. Instead, this approach relies on the hypothesis that entrainment is the sole reason that fish are uncommon or absent in the immediate vicinity of the diversion and that, without entrainment, fish density near the diversion would be similar to density in upstream sections of the streams. This approach was used so that entrainment rates could be viewed from a different perspective. The length of each stream was divided into 200 m segments, and the number of fish present in each segment for each year was determined with a histogram function in Microsoft Excel. The number lost to entrainment in the 200 m segment just upstream of the diversion in each stream in each year was assumed to be the mean of the number of fish in all of the other inhabited segments. The typical upper limit of fish distribution was 2,200 m upstream of the diversion in Bobtail Creek and 2,800 m upstream of the diversion in Steelman Creek. Therefore, the fish lost from the 0 to 200 m segment in Bobtail Creek was the average number of individuals in the 200 m

segments from 200 to 2,200 m upstream of the diversion, and the fish lost from the 0 to 200 m segment in Steelman Creek was the average number of individuals in the 200 m segments from 200 to 2,800 m upstream of the diversion.

Results of Entrainment Study - Model estimates of cutthroat trout entrainment under existing conditions varied by year, stream, and estimation approach (Table 2). The model entrainment estimates ranged from 2 to 25 fish per year in Bobtail Creek and from 5 to 89 fish per year in Steelman Creek. The high estimates in both streams in 2013 are the result of the high number of young fish collected that year, and, given the purported potential nursery habitat identified more than 0.6 miles upstream of the diversions and the low likelihood that the smaller fish would actually disperse that far, these estimates could be artificially high. A large number of young fish occurred nearly 0.6 miles upstream of the diversions in both streams.

Table 3. Estimates of Cutthroat Trout entrainment for Bobtail and Steelman creeks, according to the three approaches (Corps 2015).

Stream/Year	Number of Cutthroat Trout Captured	Number of Cutthroat Trout Entrained			Proportion of Total Population Entrained (Range)
		Approach 1: Simple, Separate Estimates	Approach 2: Spatially Explicit Model	Approach 3: Missing Trout 100% Lost	
Bobtail Creek 2011	38	5	2	3	5-12%
Bobtail Creek 2012	40	4	3	3	7-9%
Bobtail Creek 2013	116	25	9	8	6-18%
Steelman Creek 2011	85	9	9	5	6-10%
Steelman Creek 2013	270	27	89	19	7-25%

The estimates vary widely from year to year even within the same estimation approach. This variation is due in large part to the different number of trout collected each year. This variation demonstrates that there is not a consistent number of trout entrained every year. Entrainment rates likely change with many biological factors that could vary each year, including population size, fish location, the relative densities of different size classes of trout, as well as weather-related factors that could affect trout movement such as spring runoff flows, summer flows, and water temperature. In most cases, the combined estimates of take from the three models indicate that fewer than 10 cutthroat trout are entrained each year in each diversion at Bobtail and Steelman creeks, representing less than 10 percent of the resident populations.

Estimates of Current Entrainment

Using this general assumption that the annual rate of entrainment is 10 percent of the existing populations, recognizing that this only a rough estimation since differences occur in stream

hydrology, population, and habitat characteristics, we estimate that approximately 79 fish are lost from the Bobtail Creek population each year due to entrainment under the current conditions (based on a population size of 791 fish +/- 165, as provided in *Environmental Baseline* section). We estimate that approximately 91 fish are lost from the Steelman Creek population each year due to entrainment under the current conditions (based on a population size of 908 fish +/- 532, as provided in *Environmental Baseline* section). We estimate that approximately 11 fish are lost from the Little Vasquez Creek population each year due to entrainment under the current conditions (based on a population size of 108 fish +/- 51, as provided in *Environmental Baseline* section). We estimate that 120 fish are lost from the Hamilton Creek population each year due to entrainment under the current conditions (based on a population size of 1,206 fish +/- 202, as provided in *Environmental Baseline* section). The estimated combined number of fish lost to entrainment for the four green lineage cutthroat trout streams under the current condition is 301 fish per year.

Downstream of Denver Water's Diversions – Under the current diversion conditions, green lineage cutthroat trout that move downstream of the diversions would be lost from the conservation populations identified above the diversions since downstream migrants cannot return to the isolated headwater population due to the existing diversion structures. However, the green lineage cutthroat trout populations above the diversions would not be affected by stream flow changes below the diversions. Under the current diversion conditions, the streams below the diversions are completely diverted for much of the year. Because the green lineage cutthroat trout populations do extend below the diversion structures, green lineage cutthroat populations would not be affected by the removal of the water below the structures, although individual green lineage cutthroat trout that may present would be likely killed by means of being stranded.

Summary – Existing water diversions were estimated to result in annual entrainment rates of approximately 10 percent, with a range from 5-25 percent, of the fish populations in Bobtail and Steelman creeks, based on a study conducted by the Corps and provided in the BA. Using the entrainment rate of 10 percent of a stream population per year, we estimate that the combined number of fish lost to entrainment for the four green lineage cutthroat trout streams under the current condition is 301 fish per year. As provided by the BA, in spite of current entrainment rates, the fish populations in these streams continue to be maintained.

Entrainment under Full Use and Moffat Project

The Full Use and Moffat Project diversion scenarios are likely to increase entrainment of green lineage cutthroat trout in the future due to projected increases in the amount of water diverted. A summary of the anticipated increases to average annual diversions (AF/yr) in Little Vasquez, Hamilton, Steelman, and Bobtail creeks is presented in Table 4 and a summary of average changes in diversions (cubic feet per second (cfs)) is shown in Table 5.

Table 4. Change in Average Diversions at Denver Water's Diversion Points from Current Conditions[1] to Full Use[2] and Full Use to the Moffat Project[3] (Corps 2015).

Diversion Point	Full Use (AF/yr)	Moffat Project (AF/yr)
Little Vasquez Creek	96	318
Hamilton Creek [4]	64	245
Steelman Creek	229	457
Bobtail Creek	390	855
Total	**779**	**1,875**

Source: Appendix H, Moffat Project FEIS (Corps 2014).

Notes:

[1] Current Conditions are associated with an average annual demand of 285,000 acre-feet (AF). At this demand level, average annual diversions through the Moffat Tunnel are 63,799 AF.

[2] Full Use diversions are associated with an average annual demand of 345,000 AF. At this demand level, average annual diversions through the Moffat Tunnel are 66,512 AF.

[3] Moffat Project diversions are associated with an average annual demand of 363,000 AF. At this demand level, average annual diversions through the Moffat Tunnel are 76,797 AF.

[4] Includes diversions from all streams in the Englewood Ranch Gravity System. Hamilton Creek diversions account for approximately 24 percent of the total diversions shown above for Full Use and the Moffat Project.

AF/yr = acre-feet per year

Table 5. Change in Average Annual Diversions (cfs) at Denver Water's Diversion Points from Current Conditions [1] to Full Use [2] and Full Use to the Moffat Project [3] (Corps 2015).

Diversion Point	Full Use (cfs)	Moffat Project (cfs)
Little Vasquez Creek	0.1	0.4
Hamilton Creek [4]	0.1	0.3
Steelman Creek	0.3	0.6
Bobtail Creek	0.5	1.2

Source: Appendix H, Moffat Project FEIS (Corps 2014).

Notes:

[1] Current Conditions are associated with an average annual demand of 285,000 acre-feet (AF). At this demand level, average annual diversions through the Moffat Tunnel are 63,799 AF.

[2] Full Use diversions are associated with an average annual demand of 345,000 AF. At this demand level, average average annual diversions through the Moffat Tunnel are 66,512 AF.

[3] Moffat Project diversions are associated with an average annual demand of 363,000 AF. At this demand level, average annual diversions through the Moffat Tunnel are 76,797 AF.

[4] Includes diversions from all streams in the Englewood Ranch Gravity System. Hamilton Creek diversions account for approximately 24 percent of the total diversions shown above for Full Use and the Moffat Project.

cfs = cubic feet per second

Little Vasquez Creek

Changes in Diversions from Current Conditions to Full Use

Average annual diversions (45-year average) in Little Vasquez Creek would increase by 0.1 cfs from Current Conditions to Full Use, which represents a 3 percent increase in diversions. The increase in diversions would occur mostly during times of high runoff, typically in June. There would be no change in diversions in dry years. In wet years, average annual diversions would increase by 0.4 cfs, which represents an 8 percent annual increase in diversions, although

average monthly increases during high runoff periods (e.g., June) could result in a 19 percent increase in water diverted. We expect that the increased water diversion in Little Vasquez Creek would result in increased entrainment of green lineage cutthroat trout, although that value is difficult to calculate.

Changes in Diversions from Full Use to Moffat Project

Average annual diversions (45-year average) in Little Vasquez Creek would increase by 0.4 cfs from Full Use to the Moffat Project, which represents an 8 percent increase in diversions. The increase in diversions would occur mostly during times of high runoff, typically in June. There would be no change in diversions in dry years. In wet years, average annual diversions would also increase by 0.4 cfs, which represents an 8 percent increase in diversions, although average monthly increases during high runoff periods (e.g., June) could result in a 54 percent annual increase in water diverted. We expect that the increased water diversion in Little Vasquez Creek would result in increased entrainment of green lineage cutthroat trout, although that value is difficult to calculate.

Hamilton Creek

Hamilton Creek is part of the Englewood Ranch Gravity System and accounts for approximately 24 percent of the total diversions in the system. There is a USFS minimum flow requirement for Hamilton Creek of 1.5 cfs from June 15 through April 30 and 1.0 cfs from May 1 through June 14.

Changes in Diversions from Current Conditions to Full Use

Average annual diversions (45-year average) in the Englewood Ranch Gravity System would increase by 0.1 cfs (0.02 cfs for Hamilton Creek) from Current Conditions to Full Use, which represents a 4 percent increase in diversions. The increase in diversions would occur mostly during times of high runoff, typically in June. There would be no change in diversions in dry years. In wet years, average annual diversions would increase by 0.3 cfs (0.07 cfs for Hamilton Creek), which represents a 18 percent increase in diversions, although average monthly increases during high runoff periods (e.g., June) could result in a 81 percent increase in water diverted. We expect that the increased water diversion in Hamilton Creek would result in increased entrainment of green lineage cutthroat trout, although that value is difficult to calculate.

Changes in Diversions from Full Use to Moffat Project

Average annual diversions (45-year average) in the Englewood Ranch Gravity System would increase by 0.3 cfs (0.07 cfs for Hamilton Creek) from Full Use to the Moffat Project, which represents a 13 percent increase in diversions. The increase in diversions would occur mostly during times of high runoff, typically in June. There would be no change in diversions in dry years. In wet years, average annual diversions would also increase by 0.5 cfs (0.12 cfs for Hamilton Creek), which represents a 22 percent increase in diversions, although average monthly increases during high runoff periods (e.g., June) could result in a 1,823 percent increase (or 2.1 cfs of which 0.5 cfs represents Hamilton Creek) in water diverted. We expect that the increased water diversion in Hamilton Creek would result in increased entrainment of green lineage cutthroat trout, although that value is difficult to calculate.

Steelman Creek

Changes in Diversions from Current Conditions to Full Use

Average annual diversions (45-year average) in Steelman Creek would increase by 0.3 cfs from Current Conditions to Full Use, which represents a 10 percent increase in diversions for Steelman Creek. The increase in diversions would occur mostly during times of high runoff, typically in June. Dry year diversions would increase on average by 0.4 cfs (14 percent) on Steelman Creek. In wet years, average annual diversions would increase by 0.3 cfs, which represents an 11 percent increase in diversions for Steelman Creek, although average monthly increases during high runoff periods (e.g., May) could result in a 36 percent increase in water diverted. We expect that the increased water diversion in Steelman Creek would result in increased entrainment of green lineage cutthroat trout, although that value is difficult to calculate. There are no required bypass flows in this creek and it is already fully diverted for much of the year.

Changes in Diversions from Full Use to Moffat Project

Average annual diversions (45-year average) in Steelman Creek would increase by 0.6 cfs from Full Use to the Moffat Project, which represents an 18 percent increase in diversions for Steelman Creek. The increase in diversions would occur mostly during times of high runoff, typically in June. There would be no change in diversions in dry years. In wet years, average annual diversions would also increase by 0.4 cfs, which represents a 17 percent increase in diversions for Steelman Creek, although average monthly increases during high runoff periods (e.g., June) could result in a 126 percent increase in water diverted. We expect that the increased water diversion in Steelman Creek would result in increased entrainment of green lineage cutthroat trout, although that value is difficult to calculate. There are no required bypass flows in this creek and it is already fully diverted for much of the year.

