United States Department of Agriculture | **Forest Service** | **Arapaho and Roosevelt National Forests and Pawnee National Grassland**

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File Code: 2770
Date: January 7, 2009

Travis Bray
Project Manager
Denver Water
1600 West 12th Avenue
Denver, CO 80204-3412

Dear Mr. Bray:

Thank you for the time extension to comment and provide study requests to Denver Water's proposal to increase storage capacity at Gross Reservoir. These comments and study requests address Denver Water's proposal letters dated May 1, June 18, July 21, October 16, and November 7, 2008, the Initial Consultation Document, and additional Hydrology information.

We are concerned about the statement in your October 16 letter, where it suggests that the Federal Energy Regulatory Commission (FERC) will not address impacts to western slope resources. FERC is required by the National Environmental Policy Act (NEPA) to disclose all direct, indirect, and cumulative effects of your proposal and the fact that a FERC project boundary is in place, does not limit the area of effect.

I am requesting the following 9 studies, designed to disclose effects on National Forest System lands due to the proposed capacity increase to Gross Reservoir:

1. Cultural Resources - Complete pedestrian inventory of the area of potential effect
2. Fisheries - Provide physical description of project operation facilities
3. Fisheries - Perform IFIM-PHABSIM study on streams containing cutthroat trout
4. Fisheries - Perform R2Cross instream flow studies for non-cutthroat trout streams
5. Hydrology - Develop unregulated and regulated hydrology for project-affected streams
6. Fisheries/Hydrology - Aquatic, Riparian and Wetland Habitat loss due to inundation
7. Botany - Perform project area sensitive and rare plant survey
8. Terrestrial Wildlife – Special status terrestrial wildlife species and habitats
9. Invasive Plants – Evaluate invasive plant species

A complete description of each study request can be found in the following enclosure. These study requests were developed according to regulations found at 18 CFR 5.9. Study requests must address seven criteria. The USDA Forest Service is a resource managing agency; therefore, Criteria 3, which deals with requests from non-resource managing agencies, has not been addressed in the study requests.

Please contact Mike Johnson of the Boulder Ranger District at 303-541-2534 if you have any questions.

Sincerely,

/s/ Susan B. Ford (for)
GLENN P. CASAMASSA
Forest Supervisor

Enclosure

cc: Peter Yarrington - FERC

USDA Forest Service Study Requests
Gross Reservoir Hydroelectric Project, P-2035

Gross Reservoir Project Study Request No. 1

Title of Proposed Study: Cultural Resource Inventory - This study request is for a complete pedestrian inventory of the area of potential effect for this project.

1.) Goals, Objectives and Information to be Obtained: In order for the Forest Service (FS) and Federal Energy Regulation Commission (FERC) to be in compliance with the National Historic Preservation Act, as amended (NHPA), Archaeological Resources Protection Act (ARPA) and Native American Graves Protection and Repatriation Act (NAGPRA), an archaeological inventory for cultural resources is required. A cultural resource inventory of the entire Area of Potential Effect (APE) will provide FERC and FS with up to date information regarding cultural resources located within the APE and will allow the agencies to make a recommendation to the Colorado State Historic Preservation Office (COSHPO) as to the significance of these resources and the effect that this project may have on these resources. This consultation is required by 36 Code of Federal Regulations (CFR) Part 800.

2.) Relevant Forest Service Resource Management Goals: The Forest Service Resource Management Goals are outlined in the Forest Service Manual (FSM) 2360- Heritage Program Management. Specific management goals and objectives that are pertinent to this project are outlined below.

FSM 2361.1 – Program Coordination

Programs are coordinated at the national, regional, and forest levels to implement the historic preservation activities outlined in NHPA Section 110. NHPA Section 110 requires Federal agencies to develop a program that ensures:

1. Historic properties under the jurisdiction or control of the agency are identified, evaluated, and nominated to the National Register.

2. Historic properties are maintained in a way that considers the preservation of their historic, archaeological, architectural, and cultural values.

3. Historic properties not under the jurisdiction or control of the agency, but potentially affected by agency or agency-authorized activities, are fully considered during planning.

4. The agency's preservation-related activities are carried out in coordination with other Federal, State, and local agencies, Indian tribes, Native Hawaiian organizations, and the private sector.

5. The agency's procedures for compliance with NHPA Section 106 follow the implementing regulations at 36 CFR 800.

FSM 2360.6 – Heritage Program Activities

The study of cultural resources provides a broader understanding of past human interaction with the land. It helps guide actions that affect resources and the people who depend on them, and creates a sense of time and place for all who enjoy and depend on National Forest System (NFS) lands.