Bobtail Creek

Changes in Diversions from Current Conditions to Full Use

Average annual diversions (45-year average) in Bobtail Creek would increase by 0.5 cfs, which is a 10 percent increase. The increase in diversions would occur mostly during times of high runoff, typically in June. Dry year diversions would increase on average by 0.8 cfs (15 percent). Bobtail Creek average annual diversions in wet years would increase by 0.5 cfs, which is a 13 percent increase, although average monthly increases during high runoff periods (e.g., May) could result in a 36 percent increase in water diverted. We expect that the increased water diversion in Bobtail Creek would result in increased entrainment of green lineage cutthroat trout, although that value is difficult to calculate. There are no required bypass flows in this creek and it is already fully diverted for much of the year.

Changes in Diversions from Full Use to Moffat Project

Average annual diversions (45-year average) in Bobtail Creek would increase by 1.2 cfs, which is a 20 percent increase. The increase in diversions would occur mostly during times of high runoff, typically in June. There would be no change in diversions in dry years. Bobtail Creek average annual diversions in wet years would increase by 0.9 cfs, which is a 22 percent increase, although average monthly increases during high runoff periods (e.g., June) could result in a 167 percent increase in water diverted. We expect that the increased water diversion in Bobtail

Creek would result in increased entrainment of green lineage cutthroat trout, although that value is difficult to calculate. There are no required bypass flows in this creek and it is already fully diverted for much of the year.

Entrainment under Full Use and the Moffat Project

Estimating the additional entrainment due to the Full Use and Moffat Project is difficult because the entrainment estimates by GEI (Corps 2015) were based on the number of fish that encountered the diversions, not on a rate of flow or the number of days of flow into the diversion. This analysis assumed that the rate of entrainment is more a function of the number of fish in the vicinity of the diversion rather than the rate of flow or duration of flow into the diversion. Nonetheless, it is likely that the risk of entrainment in the four creeks from operation of the Full Use and Moffat Project is likely to increase compared to the Current Conditions because of increased water diversions. The FEIS (Corps 2014) concluded that the Moffat Project would cause take of some individual green lineage cutthroat trout, and that the increased risk of entrainment represents an adverse effect to the species. Based on the original estimate that less than 10 fish are expected to be entrained under the Current Conditions, the increased number of fish entrained is likely to be much less than 10 fish from each stream each year (Corps 2015). Therefore, the estimated number for fish lost from the population due to entrainment from the increased future diversions under the Moffat Project is 40 fish (10 fish each for Little Vasquez, Hamilton, Steelman, and Bobtail creeks).

Additional impacts resulting from entrainment are expected to occur once green lineage cutthroat trout have been reintroduced into McQueary Creek and St. Louis Creek because diversion structures are also present on those streams. We consider it difficult to estimate the amount of future entrainment at those locations without knowing the population sizes in those streams. This biological opinion covers future potential entrainment caused by Denver Water's operations and maintenance at those locations through the conservation measures included in this biological opinion.

Summary - Diversion of water from green lineage cutthroat trout streams within the action area under the Current Conditions is estimated to result in a loss of 301 fish per year due to entrainment, based on an estimate provided in the BA that approximately 10 percent of each population may become entrained (Corps 2015). Increased water diversions under the Full Use and Moffat Project conditions are expected to result in increased entrainment of fish. Increased diversions will primarily occur during wet years, with average annual increases ranging from 8 percent to 22 percent in the green lineage cutthroat trout streams under the Moffat Project, although much higher monthly increases will occur during high runoff months of May and June. However, an estimated increased entrainment amount is difficult to calculate since the analysis that was used for the Current Conditions assumed that the rate of entrainment was more a function of the number of fish in the vicinity of the diversion rather than the rate of flow or duration of flow into the diversion. The BA (Corps 2015) estimated that the increased number of fish entrained is likely to be much less than 10 fish from each stream each year under the Moffat Project. Therefore, using this same principle, we estimate that the number of fish lost from the increased future diversions under the Moffat Project would be 40 fish per year, resulting in a future project entrainment total of 341 fish per year. The BA (Corps 2015) concludes that future additional diversions during high flows in average and wet years should not affect the ability of

existing green lineage cutthroat trout populations to continue to sustain themselves above the diversion points.

Effects from Implementation of Conservation Measures

Conservation Measures 1 and 2 were designed and intended to fully mitigate the impacts to the green lineage cutthroat trout resulting from the proposed action, which includes the Current Conditions, Full Use, and the Moffat Project. Conservation Measures 1 and 2 were specifically developed to address what was considered to be the greatest threat to the fish, namely the invasion of non-native fish (i.e., brook trout). Brook trout compete for habitat and food sources with cutthroat trout and also prey upon young cutthroat trout. Brook trout are currently present in Steelman and Bobtail creeks above the diversion structures. If these non-native species of trout continue to occupy green lineage cutthroat trout habitat in these streams, the long-term survivability of these native fish populations is at risk.

Therefore, Conservation Measures 1 and 2 will provide:

- f protection of existing green lineage cutthroat trout populations;
- f enhancement of green lineage cutthroat trout populations through brook trout eradication in Steelman and Bobtail creeks; and
- f expansion of the green lineage cutthroat trout distribution through re-introduction of the species in West Slope streams.

Conservation Measure 1: Protection, Enhancement, and Recovery of Green Lineage Cutthroat Trout in the Upper Williams Fork River Basin

As part of the proposed action, Denver Water has committed to a number of measures that are expected to greatly enhance and secure the green lineage cutthroat trout in the Upper Williams Fork River Basin by addressing the current and future threats of invasions of non-native fish. Currently, the diversions on Bobtail and Steelman creeks serve as an effective barrier to upstream fish passage when the sluice gates are closed; however, both brook trout and cutthroat trout have been identified above and below these diversions, indicating that brook trout are able to travel upstream of the diversions through the sluice gates. Denver Water and CPW will jointly cost-share the eradication of brook trout in Bobtail Creek (3.7 miles), Steelman Creek (2.6 miles), and McQueary Creek/Lake (2.6 miles). The proposed action will also establish a new green lineage cutthroat trout population through re-introduction in McQueary Creek/Lake, resulting in an additional 2.6 miles of green lineage cutthroat trout stream plus McQueary Lake (3 acres). Bobtail, Steelman, and McQueary creeks are all at the headwaters of the Upper Williams Fork River. Since these three streams (and lake) are in the same general vicinity, Denver Water is adding additional protections to Steelman and Bobtail creeks, and habitat expansion into McQueary Creek and Lake.

The treatments to eradicate brook trout and the general handling and transporting of the fish for the reintroduction will likely result in some injury and, potentially, mortality to a small number of individual fish; this work will be conducted primarily by the CPW and incidental take will be covered through CPW's Section 6 agreement with the Service.

Denver Water will also construct and maintain three fish migration barriers immediately downstream of its existing diversion structures on Bobtail, Steelman, and McQueary creeks, further securing the green lineage cutthroat trout populations from non-native fish invasions. Based on Denver Water's preliminary engineering evaluations, the fish migration barriers will require replacement of the culverts on Bobtail and McQueary creeks below the existing diversion structures, and the construction of a sluice gate channel at the existing diversion on Steelman Creek. Denver Water will incorporate a minimum of a 4-foot drop (more if possible) into the barrier and a downward-sloping flat splash pad or rip rap (laid flat or rolled) to minimize pool development below the barrier; these features are expected to prevent the upstream migration of fish. Because green lineage cutthroat trout populations exist above the barriers, construction work below the barriers will not affect these populations or their aquatic habitat.

Removal of brook trout from Bobtail and Steelman creeks will provide a significant benefit by removing the current competition and predation impacts, resulting in enhanced survival and reproduction. Reintroduction of green lineage cutthroat trout into McQueary Creek/Lake will also add an additional green lineage cutthroat trout population to the existing 60 populations currently present throughout its range.

Denver Water's operation and maintenance activities require the occasional opening of the sluice gates when maintenance is required, for mechanical removal of sediment at the diversion structures, and during periods of high flow conditions that may cause damage or jeopardize the integrity of the diversion structures. Denver Water will make a good faith effort to only partially open the sluice gates wide enough to safely release water past the diversions and maintain sufficient water velocities through the sluice gates to impede upstream fish migration. Keeping the sluice gates closed as much as possible will provide a second barrier towards upstream fish migration. Denver Water shall notify the USFS Sulphur District Ranger and the CPW Hot Sulphur Springs office in the event the sluice gates are opened during high flow conditions; this notification will provide CPW the opportunity to conduct surveys and remove non-native fish, if necessary. Denver Water's commitment to operate the sluice gates as outlined in Conservation Measure 1(B) will commence upon issuance of the FERC license amendment for the Moffat Project, although the Service acknowledges that Denver Water is currently keeping the sluice gates closed as much as possible at the request of CPW and USFS to prevent upstream fish migration.

The Service recognizes that Denver Water may decide to remove the barriers on Bobtail, Steelman, and McQueary creeks in the future if: 1) a permanent fish barrier is constructed on the Williams Fork River below the confluence of Steelman Creek; 2) eradication of non-native fish has occurred in the Williams Fork River between the new barrier and Denver Water's existing diversions on Bobtail, Steelman, and McQueary creeks, and 3) if CPW has certified that brook trout have been successfully removed from the mainstem of the Upper Williams Fork River. A barrier on the mainstem of the Williams Fork River would provide for a metapopulation that would connect Bobtail, Steelman, and McQueary creeks, resulting in enhanced conservation for the green lineage cutthroat trout. A metapopulation would also provide greater protection from stochastic events (i.e., fire, flood event) by providing refugia and allowing for repopulation of disturbed areas. Establishment of a metapopulation in the main stem of Upper Williams Fork River may require additional section 7 consultation by other(s) with the Service (separate from

this consultation) due to the presence of green lineage cutthroat trout above the diversion structures and the effects of the actual removal of the barriers described in this biological opinion.

Conservation Measure 1 is expected to greatly enhance and secure the green lineage cutthroat trout in the Upper Williams Fork River Basin by removing existing invasive fish species and securing the population from additional invasions of non-native fish, resulting in improved survival of the green lineage cutthroat trout in these streams. Conservation Measure 1 will also increase the number of green lineage cutthroat trout populations by the reintroduction of green lineage cutthroat trout into McQueary Creek/Lake and, additionally, may further increase the number of green lineage cutthroat trout populations if a metapopulation is developed in the mainstem of the Upper Williams Fork River. We anticipate that only insignificant and discountable impacts would occur to green lineage cutthroat trout as a result of these activities because most of this work will occur in areas that are not occupied by the fish or, in the case of the reintroduction and eradication activities, work will be conducted with CPW fisheries biologists and incidental take will be addressed through CPW's Section 6 Agreement with the Service.

Conservation Measure 2: Protection of Green Lineage Cutthroat Trout in the Fraser River Basin

As part of the proposed action, Denver Water has committed to a number of measures that will greatly enhance and protect the green lineage cutthroat trout in the Fraser River Basin. These measures include maintaining the barriers on the existing green lineage cutthroat trout streams (i.e., Hamilton and Little Vasquez creeks) and reintroducing a new green lineage cutthroat trout population into St. Louis Creek.

Hamilton and Little Vasquez Creeks - Denver Water will continue to maintain its diversion structures on Hamilton and Little Vasquez creeks permanently in a manner that safeguards the populations of green lineage cutthroat trout located above the diversions from the threat of invasion of non-native fish, resulting in the continued protection of 2.7 miles of occupied stream in Hamilton Creek and 7.1 miles in Little Vasquez Creek. If new diversion structures are constructed on Hamilton or Little Vasquez creeks in the future, Denver Water will design the replacement structures to be barriers to upstream fish migration. The existing diversions on Hamilton and Little Vasquez creeks appear to be providing a sufficient barrier to non-native fish; therefore, additional barriers beyond the existing diversion structures on these streams are not considered necessary to protect from invasion of non-native fish. These proposed measures are anticipated to be sufficient to continue to protect the green lineage cutthroat trout populations on Hamilton and Little Vasquez creeks from invasion of downstream non-native fish, resulting in the continued survival of these populations.