Heritage Program activities address three broad areas of responsibilities to:

1. Protect historic properties,
2. Share their values with the American people, and
3. Contribute relevant information and perspectives to natural resource management.

FSM 2360.63 – Protection and Stewardship

Once historic properties have been identified and evaluated, protection measures eliminate, reduce, or mitigate harm to those properties that result from natural processes, illegal activities, overuse, and effects of Forest Service or Forest Service-authorized activities.

4.) Existing Information and the Need for Additional Information: Cultural resource inventories were conducted in 1997 (Gross Reservoir Hydroelectric FERC License) and 1998 (Winiger Ridge Landscape Assessment). One site that is eligible for the National Register of Historic Places (NRHP) (5BL7019.1) the Resumption Flume has been recorded within the current area of potential effect. Although these inventories were to standard when they were completed, they are now over ten years old and no longer current. In 2006, the Army Corps of Engineers (Corps) conducted an additional cultural resource inventory for the Moffat Collection System Environmental Impact Statement that may be sufficient for the Gross Reservoir FERC licensing project; however, the Forest Service has not been provided the opportunity to review, comment, or consult on this cultural resource inventory. Therefore it is unknown if the 2006 Corps cultural resource inventory covered the entire APE of this project or that the report was to Forest Service standards.

5.) NEXUS Between The Study And The Project: The Federal Energy Regulatory Commission and the USDA Forest Service are required to comply with the National Historic Preservation Act of 1966 (NHPA) (16 U.S.C. 470), and the 36 CFR Part 800. Cultural resource inventories are required to locate and evaluate cultural resources prior to FERC issuing a license for the Gross Reservoir Hydroelectric Station.

6.) Study Methodology: A Literature search and 100% pedestrian inventory of the APE using the methods and standards as required by FERC, FS and Colorado SHPO will be required. The area of potential effect for this project includes the entire permit area and any FS and/or privately owned lands that may have indirect or cumulative effects from this project. Limited testing of cultural resource sites will be conducted to assess project effects. The Principal Investigator, and field personnel will be appropriately permitted as required by Forest Service.

Definition of Cultural Resources Inventory Area of Potential Effect

The area of potential effect for this project is defined by the FS as the land located within the license boundary and all areas that may be directly, indirectly or cumulatively affected by the implementation of this project.

Resource Definitions

Generally, archaeological sites are defined as follows:

> A Prehistoric Site is 15 or more associated artifacts without associated features. Or a single feature without associated artifacts. Artifacts and/or features may be completely deposited on the surface of the ground, may be partially on the surface and partially subsurface or buried, or may be completely buried.
>
> A Historic Site is 15 or more associated artifacts with or without features. In general, cultural material recorded should be 50 years of age or older. One bottle 51 years of age and broken into 50 pieces is not a historic site. Artifacts and/or features, may be completely deposited on the surface of the ground, may be partially on the surface and partially subsurface or buried, or may be completely buried. Discarded modern trash adjacent to highways, roads and two-tracks is not to be recorded.

The Agency will review the justification and make the final determination. When an artifact is observed during inventory, it will be flagged, and an intensive examination of an area of 30 meters (m) (100 ft) in radius, or greater, around the find will be undertaken to determine if additional associated artifacts or features are present to determine the extent of the resource.

Field Inventory

The project area will be inventoried using a maximum of 15-m-wide (50-ft-wide) linear transects to cover the entire APE. The ground surface will be examined for artifacts, features, or other evidence of cultural occupation such as charcoal-stained sediments, with special attention focused on outcrops, cutbanks, eroded areas, anthills, animal burrows, and two-track road exposures. Historic structures, including, but not limited to dugouts, trails/roads/canals, and historic camps will be recorded and evaluated. To conduct field surveys, 75 percent of the ground surface must be visible with no more than 25 percent snow coverage is permitted.

Field Recording

All sites and Isolated Finds (Ifs) will be recorded on Colorado Cultural Resource Inventory Forms (CCRIFs). Previously recorded sites will be recorded on the Colorado Re-evaluation form, if the previous site forms are not adequate, then the previously recorded sites will be re-recorded as are the newly recorded sites. Newly recorded sites will be mapped with a Global Positioning System (GPS) unit with sub-meter accuracy. All linear site features such as site boundaries, roads, fence lines, and vegetation communities, as well as point features such as the site datum, features, and tools, will be mapped with the GPS unit. Field GPS data for sites will be post-processed using FS acceptable software and projected into Universal Transverse Mercator (UTM), Zone 13 north, North American Datum (NAD) 1983 with electronic

shapefiles. All GPS data will be exported into ArcMap 9.0 and/or 9.1 shapefiles and plotted onto the associated geo-referenced U.S. Geological Survey (USGS) 7.5' quadrangle to ensure accuracy and produce location maps of all resources. In addition to the site mapping, project personnel will take overview photographs of each site. Associated features and diagnostic artifacts will be described, measured, recorded with GPS, and photographed, as appropriate. The environmental setting, depositional context, structure, topography, and geographical location will be noted for each site.