St. Louis Creek - Denver Water will greatly enhance the distribution and conservation of the green lineage cutthroat trout by actively participating in a cooperative recovery program with USFS, CPW, USFWS, and possibly others, to reintroduce a green lineage cutthroat trout population to St. Louis Creek. The new population would be approximately 14 miles in length, starting approximately 2 miles below the existing diversion on St. Louis Creek and extending above the diversion. We consider the reintroduction of a green lineage cutthroat trout population into St. Louis Creek to be extremely beneficial to the conservation of the green lineage cutthroat

trout as it will add an additional population to the existing 60 green lineage cutthroat trout populations that are present throughout its range.

The plans for this effort are specified in detail in the *Proposed Action* section of this biological opinion. To summarize, as part of this effort, Denver Water will ensure that its existing diversion structure on St. Louis Creek provides a complete barrier, thereby reducing the threat of invasion of non-native fish for the green lineage cutthroat trout population that will be reintroduced in the future. Denver Water and the other partners will identify and dedicate funding for developing the design and implementation of a fish eradication program and a green lineage cutthroat trout re-introduction program for St. Louis Creek above and below Denver Water's existing diversion. This plan includes the construction of a new barrier below the existing diversion on St. Louis Creek (location to be determined) in order to gain additional occupied stream miles for the population. The Service recognizes, in accordance with the *Proposed Action*, that if a barrier location is selected such that the construction costs exceed $1.2 million, Denver Water and the partners shall work cooperatively to secure the additional funding needed to complete the barrier and Denver Water shall not be obligated to contribute additional funding beyond $1.2 million. Transporting and handling the fish for the reintroduction will likely result in some injury and, potentially, mortality to a small number of individual fish; this work will be conducted primarily by the CPW and incidental take will be covered through CPW's Section 6 Agreement with the Service. Construction work on the existing diversion on St. Louis Creek and on the lower barrier will not impact the green lineage cutthroat trout population since the fish would not have been reintroduced into the stream yet.

Following construction of the lower barrier and reintroduction of green lineage cutthroat trout, Denver Water will construct a fish ladder at the existing diversion structure on St. Louis Creek that will allow fish to move upstream when Denver Water is spilling water at this diversion. Development of a fish ladder will provide for a longer and better connected green lineage cutthroat trout population. During the design phase, Denver Water will, in consultation with partners, evaluate a fish passage design to make use of the existing minimum bypass flows. The partners will then collaboratively determine which technique to use for fish passage. The Service recognizes, in accordance with the *Proposed Action*, that should the construction cost of the alternative fish passage exceed $500,000, Denver Water and the partners shall identify the additional funding needed to complete the passage and Denver Water shall not be obligated to contribute additional funding. A fish ladder that utilizes the existing minimum bypass flow on St. Louis, as opposed to only operating when the diversion is spilling water, should greatly facilitate the movement of fish up the fish ladder, resulting in even greater benefits to both survival and reproduction of the green lineage cutthroat trout. Construction of the fish ladder could result in downstream water quality impacts to reintroduced fish present below the St. Louis barrier, although Denver Water's erosion control BMPs and their commitment to avoid contact between uncured concrete and stream water will minimize impacts. Following construction of the fish ladder, Denver Water will provide up to $5,000 to CPW for a Passive Integrated Transponder (PIT) tag study to conduct an evaluation, in consultation with USFS, on the success and movements of the reintroduced population. Handling of the fish for the pit tag study will likely result in some injury and, potentially, mortality to a small number of individual fish; this work will be conducted primarily by the CPW and incidental take will be covered through CPW's Section 6 Agreement with the Service.

The Service recognizes, in accordance with the *Proposed Action*, that if the cooperating partners cannot identify and dedicate funding for Conservation Measure 2(B)(ii) (i.e., funding for eradication of brook trout and introduction of green lineage cutthroat trout) in the Proposed Action within 15 years after the date of issuance of the FERC license amendment for the Moffat Project, Denver Water shall have no obligation to complete items in Conservation Measure 2(C) (i.e., reintroduction of green lineage cutthroat trout into St. Louis Creek) under this Section 7 consultation. Denver Water's commitments as outlined in Conservation Measures 2(A)(i.e., maintain secure barriers in Little Vasquez and Hamilton creeks) and 2(B) (i.e., maintain secure barrier on existing diversion on St. Louis Creek) will become effective upon the date of issuance of the FERC license amendment for the Moffat Project. Denver Water shall be responsible for the commitment under Conservation Measure 2(B)(ii) (i.e., funding for eradication of brook trout and introduction of green lineage cutthroat trout) for the recovery program in St. Louis Creek for a period of 15 years after the date of issuance of the FERC license amendment for the Moffat Project. Once funding is dedicated, Denver Water will make its best effort to complete design, acquire permit(s), and construction within 10 years.

We consider the removal of the threat of invasion of non-native fish from Hamilton Creek and Little Vasquez Creek to be extremely beneficial to the conservation of the green lineage cutthroat trout. We also consider the reintroduction of a green lineage cutthroat trout population into St. Louis Creek to be extremely beneficial to the conservation of the green lineage cutthroat trout by contributing approximately 14 miles of additional occupied stream habitat. We anticipate that only insignificant and discountable impacts will occur to green lineage cutthroat trout fish because most of these actions will occur in areas that are not occupied by the fish or, in the case of the reintroduction and eradication activities, a small number of fish would be impacted and work will be conducted with CPW fisheries biologists and incidental take will be addressed through CPW's Section 6 Agreement with the Service. The Service recognizes that if Denver Water and its partners, including CPW, USFS, USFWS and others, are not able to secure funding for eradication of brook trout, for introduction of green lineage cutthroat trout, and for a lower barrier on St. Louis Creek, then these conservation actions may not occur. Therefore, under Conservation Measure 2, Denver Water has committed to maintaining secure barriers on Little Vasquez and Hamilton creeks and will be committed to the other portions of Conservation Measures 2 if Denver Water and the joint partners are able to secure funding.

Summary of Conservation Measures 1 and 2

Collectively, Conservation Measures 1 and 2 are expected to greatly enhance and secure the green lineage cutthroat trout in the Upper Williams Fork and Fraser river basins by removing existing invasive fish species and securing the population from future invasions on approximately 19 miles of existing green lineage cutthroat trout streams, resulting in improved survival of the green lineage cutthroat trout in these streams. Conservation Measures 1 and 2 will also increase the number of green lineage cutthroat trout populations through the reintroduction of green lineage cutthroat trout into McQueary Creek/Lake, resulting in an additional 2.6 miles of occupied stream plus the 3 acre lake, and will further increase the number of populations if a metapopulation is developed on approximately 14 miles of the mainstem of St. Louis Creek. We anticipate that only insignificant and discountable impacts will occur to green lineage cutthroat trout from these actions because most of the work will occur in areas that are not occupied by the fish or, in the case of the reintroduction and eradication activities, only a

small number of fish are expected to be negatively affected and work will be conducted with CPW fisheries biologists, with incidental take to be addressed through CPW's Section 6 Agreement with the Service.

Conservation Measures 1 and 2 were designed and intended to fully mitigate the impacts to the green lineage cutthroat trout resulting from the proposed action, which includes the Current Conditions, Full Use, and the Moffat Project. Conservation Measures 1 and 2 were specifically developed to address what was considered to be the greatest threat to the fish, namely the invasion of non-native fish (i.e., brook trout). Denver Water (Corps 2015) believes that the presence of non-native fish likely do more harm to existing green lineage cutthroat trout populations than Denver Water's diversions. The Service considers that both threats are likely negatively affecting the populations. The Service considers that Conservation Measures 1 and 2 are sufficient to offset the entrainment resulting from the Current, Full, and Moffat Project diversion amounts based on the rate of entrainment of 10 percent of the fish population that was estimated for this project (Corps 2015). We believe that implementation of these conservation measures will result in improved survival and reproduction in these green lineage cutthroat trout streams.

Operation and Maintenance Activities

Denver Water's operation and maintenance activities for its diversion structures and water collection system are expected to result in some impacts to the green lineage cutthroat trout, primarily in the form of sedimentation and disturbance impacts. Additional risks from these activities include potential contamination from equipment and from potential introduction of whirling disease. Denver Water anticipates conducting the following activities: opening and closing of diversion gates, opening and closing of sluice gates, operation of water delivery structures, operation of spillways, maintenance of diversion dams, removal of sediment by mechanical means above and below diversion dams, operation of minimum bypass facilities and channels, construction and operation of fish ladders (if built in the future), reconstruction of diversion dams and associated structures, maintenance and replacement of diversion canals, and transportation activities to diversion facilities. Denver Water currently implements Best Management Practices (BMPs) during construction activities to avoid or minimize sediment and erosion impacts.

Activities that involve the use of heavy equipment within occupied streams are likely to result in sedimentation impacts and disturbance risks to the green lineage cutthroat trout; such activities include mechanical removal of sediment at diversion dams, maintenance and reconstruction of diversion dams and associated structures. Denver Water estimates that sediment removal from diversion structures occurs approximately five times per year at the Bobtail and Steelman creek diversions, although this frequency varies from year to year. Transportation-related activities to diversion facilities may also result in soil disturbances, especially if new access routes are constructed, and erosion from disturbed areas could result in sedimentation within the stream channel, especially following storm events.

Sedimentation Impacts

Existing sediment within the stream channel could be disturbed and redistributed during the mechanical removal of sediment within the streams and possibly other in-stream activities.

Green lineage cutthroat trout habitat located downstream of the treatment areas would be impacted if disturbed sediment fills in pool habitats, interstitial spaces in riffles, affecting food resources and reproduction.

The magnitude of these negative effects would vary based on the proximity and intensity of the in-stream work. Sediment displacement would be most pronounced at sites treated with equipment. Sedimentation in the stream channel could affect feeding by the green lineage cutthroat trout (i.e., sediment can fill in interstitial areas in riffles where macroinvertebrate production occurs), sheltering (i.e., sediment can fill in pool habitats and reduce available habitat, especially winter pools), and breeding (i.e., sediment that can alter and smother spawning sites (i.e., redds). Sedimentation in the creek can also increase turbidity levels, which can affect trout health and survival. Suspended sediment concentrations that reach 3,000 mg/l can cause gill trauma and/or temporary changes in blood physiology (Bash et al. 2001). Lethal effects can occur if suspended concentrations reach 22 mg/l at any one time, or remain at concentrations of 3,000 mg/l for 3 hours (Newcomb and Jenson 1996). However, in-stream work is not expected to result in long-term effects to macroinvertebrates or to fish health due to the relatively small area that will be affected by sediment removal and the short-term nature of this work.

Risk of Injury and Disturbance

In-stream work with equipment has the potential to injure and disturb fish. However, trout typically move away from the area of disturbance and recolonize the site when the conditions stabilize or the disturbance is removed. We anticipate that these fish would have a similar behavioral response to disturbance generated by in-stream work, although the possibility remains that some fish may not be able to relocate and individuals may suffer abrasion, suffocation, or may be buried by streambed sediment. This in-stream work includes mechanical removal of sediment at diversion structures and is generally considered to occur in the pool area immediately adjacent to the diversion structure. Mechanical sediment removal can occur 3 to 5 times per year, but varies as needed. We anticipate that a small number of individuals could be injured or killed as a result of in-stream work with heavy equipment.

Fish that are present downstream of a diversion structure can also be stranded following the complete diversion of the stream flow, likely resulting in the death of the fish. These stranding occurrences for green lineage cutthroat trout are estimated to be relatively infrequent due to the low number of these fish believed to be present below the diversion and the relatively short length of stream where this may occur, due to the stream channels gaining water from side slopes further downstream. Therefore, based on this information, we consider impacts resulting from fish stranding to be insignificant and discountable.

Contamination Risk

Work within the stream channel involves a potential risk to green lineage cutthroat trout from invasive species (e.g., whirling disease), spills from heavy equipment, as well as from uncured concrete; these potential sources of contamination could decrease the survival of the green lineage cutthroat trout if present in the streams.

Whirling disease is known to be present within the project area, however, we do not know if it is present with the existing green lineage cutthroat trout streams in the project area. Observations of green lineage cutthroat trout during fish surveys have not detected the presence of deformities in the fish (K. Larkin, USFS, pers. comm.). The FEIS (Corps 2014) for the project concluded that the Moffat Project would not have an effect on whirling disease because the project would not result in an increase in the habitat for the tubifex worm (FEIS 5.11.1.2). However, whirling disease could be spread to uninfected streams through the use of infected equipment, including both personal equipment and heavy equipment, within the stream channel.

The potential also exists for spills of gasoline and other fluids to result from equipment present in or near the green lineage cutthroat trout streams, however, implementation of Denver Water's BMPs should greatly minimize this potential risk. Additionally, uncured concrete is considered to be toxic to aquatic organisms due to its low pH. Maintenance of diversion structures within the stream channel of green lineage cutthroat trout streams has the potential to adversely affect these fish; however, Denver Water has committed to divert streams away from the work area where concrete is required within the streams and will not place uncured concrete in contact with streams containing green lineage cutthroat trout populations. Because of Denver Water's commitment to implement the BMPs, the potential impacts to green lineage cutthroat trout from potential contamination risks from chemical contamination are expected to be insignificant and discountable, although the risk remains for equipment infected with whirling disease to introduce whirling disease into the green lineage cutthroat trout streams. Therefore, we are adding a Term and Condition to this biological opinion that requires a thorough cleaning and disinfecting of equipment before entering the green lineage cutthroat trout streams.

Summary of Operation and Maintenance Activities - Denver Water's operation and maintenance activities have the potential to negatively affect green lineage cutthroat trout in the form of sedimentation and disturbance impacts. Potential impacts also include the possibility of contamination and introduction of whirling disease due to equipment within the stream channels. Denver Water's erosion control BMPs are expected to minimize the sedimentation and contamination impacts that may result from the operation and maintenance activities. Given that most of the operation and maintenance work will likely occur at diversion structures, which are at the downstream end of occupied habitat, we anticipate that instream work at these locations will have only minimal effects on green lineage cutthroat trout populations. We recognize, however, that these actions will likely result in short-term disturbances within the stream that may also result in slight increases in sedimentation, although this amount is difficult to quantify. We also recognize that heavy equipment within the stream channel has the potential to injure or kill fish. Based on the potential impacts resulting from mechanical removal of sediment in the green lineage cutthroat trout streams as well as the other operations and maintenance activities, we estimate that 4 fish in each of the green lineage cutthroat trout streams could be injured or killed per year, resulting in a total loss of 16 fish per year for the project.

East Slope – Gross Reservoir

At Gross Reservoir, Current Conditions of the existing system, Full Use, and the Moffat Project are unlikely to adversely affect green lineage cutthroat trout because the cutthroat trout stocked in Gross Reservoir in 2002 and 2004 were a hybrid stock and, therefore, are not considered to be a protected population under the ESA.

Summary of the Effects Analysis

Entrainment - Diversion of water from the green lineage cutthroat trout streams within the action area under the Current Conditions is estimated to result in a loss of 301 fish per year due to entrainment, based on an estimate provided in the BA (Corps 2015) that approximately 10 percent of a population may become entrained. Increased water diversions under the Full and Moffat Project conditions are expected to result in increased entrainment of fish. Increased diversions will primarily occur during wet years, with average annual increases ranging from an 8 percent to 22 percent increase in green lineage cutthroat trout streams under the Moffat Project, although even higher monthly increases will occur during high runoff months. The BA (Corps 2015) estimated that the increased number of fish entrained is likely to be much less than 10 fish from each stream each year, therefore, using this same principle, we estimate that the number of fish lost from the increased future diversions under the Moffat Project would be 40 fish per year, resulting in a future project entrainment total of 341 fish per year.

Conservation Measures 1 and 2 - Collectively, Conservation Measures 1 and 2 are expected to greatly enhance and secure the green lineage cutthroat trout in the Upper Williams and Fraser river basins by removing existing non-native fish species and by securing the population from future invasions on approximately 19 miles of existing green lineage cutthroat trout streams. These actions are expected to result in improved survival and reproduction of the green lineage cutthroat trout in these streams. Conservation Measure 1 will also increase the number of green lineage cutthroat trout populations through the reintroduction of green lineage cutthroat trout into McQueary Creek/Lake, resulting in an additional 2.6 miles of occupied stream plus the lake (3 acres). Conservation Measure 2 will further increase the number of populations if fish are reintroduced into St. Louis Creek, resulting in approximately 14 miles of occupied habitat. We anticipate that only insignificant and discountable impacts would occur from implementation of activities involving these conservation measures because most of these actions will occur in areas that are not occupied by the green lineage cutthroat trout, or, in the case of reintroduction and eradication activities, only a small number of fish would be harmed and work will be conducted with CPW fisheries biologists, therefore, incidental take will be addressed through CPW's Section 6 Agreement with the Service.

Conservation Measures 1 and 2 were designed and intended to fully mitigate the impacts to the green lineage cutthroat trout resulting from the proposed action, which includes the Current Conditions, Full Use, and the Moffat Project water diversions. Conservation Measures 1 and 2 were specifically developed to address what was considered to be the greatest threat to the fish, namely the invasion of non-native fish (i.e., brook trout). The Service believes that both threats, the entrainment of fish and the invasion of non-native fish, are likely negatively affecting the populations. The Service considers that Conservation Measures 1 and 2 are sufficient to offset the entrainment resulting from the Current, Full, and Moffat Project diversion amounts, based on the estimated rate of entrainment of 10 percent, with a range of 5 - 25 percent, of the fish population. The securement of the barriers and removal of brook trout on Bobtail and Steelman creeks will increase the number of green lineage cutthroat trout in these streams by removing competition and predation threats, although it is difficult to estimate future population numbers at this time. Percentages of brook trout in Bobtail (2014) and Steelman (2013) creeks have been high recently, representing approximately 75 percent and 50 percent, respectively, of the trout

population, as previously discussed in the *Environmental Baseline* section. Therefore, removal of brook trout from these streams is expected to result in significant increases in the survival and reproduction of the green lineage cutthroat trout. Construction of the fish barriers will occur prior to completion of the expansion of Gross Reservoir; therefore, the green lineage cutthroat trout populations in Bobtail and Steelman creeks should be secure from threats from brook trout prior to increased water diversions and associated entrainment issues relating to the Moffat Project. Green lineage cutthroat trout populations in Little Vasquez and Hamilton creeks will continue to remain secure from the threat of invasion of non-native fish. In terms of stream miles, the proposed action will remove the threat of invasion of non-native fish on 19 miles of streams. These improvements will occur in two drainages, including the Williams Fork and Fraser drainages. We believe that implementation of these conservation measures will result in improved survival and reproduction in the existing green lineage cutthroat trout streams.

Operation and Maintenance Activities - Denver Water's erosion control BMPs are expected to minimize the sedimentation and contamination impacts that may result from the operation and maintenance activities. Given that most of the operation and maintenance work will likely be occurring at the downstream end of the occupied green lineage cutthroat trout streams where the diversion structures are located, sedimentation impacts are expected to be generally restricted to the work area and sediment displaced by these actions would primarily be deposited downstream of occupied habitat. We recognize, however, that these actions will likely result in short-term disturbances within the stream that may also result in slight increases in sedimentation, although this amount is difficult to quantify. We also recognize that heavy equipment within the stream channel has the potential to injure or kill fish, or introduce diseases (e.g., whirling disease) or contaminants to the streams, although Denver Water's BMPs will minimize erosion and contaminant impacts. We have included a Term and Condition in this biological opinion that will require thorough cleaning of all equipment before entering the streams. Based on the potential impacts resulting from mechanical removal of sediment at the four green lineage cutthroat trout streams as well as the other operations and maintenance activities, we estimate that 4 fish in each of the green lineage cutthroat trout streams could be injured or killed per year, resulting in a total loss of 16 fish per year for the project.

Considering the combined estimated annual impacts for each of the streams that would result from the existing and future entrainment plus impacts from operation and maintenance activities, we estimate that the proposed action would annually affect approximately 12 percent of the existing population each in Hamilton, Bobtail, and Steelman creeks and approximately 23 percent of the population in Little Vasquez Creek, as shown in Table 6, based on the population estimates provided in the BA (Corps 2015). These values provide a rough estimate of the percentage of the population that we expect would be affected by the proposed action. Collectively, the anticipated incidental take resulting from the implementation of the proposed project is approximately 341 fish per year resulting from entrainment under the Current, Full, and Moffat Project Conditions and approximately 16 fish per year resulting from Denver Water's operation and maintenance activities, resulting in a project total annual incidental take of 357 fish for the combined green lineage cutthroat trout streams, affecting approximately 12 percent of the combined green lineage cutthroat trout population within the action area.

Table 6. Estimate of combined project impacts to green lineage cutthroat trout populations.

Stream	Population Estimate (number of fish)[1]	Estimated Current Annual Entrainment[2]	Estimated Future Annual Entrainment under Moffat Project[3]	Estimated Annual Loss of Fish from Denver Water's O&M Activities[4]	Estimated Remaining Population (Population %)
Little Vasquez	108	11	10	4	83 (77%)
Hamilton	1206	120	10	4	1072 (88%)
Bobtail	791	79	10	4	698 (88%)
Steelman	908	91	10	4	803 (88%)
Total	3,013	301	40	16	2,656 (88%)

1. Population estimate provided in BA (Corps 2015).
2. Based on estimate provided in BA (Corps 2015) that approximately 10 percent of population is currently @ entrained. @
3. Based on estimate provided in BA (Corps 2015).
4. Operation and Maintenance Activities - based on USFWS estimate, includes consideration for in-stream @ mechanical sediment removal approximately 3 to 5 times per year and other activities. @

In summary, the Service believes that the impacts from entrainment and the invasion of non-native fish are all likely negatively affecting the green lineage cutthroat trout populations. The Service considers that Conservation Measures 1 and 2 are sufficient to offset the entrainment resulting from the Current, Full, and Moffat Project diversions based on the estimated annual rate of entrainment of 10 percent of the fish population. We believe that implementation of these conservation measures will result in increased fish survival and reproduction in these green lineage cutthroat trout streams.

Cumulative Effects

Cumulative effects include the effects of future State, tribal, local, or private actions that are reasonably certain to occur in the action area considered in this biological opinion. Future Federal actions that are unrelated to the proposed action are not considered in this section because they require separate consultation pursuant to section 7 of the Act.

These green lineage cutthroat trout streams occur in area relatively remote areas and receive primarily recreational use. Bobtail and Steelman creeks occur in the Upper Williams Fork River, which is very remote with difficult access. Hamilton Creek in the Fraser River drainage is also relatively remote. Recreational activities in these areas primarily include a minor level of use by angler and hunters. Little Vasquez Creek is located on the west side of the Winter Park Ski Area and receives winter ski use and summer angling and mountain bike use. We consider that these recreational activities result only in minor impacts to the green lineage cutthroat trout populations from disturbances and sedimentation impacts. Activities within the ski area already undergo section 7 consultations through the USFS and future bike trail construction would undergo section 7 consultation through the USFS; therefore, these activities that undergo section 7 consultation through the USFS are not considered to be cumulative impacts in this biological opinion.

Aside from some recreational uses in these areas, we are not aware of additional future State, local, or private actions that are expected to occur within the action area that would not require

some type of Federal permitting or review due to potential impacts to waterways, wetlands, or the habitats of federally listed species.

JEOPARDY DISCUSSION AND CONCLUSION

As part of this formal consultation, we evaluate whether or not a proposed action would jeopardize the continued existence of a species. "Jeopardize the continued existence of", is defined as, "to engage in an action that reasonably would be expected, directly or indirectly, to reduce appreciably the likelihood of both the survival and recovery of a listed species in the wild by reducing the reproduction, numbers, or distribution of that species." (50 CFR § 402.02)

For this evaluation, we consider the following information:

- Š The green lineage cutthroat trout populations in Bobtail and Steelman creeks are expected to experience a significant increase in number of fish over time due to the construction of secure barriers and the removal of brook trout. While it is difficult to estimate the future cutthroat populations in these streams, based on our assumption that the carrying capacity of the stream can handle a similar amount of cutthroat trout as the brook trout that were removed, we anticipate that the cutthroat trout populations in Bobtail and Steelman creeks will increase and replace the brook trout numbers, potentially replacing the 75 percent and 50 percent of the trout population, respectively, currently represented by brook trout.

- Š The green lineage cutthroat trout populations in Hamilton and Little Vasquez creeks are anticipated to remain stable over time due to the commitment to maintain the barriers that protect against the invasion of non-native fish.

- Š Current entrainment levels are presently maintaining the green lineage cutthroat trout populations in Bobtail, Steelman, Little Vasquez, and Hamilton creeks. For our calculation purposes, we are using the estimate that current entrainment rates are approximately 10 percent. However, we recognize that this rate likely overestimates the actual current entrainment rate as most of the current entrainments estimates are below 10 percent, as discussed in this biological opinion and provided in greater detail in Appendix A.

- Š Future entrainment levels under the Full Use and Moffat Project are not expected to result in larges increases of entrained fish; the BA (Corps 2015) estimates that the increased number of fish entrained is likely to be much less than 10 fish from each stream per year. For our calculation purposes, we used the value of 10 fish per stream, recognizing that actual rates will likely be lower.

- Š The increased water diversions that would occur under the Moffat Project would take place after the barriers have been improved on Bobtail and Steelman creeks. Therefore, increased entrainment would occur after the cutthroat trout populations have been secured in Bobtail and Steelman creeks.

- Approximately 12 percent of the populations in Bobtail, Steelman, and Hamilton creeks would potentially be affected each year by the combined impacts from current/future entrainment and operation and maintenance impacts. The potential impacts in Little Vasquez are a little more of concern, with approximately 23 percent of the population affected each year by the combined impacts from current/future entrainment and operation and maintenance impacts, although this population is also expected to remain viable based on the how the project is doing under the current level of entrainment and the relatively low level of expected entrainment increases projected under the future diversions.

- The proposed action will affect only four of the existing 60 green lineage cutthroat populations (representing approximately 7 percent of the green lineage cutthroat trout populations). We expect these four populations to remain viable into the future, and expect two of these populations (Bobtail and Steelman creeks) to increased survival and reproduction of the green lineage cutthroat trout.

- The proposed action will improve the distribution of the species by creating a new green lineage cutthroat trout population through reintroductions into McQueary Creek/Lake in the Upper Williams Fork River drainage. The length of occupied stream will be approximately 2.6 miles and the area of the lake is approximately 3 acres. The population within the lake has the additional benefit of providing refugia for fish in case of drought and disturbances, such as fire.

- We consider that the combined benefits of improved/maintained barriers to protect the populations from non-native fish on 19 miles of stream, and the removal of brook trout from Bobtail and Steelman creeks, plus the addition of a new green lineage cutthroat trout population in Mcqueary Creek/Lake, will offset the impact of the fish entrainment that will result from continued and future water diversions on these streams.

- Operation and maintenance activities are anticipated to provide minimal impacts to the fish. Sedimentation impacts will be minimized by Denver Water's BMPs.

After reviewing the current status of the green lineage cutthroat trout, the environmental baseline for the action area, the effects of the proposed action and the cumulative effects, it is the Service's biological opinion that the action, as proposed, is not likely to jeopardize the continued existence of the green lineage cutthroat trout.

The evaluation of whether or not the proposed action would jeopardize the continued existence of the green lineage cutthroat trout did not rely on the reintroduction of green lineage cutthroat trout into approximately 14 miles St. Louis Creek; this action is considered to be an additional benefit of the proposed action, provided that funding is secured by Denver Water and its partners, and was not evaluated in the jeopardy analysis for this project.

Critical habitat has not been designated for the green lineage cutthroat trout.

INCIDENTAL TAKE STATEMENT

Section 9 of the ESA and Federal regulations pursuant to section 4(d) of the ESA prohibit the take of endangered and threatened species, respectively, without special exemption. Take is defined as to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture or collect, or to attempt to engage in any such conduct. Harm is further defined as "an act which actually kills or injures wildlife. Such act may include significant habitat modification or degradation where it actually kills or injures wildlife by significantly impairing essential behavioral patterns, such as breeding, feeding, or sheltering." Harass is defined as "...an intentional or negligent act or omission which creates the likelihood of injury to wildlife by annoying it to such an extent as to significantly disrupt normal behavioral patterns which include, but are not limited to, breeding, feeding or sheltering." Incidental take is defined as take that is incidental to, and not the purpose of, the carrying out of an otherwise lawful activity. Under the terms of section 7(b)(4) and section 7(o)(2), taking that is incidental to and not intended as part of the agency action is not considered to be prohibited taking under the ESA provided that such taking is in compliance with the terms and conditions of an incidental take statement.

In general, an incidental take statement anticipates the amount of any incidental taking of endangered or threatened species. It also provides reasonable and prudent measures that are necessary to minimize the impacts of the take and sets forth terms and conditions that must be complied with in order to implement the reasonable and prudent measures.

The measures described below are non-discretionary, and must be undertaken by the Corps so that they become binding conditions of project approval issued to the Corps for the exemption in section 7(o)(2) to apply. The Corps has the continuing duty to regulate the activity covered by this incidental take statement. If the Corps fails (1) to assume and implement the terms and conditions, or (2) fails to adhere to the terms and conditions of the incidental take statement through enforceable terms that are added to the project approval, the protective coverage of section 7(o)(2) may lapse. In order to monitor the impact of incidental take, the Corps must report the progress of the action or its impact on the species to the Service as specified in the incidental take statement.

The Service anticipates that take of green lineage cutthroat trout will result in the form of harm. Take in the form of harm is anticipated to result from entrainment of fish, although a relatively small portion of the populations are expected to be removed from the populations by entrainment. Take in the form of harm is also expected to result from operation and maintenance activities that may impact fish habitat and may injure or kill individual fish, although the disturbances that impact fish habitat are expected to be short term and fish often move away from disturbance sites, thereby reducing the potential for injury and death. Additionally, impacts from sediment-contributing activities will be minimized by Denver Water's BMPs.

In this biological opinion, the Service determined that the anticipated take is not likely to result in jeopardy to the species.

AMOUNT OR EXTENT OF TAKE:

Take is anticipated due to entrainment of approximately 341 fish per year resulting from the implementation of the proposed action under the Current, Full, and Moffat Project water diversion levels. Take is also anticipated due to disturbance, habitat degradation, and potential injuries that would harm up to 16 fish per year as a result of Denver Water's operation and maintenance activities. Collectively, we anticipate that these impacts would result in an annual incidental take of 357 fish for the combined green lineage cutthroat trout streams within the action area.

We recognize that it is difficult to evaluate the project's potential entrainment impacts in the absence of an entrainment study; therefore, we would consider that the amount or extent of incidental take resulting from entrainment is exceeded if project diversions are greater than those analyzed by the Corps' EIS and the Corps' BA (2015) and consulted for in this biological opinion. For potential impacts resulting from operation and maintenance activities, we believe that it is more likely that Denver Water will be able to observe injured or dead fish resulting from this activity, especially the mechanical removal of sediment at the diversion structures, therefore, we consider that incidental take has been exceeded if more than 4 fish are injured or killed in any of the green lineage cutthroat trout streams as a result of operation and maintenance activities.

Effect of Take

Adverse effects resulting from the implementation of the proposed project is likely to result in low level, negative effects from entrainment in the four streams and operation and maintenance activities in the action area, although these negative effects are expected to be offset by project conservation measures that will secure these populations from the threat of invasive non-native fish and will create a new green lineage cutthroat trout population by means of a reintroduction. In the accompanying biological opinion, the Service determined that this level of anticipated take is not likely to result in jeopardy to the species.

Reasonable and Prudent Measures

The reasonable and prudent measures, and implementing terms and conditions, minimize the effects of incidental take that might otherwise result from the action. In addition to the conservation measures already proposed as part of the project description, the Service believes that the following reasonable and prudent measures are necessary and appropriate to minimize impacts of incidental take of the green lineage cutthroat trout:

1. B The Corps will ensure that Denver Water will monitor the proposed action as set forth in the Terms and Conditions to ensure that it does not exceed the authorized take limits.

2. B The Corps will ensure that Denver Water and its contractors do not result in the spread of diseases, including whirling disease, into the four green lineage cutthroat trout streams (Hamilton, Little Vasquez, Bobtail, and Steelman creeks) in the action area.

Terms and Conditions

In order to be exempt from the prohibitions of section 9 of the Act, the Corps must ensure that Denver Water complies with the following terms and conditions, which implement the reasonable and prudent measures described above and outline the required reporting/monitoring. These terms and conditions are non-discretionary.

Prior to Implementation

1. Prior to implementation of Conservation Measures 1 and 2, the Corps, Denver Water, USFS, CPW, and USFWS shall meet to coordinate final project plans.

2. „Prior to implementation of Conservation Measures 1 and 2, the Corps, Denver Water, USFS, CPW, and USFWS shall meet to coordinate on appropriate brood stock for the reintroduction of green lineage cutthroat trout into McQueary Creek/Lake and St. Louis Creek.

3. Prior to entering the stream channels in Hamilton, Little Vasquez, Bobtail, and Steelman creeks, as well as St. Louis Creek and McQuery Creek once green lineage cutthroat trout populations have been re-established, all equipment shall be inspected to confirm that it is clear of mud and other potential contaminant sources that could spread whirling disease. All equipment shall be clean, disinfected, and rinsed (e.g., personal protective equipment, heavy equipment, waders, hand tools, etc.) prior to use in the green lineage cutthroat trout streams.

During Implementation in Green Lineage Cutthroat Trout Streams

4. Prior to entering a green lineage cutthroat trout stream to conduct in-stream work with heavy equipment, project personnel should wade into the stream, or enter the stream slowly, at the treatment sites in order to encourage fish to move away from the in-stream work sites, thus minimizing potential injury to fish.

5. In the event that a dead green lineage cutthroat trout is encountered during operation and maintenance activities in the green lineage cutthroat trout streams affected by the project, Denver Water personnel shall record the number of fish observed and the location and provide that information to the Corps for the annual monitoring report, described below.

Monitoring and Reporting

6. „The Corps, Denver Water, USFS, CPW, and USFWS will meet jointly as necessary to review activities, discuss the year's previous activities and the upcoming activities, project monitoring results, and to document compliance with this biological opinion.

7. „The Corps shall provide an annual monitoring report to the USFWS by December 1 during each year of project implementation for 15-years. Monitoring reports will include a description of the activities that were implemented during the year, results of the monitoring activities, and project plans for the upcoming year. In addition, the report

shall contain a discussion of: a) any problems encountered in implementing the terms and conditions; b) recommendations for modifying the stipulations to enhance the conservation of the green lineage cutthroat trout; and c) any other pertinent information.

8. Monitoring and reporting shall be consistent with commitments described in the *Proposed Action* section of this biological opinion.

The Service believes that the proposed action will result in incidental take of no more than 357 green lineage cutthroat trout per year. The reasonable and prudent measures, with their implementing terms and conditions, are designed to minimize the impact of incidental take that might otherwise result from the proposed action.

CONSERVATION RECOMMENDATIONS:

Section 7(a)(1) of the Act directs Federal agencies to utilize their authorities to further the purposes of the Act by carrying out conservation programs for the benefit of endangered and threatened species. Conservation recommendations are discretionary agency activities to minimize or avoid adverse effects of a proposed action on listed species or critical habitat, to help implement recovery plans, or to develop information.

1. 2To the degree possible, in-stream work in the green lineage cutthroat trout streams should avoid the reproductive period from May through August in order to avoid or reduce potential negative effects to spawning, egg development and hatching, and early rearing. The Service recognizes that avoidance of this period is not always possible, especially during emergency work.

2. 2We encourage Denver Water and the partners to work with the local communities to share information on the reason and importance of the proposed reintroduction of green lineage cutthroat trout into St. Louis Creek.

REINITIATION NOTICE:

This concludes formal consultation for the Corps' issuance of a Clean Water Act Section 404 Individual Permit for Denver Water's Current Conditions, Full Use and Moffat Collection System Project for the green lineage cutthroat trout in Grand County, Colorado. As required by 50 CFR § 402.16, reinitiation of formal consultation is required if:

1. 2The amount or extent of taking specified in the incidental take statement is exceeded;

2. 2New information reveals effects of the agency action that may affect listed species or critical habitat in a manner or to an extent not previously considered;

3. 2The agency action is subsequently modified in a manner that causes an adverse effect to the listed species or critical habitat that was not considered in this biological opinion; or

4. 2A new species is listed or critical habitat designated that may be affected by the identified action.

5. Additionally, if stream barriers fail to restrict brook trout from travelling above the diversions structures, as potentially indicated by the presence of brook trout above the diversion structures in Hamilton or Little Vasquez creeks at any time, or if brook trout are detected in Bobtail or Steelman creeks after the brook trout eradication treatments have been completed in these streams, we recommend the Corps consider reinitiation of this consultation to further evaluate, in coordination with the Service and Denver Water, whether or not their presence is due to a failure of the barrier.

If the Service can be of any additional assistance, please contact Leslie Ellwood of the Colorado Field Office by telephone at (303) 236–4747 or by email to leslie_ellwood@fws.gov.

Sincerely,

Drue DeBerry
Acting Colorado Field Supervisor

cc: L. Ellwood (COFO – Lakewood)

Project/COE/COE_Denver Water Moffat Project BO

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Appendix A

Denver Water's Best Management Practices (BMPs)

Appendix A, Table 1. Performance Standards for Erosion and Sediment Control BMPs

1	All regulated land disturbance activities shall be conducted in such a manner as to effectively reduce accelerated soil erosion, and reduce the movement or deposition of sediment off site.
2	All regulated land disturbance activities shall be designed, constructed, and completed in such a manner that disturbed land shall be exposed for a minimum period of time.
3	Soil stabilization measures shall be implemented within fourteen (14) days following completion of grading activities.
4	All sediment resulting from accelerated soil erosion shall be removed to the maximum extent practicable from storm or surface runoff prior to leaving the site.
5	All temporary facilities for conveying water around, though, or from land disturbed by construction activity shall be designed and constructed so as to limit flows to non-erosive velocities.
6	All temporary erosion and sediment control facilities shall be removed and locations permanently stabilized when land disturbing activities are completed.
7	Re-vegetation or stabilization of disturbed land shall take place immediately upon completion of construction activity in that part of the development.
8	All construction wastes, fuel, lubricants, chemical wastes, trash, or debris shall be contained on site and protected from contact with rainfall or surface runoff.
9	All chemical wastes, sanitary waste, trash, debris, or contaminated soil shall be periodically removed from the construction site and disposed of properly.

Appendix A, Table 2. Potential Pollution Sources and BMPs

Potential Pollution Source	BMPs
Disturbed and stored soils	Activities associated with this pollution source are the earth-disturbing activities typically associated with excavation, cutting and filing, and backfilling. BMPs selected to control this source are straw watties (sediment control logs), rock socks, vehicle tracking control, inlet protection, check dams, restoration of landscaped areas and repaving. Non-structural measures include phasing construction to the extent feasible to limit the amount of trench open at any one time.
Vehicle tracking of sediments	Activities associated with this pollution source are the movement of vehicles from disturbed areas to paved streets. BMPs selected to control this source are VTC, stabilized construction entrances including vehicle tracking control pads, geotextiles, and street cleaning. Construction fencing may be used to limit entry to designated access points.
Management of contaminated soils	If contaminated soils are encountered, all activity will be stopped until the situation can be assessed by project environmental personnel. The Project Manager will be contacted for further direction.
Loading and unloading operations	Activities associated with this pollution source are potential spills during delivery and unloading of materials. Loading and unloading operations should occur on stabilized surfaces. BMPs selected to control this source are materials management practices, personnel training, providing spill kits where needed, and following standard Materials Handling and Spill Prevention Procedures.
Outdoor storage activities (including building materials, chemicals, etc.)	The activities associated with this pollution source are storage of material at the staging areas and the potential for spills and leaks from these materials. BMPs selected to control this source are use and installation of straw wattles on the downgradient side of temporary stock piles, materials management practices, secondary containment, berms, personnel training, providing spill kits where needed, and following standard Materials Handling and Spill Prevention Procedures.
Vehicle and equipment maintenance and fueling	Activities associated with this pollution source are fueling and equipment repair. Routine vehicle maintenance will not occur on the site. However, if heavy equipment breaks on the site, on-site maintenance may become necessary and appropriate BMPs such as materials management practices, laying down a plastic liner, personnel training, providing spill kits, berms, drip pans, and following standard Materials Handling and Spill Prevention Procedures. Typically, fueling will be performed from delivery vehicles by drivers who will provide necessary spill prevention and response capability.
Significant dust or particulate generating processes	Activities associated with this pollution source are the earth-disturbing activities and equipment movement on disturbed area. There is also the potential for wind to transport dust from disturbed areas. BMPs selected to control this source are watering of disturbed areas on an as-needed basis during construction, interim stabilization measures such as surface roughening, final stabilization, and minimizing the duration that disturbed areas are exposed to the extent practical.
On-site industrial waste	Activities associated with this pollution source are the generation of industrial

Appendix A, Table 2. Potential Pollution Sources and BMPs

Potential Pollution Source	BMPs
management practices (waste piles, liquid wastes, dumpsters, etc.)	waste materials during project activities including waste generated from demolition of existing aboveground infrastructure (pavement, sidewalks etc.), boring mud and fluids, saw cutting water, pipe and joint sealing, and waste from clearing and grubbing. BMPs selected to control this source are materials and waste management practices as well as personnel training, and use of concrete washouts. For boring fluids, waste is vacuumed as it is excavated from the bore and it is disposed of offsite.
Concrete truck/equipment washing, including the concrete truck chute and associated fixtures and equipment	Activities associated with this pollution source are concrete pours for vault or switch cabinet floors, concrete anchoring at bends in conduit or pipe, pipe coating, and concrete replacement on the sidewalks or roads. The BMP selected to control this source are using a designated concrete washout area or offsite washout, and personnel training.
Non-industrial waste sources worker trash and portable toilets	Activities associated with this potential pollutant source include the generation of non-industrial waste such as discarded building materials, litter, and sanitary waste at the construction site that may cause adverse impacts to water quality. BMPs to control this source include the use of waste containers and location and placement of portable toilets which will be located as far as feasible from surface waters and inlets.
Non-stormwater discharges	Discharges to the ground of water from construction dewatering activities may be authorized by this SWMP, provided that the source is groundwater and/or groundwater combined with stormwater that does not contain pollutants in concentrations exceeding the State groundwater standards in Regulations 5 CCR 1002-41 and 42; and does not leave the site as surface runoff or discharge to surface waters. These same provisions apply to concrete washout water discharged to the ground. Other allowable non-stormwater discharges include discharges from fire-fighting activities, natural springs and irrigation return flows. If any of these non-stormwater discharges are identified in the field, the site-specific information for that project will be updated to include the location and characteristics of the discharge.

Appendix B. Estimates of "take" of Cutthroat Trout in Bobtail and Steelman creeks at Denver Water diversions

To: Rena Brand, USACOE

From: Don Conklin, Ashley Ficke, and Grant De Jong, GEI

CC: Andrea Parker, URS

Date: May 22, 2015

Re: **Estimates of "take" of Cutthroat Trout in Bobtail and Steelman creeks at Denver Water diversions**

Introduction

Denver Water operates diversion dams in the headwaters of the Williams Fork River in central Colorado. These diversions remove up to 100% of the flow in the streams at the point of diversion. Cutthroat Trout (*Oncorhynchus clarkii*) and non-native Brook Trout (*Salvelinus fontinalis*) are found above the diversion structures on Bobtail and Steelman Creeks and are subject to entrainment or "take" by the diversions. Previous reports have identified the populations of Cutthroat Trout in these streams to be the Threatened Greenback Cutthroat Trout (*O. clarkii stomias*). Recent genetic and molecular studies have suggested that these populations are not Greenback Cutthroat Trout, but are actually a mix of Colorado River Cutthroat Trout lineages (Metcalf et al. 2007, 2012). This memorandum attempts to estimate the take of Cutthroat Trout at these diversions.

Quantitative studies that directly estimate the entrainment of fish into the diversions and the take of Cutthroat Trout (e.g., using a marking or netting method) have not been conducted in these two streams. Instead, Colorado Parks and Wildlife (CPW) electrofished upstream of the diversions in Bobtail Creek in 2011, 2012, 2013, and 2014, and in Steelman Creek in 2011 and 2013, noting the location of each fish collected with geographical coordinates (except in 2014). From these data, we made an indirect estimate of the take of Cutthroat Trout at these diversions. The distribution of upstream and downstream movements exhibited by individual fish is known to be leptokurtic or "fat tailed" (Figure 1). In other words, many individual fish in a population move short distances (sedentary trout), while the remainder moves much longer distances (mobile trout), up to hundreds or thousands of meters (m) of stream (Gowan et al. 1994; Skalski and Gilliam 2000; Rodríguez 2002). Accounting for individual variability in movement rates, three modeling approaches were developed to estimate the entrainment of Cutthroat Trout in Denver Water diversions using the CPW data.

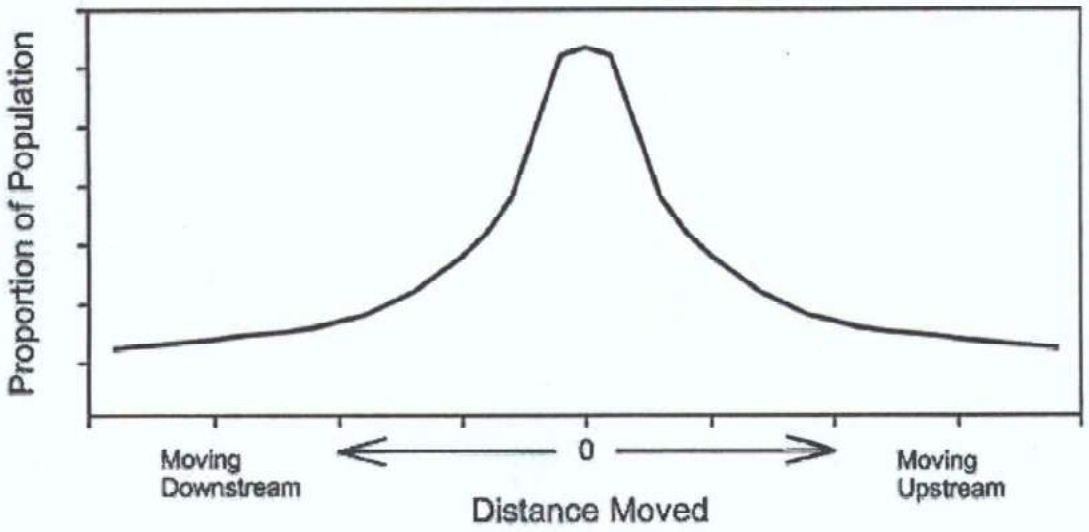

Figure 1: Schematic representation of leptokurtic distribution of fish movements.

Fish Population Data

Cutthroat and Brook Trout were captured by CPW in both streams in all years sampled. In Bobtail Creek, data are available from CPW for 2011, 2012, 2013, and 2014. However, for 2014, the data do not include the locations of the collected fish. In all years, Brook Trout were several times more abundant than Cutthroat Trout in Bobtail Creek. In Steelman Creek, data are available for 2011 and 2013. Brook Trout were several times more abundant than Cutthroat Trout in 2011 in Steelman Creek, but in 2013, there were numerous juvenile Cutthroat Trout and there were similar numbers of both species. The Brook Trout collected by CPW were removed from the streams each year.

In all years, the longitudinal pattern of Cutthroat Trout distribution in both streams had some similarities. There were relatively few or no fish in the first 200 m upstream of the diversions (Figure 2 and Figure 3). Farther upstream there were higher numbers of fish up to a point where fish numbers declined quickly with very few fish upstream of this point. In Bobtail Creek, according to the CPW field notes, there is a waterfall/barrier approximately 2,600 m upstream of the diversion and only a few fish were found upstream of this point in any of the years of sampling (Figure 2).

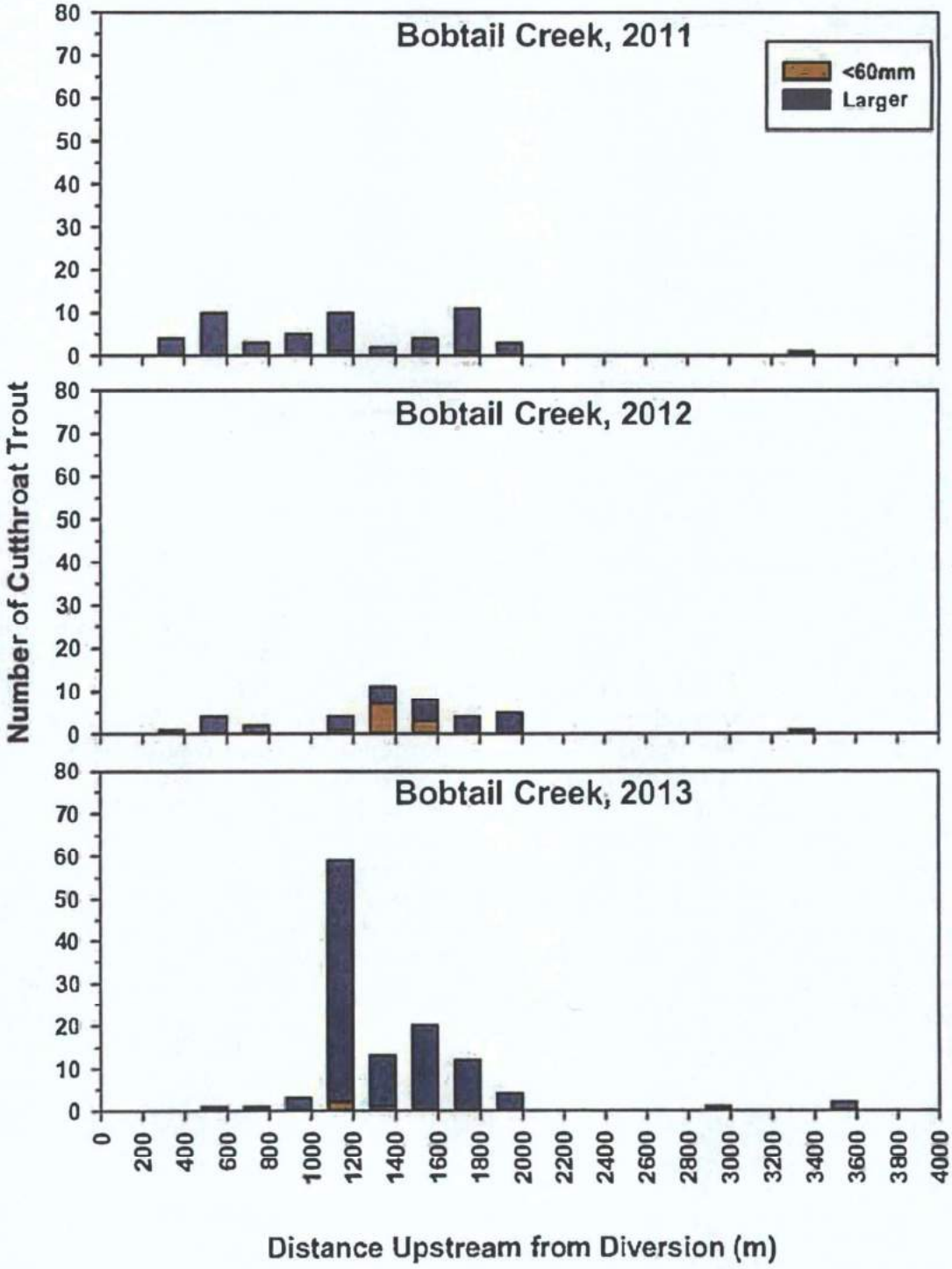

Figure 2: Number of Cutthroat Trout collected in Bobtail Creek at distances upstream of the diversion.

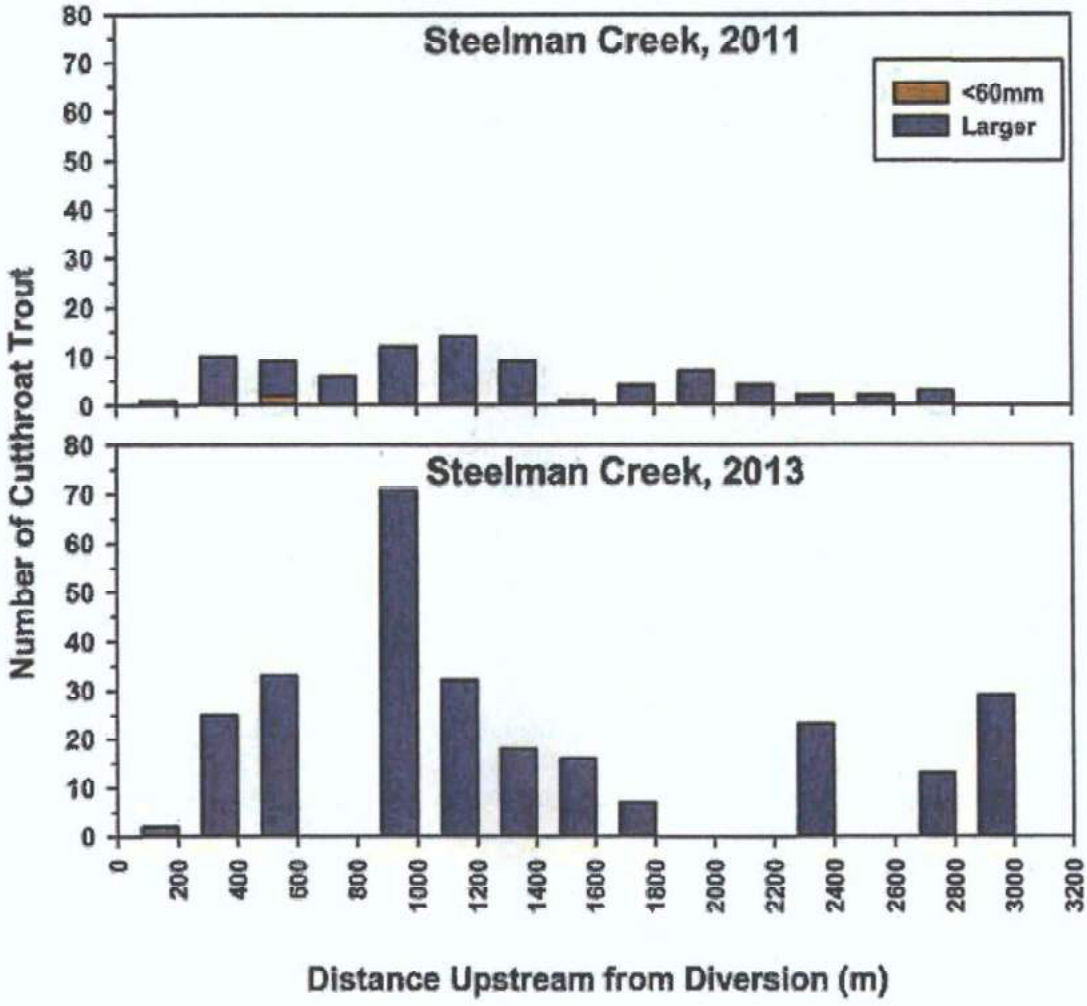

Figure 3: Number of Cutthroat Trout collected in Steelman Creek at distances upstream of the diversion.

In 2011 and 2012, there were mostly juvenile and adult Cutthroat Trout larger than 60 millimeters (mm) in both streams (Figure 2 and Figure 3). Young-of-the-Year (YOY) fish less than 60 mm in length were much less abundant. The number of fish in both streams was much higher in 2013 than in other years. Much of the increase in this year was due to juvenile fish between 60 and 100 mm. These fish likely represent one-year-old fish from the 2012 spring spawning season. Spring runoff flows were low in 2012. In June 2012, the monthly mean flow measured at the U.S. Geological Survey (USGS) gage on Bobtail Creek was 20 cubic feet per second (cfs), which is approximately one-third of the average value for mean June flows from 1965 to 2014. Apparently, the low spring runoff flows in 2012 allowed for successful spawning and recruitment of YOY Cutthroat Trout in these two streams, a situation we have seen in other streams. Although not presented in Figure 2 because of the lack of location data, many of the one-year-old fish from 2013 also were present in 2014 in Bobtail Creek as slightly larger (100 to

120 mm) two-year-old fish. Because of this cohort of fish, the total number of Cutthroat Trout collected in 2014 in Bobtail Creek (270) was several times higher than in 2011, 2012, and 2013. Because electrofishing capture probabilities increase with increasing fish size (Reynolds 1996), YOY trout are not collected efficiently (e.g., Young et al. 2005). As such, the YOY Cutthroat Trout in Bobtail and Steelman creeks are not collected efficiently as well. For example, Bobtail Creek supported a strong cohort of one-year-old Cutthroat Trout (greater than 60 mm) in 2013 that were not collected as YOY fish in 2012. Therefore, the number of Cutthroat Trout collected is somewhat of an underestimate of the total population, especially of YOY fish.

Brook Trout collected each year were removed from the streams. The data from Bobtail Creek from 2011 through 2014 indicate that the removal of Brook Trout resulted in fewer and smaller Brook Trout collected in subsequent years. This indicates that the electrofishing techniques used by CPW collected a higher proportion of larger juvenile and adult trout. However, despite the removal of several hundred Brook Trout from Bobtail Creek each year, there were still hundreds present in subsequent years, including juveniles and adults. This demonstrates that the collection techniques only collected a moderate proportion of the total population and missed trout of all sizes. Therefore, it is estimated that these collection techniques were effective in sampling only a moderate proportion of the Cutthroat Trout population as well.

Approaches to Take Estimates

We used three separate approaches to estimating the take of Cutthroat Trout into the diversions. The first takes into account the different movements between sedentary and mobile trout and the percentages that could be entrained. The second approach is similar but also incorporates specific data on Cutthroat Trout and takes into account the distances individual fish would move. The third approach simply assumes that the lack of fish near the diversion is entirely due to entrainment. Each approach is discussed briefly below.

Approach 1: Simple, Separate Estimates for Mobile and Sedentary Fish

For this approach, the fish population was separated into mobile (20%) and sedentary (80%) proportions. These proportions are typical for trout and other fishes (Heggenes et al. 1991; Rodriguez 2002; Schrank and Rahel 2006). Fish were assigned to one of two locations: 0 to 100 m upstream of the diversion (short distance), and greater than 100 m from the diversion (long distance). The frequency with which short distance fish encountered the diversion was estimated by a turnover rate, or the rate at which individuals leave and are replaced by others in a short reach. Turnover rates of Bonneville Cutthroat Trout (*Oncorhynchus clarkii utah)* were estimated to be 69% in a Wyoming drainage (Schrank and Rahel 2006). This number was divided by two to account for equal probability of upstream or downstream movement. The long distance fish that encountered the diversion were estimated by multiplying the number of fish more than 100 m upstream of the diversion by 10% (i.e., 20% mobile individuals with half moving downstream and half moving upstream). Long distance fish movement rates are highly variable and depend somewhat on distance. For example, in a study of Bonneville Cutthroat Trout, most mobile individuals moved less than 300 m. Therefore, this method will tend to overestimate take of long distance fish.

The number of individual Cutthroat Trout potentially encountering the diversion under this scenario would be

$$Total\ encounters = (^{0.69}/_{2} * n) + (^{0.20}/_{2} * x),$$

where n is the number of individuals within 100 m of the diversion, and x is the number of individuals more than 100 m upstream of the diversion. This accounts for both the short distance and long distance fish.

Approach 2: A Spatially Explicit Modeling Approach

This approach also uses the concept that the distribution of individual fish movements is leptokurtic, but movements are modeled with a mathematical distribution built with Cutthroat Trout data. This more sophisticated approach allows calculation of cumulative risk of fish encountering the diversion from multiple starting locations.

Leptokurtic movement can be modeled with a double exponential distribution (Rodríguez 2010). The exponential distribution was modeled in Microsoft Excel with a random number generator and an inverse exponential function, and function variables were obtained from studies of Colorado River Cutthroat Trout data and Bonneville Cutthroat Trout data. After Young (2011), the proportion of mobile individuals in the population was 33%, and the median home range was 33 m. Curve shape, or the "peakedness" of the curve was obtained from Randall (2012), where the proportion of mobile individuals in the population was similar to that in Young (2011).

The probability that each individual Cutthroat Trout encountered the diversion was calculated using its physical location (i.e., meters upstream of the diversion) and the exponential function. The encounter probability for each fish was divided by two (to account for the equal probability of upstream or downstream movement). Individual fish were placed in one of two categories: short distance (within 300 m of the diversion), and long distance (over 300 m upstream of the diversion), because only the mobile proportion of fish over 300 m upstream of the diversion would encounter it. The encounter probabilities of all of the individual fish were summed to estimate a proportion of each segment that encountered the diversion. This proportion was multiplied by the number present in that segment for a total number of encounters for the segment. The encounters from each segment were summed for a total number of encounters. This was done separately for each year of data in each stream.

Approach 3: Assume Missing Trout Have Been 100% Lost to Entrainment

Because Cutthroat Trout were often absent near the diversions in Bobtail and Steelman creeks, we assumed that they would be more common if the diversions were not entraining fish. For the third approach, take estimates were developed for Bobtail and Steelman creeks based on this assumption. This approach differs from the other two in that no assumptions are made about fish movement and movement is not modeled. Instead, this approach relies on the hypothesis that entrainment is the sole reason that fish are uncommon or absent in the immediate vicinity of the diversion and that, without entrainment, fish density near the diversion would be similar to density in upstream sections of the streams. This approach was used so that entrainment rates could be viewed from a different perspective. The length of each stream was divided into 200 m

segments, and the number of fish present in each segment for each year was determined with a histogram function in Microsoft Excel. The number lost to entrainment in the 200 m segment just upstream of the diversion in each stream in each year was assumed to be the mean of the number of fish in all of the other inhabited bins. The typical upper limit of fish distribution was 2,200 m upstream of the diversion in Bobtail Creek and 2,800 m upstream of the diversion in Steelman Creek. Therefore, the fish lost from the 0 to 200 m segment in Bobtail Creek was the average number of individuals in the 200 m segments from 200 to 2,200 m upstream of the diversion, and the fish lost from the 0 to 200 m segment in Steelman Creek was the average number of individuals in the 200 m segments from 200 to 2,800 m upstream of the diversion.

Additional Factors

Entrainment Estimates

Entrainment rates of fish that are in the vicinity of the diversions that actually get entrained into the diversions on Steelman and Bobtail creeks have not been directly estimated. However, assuming all fish that encounter the diversion are entrained may not be correct. Although entrainment rates of fish moving downstream are not well-studied, the estimates described below were obtained from a literature search.

A Wyoming study (Carlson and Rahel 2007) showed that a diversion taking approximately 30% of a stream's flow resulted in trout (Brown Trout [*Salmo trutta*] and Bonneville Cutthroat Trout) entrainment rates of 2 to 7%. Bahn (2007) estimated that average entrainment rates for 12 diversions on two Montana streams ranged from 46 to 96%, with an overall average of 70%. Schrank and Rahel (2004) showed that post-spawn adults moving downstream in a western Wyoming drainage were entrained at a rate of 23%.

Entrainment rates depend on factors such as the percentage of flow taken from the stream and the movement rates of resident fishes (Bahn 2007, Carlson and Rahel 2007). Because the diversions on Bobtail and Steelman creeks at times can take 100% of the flow, entrainment rates could be high. As a result, a high estimate of entrainment was set at 100% of fish encountering the diversion, which is likely higher than the true rate of entrainment.

Accounting for Annual Mortality

Annual survival rates were calculated by averaging literature-derived values for Colorado River Cutthroat Trout and Bonneville Cutthroat Trout in Wyoming. In one study, average survival was estimated at approximately 72% per year (Randall 2012), and annual survival was estimated to be 67% in another study (Carlson and Rahel 2007). Because the survival rate of trout moving long distances was roughly equal to that of less mobile individuals, it was assumed that the same proportion of fish would die in the sedentary and mobile portions of the population. Therefore, we assumed an annual survival rate of 70% and a mortality rate of 30%. As a result, fish that were entrained but would have died of natural causes (30%) were subtracted from the total loss estimate.

Assumptions

Developing these take estimates required a number of assumptions, which are listed below, with justification.

- The number of fish collected by CPW represents the total population of Cutthroat Trout each year. This assumption underestimates the true population because the data on Brook Trout removals indicate that all Cutthroat Trout were not collected each year. YOY fish are not sampled efficiently, but the sampling methods are more efficient for collecting juvenile and adult fish (i.e., trout greater than 60 mm).

- All individual fish move at the same rates, regardless of age. This assumption is not true. For example, younger fish tend to move downstream and more often, while adults tend to move shorter distances and upstream (Young 2011; Randall 2012). However, the lack of specific movement data for these streams precludes the ability to differentiate movement rates and directions by size. Furthermore, the "nursery areas" in Bobtail and Steelman creeks where YOY are generally found are more than 1,000 m upstream from the diversions. This indicates entrainment of smaller fish will likely be overestimated by making this assumption.

- Numbers used to build models and estimate take are appropriate for Cutthroat Trout in Bobtail and Steelman creeks. Data on movement rates and demographic rates were restricted to Colorado River Cutthroat Trout whenever possible. However, data were lacking for some parameters, so results of studies involving Bonneville Cutthroat Trout were used.

- For Approaches 1 and 2, it was assumed that spatial distributions of fish throughout Steelman and Bobtail creeks are snapshots, and lower fish numbers in the vicinity of the diversion are not due to entrainment. This assumption was made because although a low proportion of individuals moves a long distance, turnover rates (i.e., the rate at which individual fish move into or out of a reach) are high for short reaches (i.e., approximately 200 m [Schrank and Rahel 2006]). Therefore, in the event that loss by entrainment was high in the vicinity of the diversions, fish would be replaced through high local turnover. This assumption was not made for Approach 3. For Approach 3, we assumed that the lower numbers or lack of fish near the diversions was due to entrainment into the diversions.

- Habitat quality and the suitability of the habitat to support Cutthroat Trout are similar near the diversions as throughout the upstream reaches of the streams. This is likely not true for Steelman Creek as the habitat near the diversion may be less suitable due to bedrock outcropping and a steep channel.

Summary of Approaches

The three different approaches (Figure 4) provide three separate loss estimates for each year of data in each stream. This gives the range of entrainment rates that could be expected for these streams. This method results in a reasonable estimate of Cutthroat Trout lost to entrainment in Bobtail and Steelman creeks, given the scarcity of site-specific movement data or direct measures of entrainment for these systems.

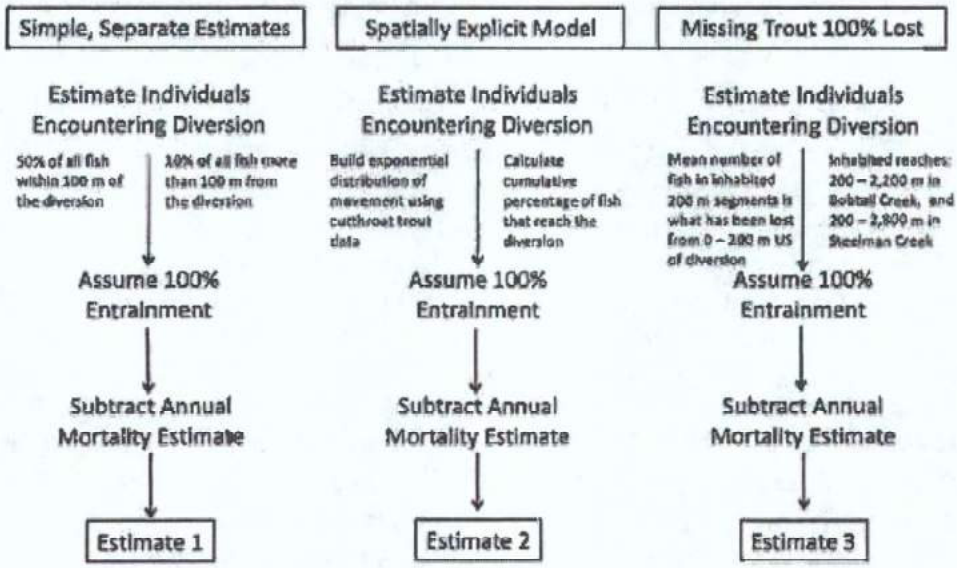

Figure 4: Summary of the three separate approaches to estimating entrainment of Cutthroat Trout into Denver Water diversions on Bobtail and Steelman creeks.

Results

Model estimates of Cutthroat Trout entrainment varied by year, stream, and estimation approach (Table 2). The model entrainment estimates ranged from 2 to 25 fish per year in Bobtail Creek and from 5 to 89 fish per year in Steelman Creek. The high estimates in both streams in 2013 are the result of the high number of young fish collected that year, and, given the purported potential nursery habitat identified more than one kilometer (km) upstream of the diversions and the low likelihood that the smaller fish would actually disperse that far, these estimates could be artificially high. The large number of young fish occurred nearly one km upstream of the diversions in both streams.

Table 2: Estimates of Cutthroat Trout entrainment for Bobtail and Steelman creeks, according to the three approaches.

Stream/Year	Number of Cutthroat Trout Captured	Number of Cutthroat Trout Entrained			Proportion of Total Population Entrained (Range)
		Approach 1: Simple, Separate Estimates	Approach 2: Spatially Explicit Model	Approach 3: Missing Trout 100% Lost	
Bobtail Creek 2011	38	5	2	3	5-12%
Bobtail Creek 2012	40	4	3	3	7-9%
Bobtail Creek 2013	116	25	9	8	6-18%
Steelman Creek 2011	85	9	9	5	6-10%
Steelman Creek 2013	270	27	89	19	7-25%

The total number of Cutthroat Trout collected by CPW plus the estimated number of entrained individuals would yield an estimated total population for the beginning of each year. We assume the number of Cutthroat Trout captured by CPW in each year is a conservative but appropriate population estimate for the fall and that adding the number entrained would equal the total starting population for each year (Captured + Entrained = Total Population). The proportion of the Cutthroat Trout total population entrained in both streams ranged from 5 to 25% (Table 2). This proportion likely pertains to fish greater than 60 mm in length since YOY fish are too small at the time of sampling to be collected efficiently and included in the total population.

Approach 1 resulted in higher take estimates than the other two approaches for all years in Bobtail Creek and in 2011 for Steelman Creek (Table 2). Approaches 2 and 3 yielded similar numbers in Bobtail Creek each year despite very different estimation techniques. In Steelman Creek, Approach 2 resulted in a very high estimate in 2013 due to the relatively high number of trout collected within 1,000 m of the diversion. Steelman Creek generally had higher estimates of the number entrained because more trout were collected in this stream than in Bobtail Creek. Despite the higher estimates of the number of trout entrained in Steelman Creek, the proportion of the population entrained was similar in both streams.

The estimates vary widely from year to year even within the same estimation approach. This is due in large part to the different number of trout collected each year. This demonstrates that there is not a consistent number of trout entrained every year. Entrainment rates change with many biological factors that could vary each year including population size, fish location, the relative densities of different size classes of trout, as well as weather-related factors that could affect trout movement such as spring runoff flows, summer flows, and water temperature. In most cases, the estimates of take indicate that fewer than 10 cutthroat trout are entrained each year in the diversions at Bobtail and Steelman creeks (Table 2), representing less than 10 % of the resident populations.

Since the assumption that the CPW data in each year represents the entire Cutthroat Trout population is an underestimate of the total population, the take estimate is likely an underestimate as well. With a larger total population size, the number of trout entrained would be higher. However, the proportion of the population entrained would stay the same as the estimates with the three approaches are based on percentages of the trout population that are independent of total population size. On the other hand, some of the assumptions are conservative, such as the assumption that 100% of the fish that encounter the diversion are entrained and that movement for smaller fish is the same as for larger fish. These assumptions would tend to overestimate entrainment.

The CPW sampling data indicate that the Cutthroat Trout in Bobtail and Steelman creeks continue to maintain viable populations upstream of the diversions after decades of operation. The variability in the number of Cutthroat Trout collected from year to year demonstrates that population size can increase with a successful year class, such as the strong year class during the low-flow year of 2012. Entrainment of Cutthroat Trout and competition from non-native Brook Trout has not prevented the long-term maintenance of the population above either diversion.

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