Limited Testing Methods

Following guidelines, eligibility for listing on the National Register of Historic Places (NRHP) of all sites within the project survey corridor will be first assessed based on surface evidence. If the surface evidence is inadequate to assess the potential of the site to provide data important to answering questions about the prehistory or history of the region. In such cases, limited testing will be carried out for the following purposes:

1. Testing to evaluate significance, usually under criterion D.
2. Testing to assess the effects of the undertaking on an eligible site.
3. Testing to look for buried cultural remains when there is reason to expect a great potential for significant cultural resources where surface evidence is absent.
4. Testing to develop a data recovery plan for an affected National Register eligible site.

Methods of Evaluative Testing

A phased approach will be utilized for evaluating site eligibility. The type of evaluative testing that is used can have variable impacts on a site, although when using mechanical testing (backhoe trenching) increased impact does not always result in greater data recovery. Evaluation based on surface evidence, shovel or auger probes, and where necessary, limited formal excavation will be carried out under Project Archaeologist's existing permit for survey and limited testing. Anything beyond this will be coordinated with the FERC and FS archaeologists, Colorado SHPO and the project proponent. Any testing beyond that specified in the permit will also require consultation with the SHPO.

Evaluation from Surface Evidence

Where possible, evaluations from surface evidence will utilize existing exposures such as cutbanks, blowouts, or the windward side of dunes. Natural disturbances such as animal burrows and backdirt, entrenched animal trails and ant beds, or human-caused disturbances such as road-cuts or trenches will also be examined. However, if the existing site conditions do not provide sufficient evidence to determine NRHP eligibility or project effect, some form of subsurface investigation will be conducted using one or more of the specified methods. It will not be assumed that no subsurface deposits are present simply because none are visible in areas with sparse vegetation cover.

Collection

Collection of surface archaeological or related material during an initial cultural resources survey or inventory is generally discouraged. Any artifact collection will be done in reference to an established datum point. A total surface collection policy will not be allowed. Diagnostic artifacts will be collected when found on FS-managed surfaces unless the FS states otherwise.

All artifacts collected will be described within an Appendix of the main Class III report and all materials collected during evaluative and effects testing will be curated at a facility that meets the standards specified in 36 CFR part 79.

Non-Archaeological Historic Sites or Components

Non-archaeological historic sites or sites with non-archaeological historic components are those primarily assessed for NRHP eligibility under Criteria A, B, or C, rather than Criterion D. These historic sites are known to mainly include linear historic features, such as transportation routes and water conduits, standing building and structure sites, and potentially extend to any historic feature on an otherwise archaeological site, such as TCP features that may be NRHP-eligible under Criterion A. The integrity of historic sites will be addressed using the guidelines presented in National Register Bulletin 15, which defines the seven elements of integrity as location, design, materials, workmanship, setting, feeling, and association.

Steps to recording and evaluating historical sites and site components will proceed with proper qualitative and quantitative documentation of site features, bounds, and environment on site forms, in photographs, and through site mapping, as for any other cultural property. This documentation will be used to assess physical integrity of site features and on-site setting. Documentation will use photography from key observation points to and from site locations and rely on other available tools to convey information for agency review, such as existing aerial photographs, Government Land Office (GLO) or other historic map copies, and digital elevation/viewshed models, where appropriate.

DISCOVERY OF HUMAN REMAINS

Although unlikely, it is possible that test excavations may reveal human remains. Cessation of ground-disturbing activity will encompass a sufficient area to protect the discovery and provide a buffer zone for adequate and safe investigation of any other associated features or artifacts. A buffer area no smaller than 30 by 30 m (approximately 100 by 100 ft) around the discovery will be established, but this area can be expanded if deemed necessary. Care will be taken to prevent any further disturbance of the potential human remains.

After all testing activity around the discovery has been halted and while the notification procedure is being implemented, steps will be taken to protect the possible/known human remains, including:

- ensuring that no other ground-disturbing activities occur within the buffer zone of the discovery;
- preventing vehicle traffic through that portion of the undertaking beyond that necessary to remove vehicles and equipment already within the area; and
- providing protection in the form of tarps, shoring, protection from the elements, and any other procedures necessary to ensure preservation of the remains.

The measure to protect the remains and any associated artifacts will remain in effect until Denver Water has received notice from the lead agency (FERC) to proceed with the site inventory, evaluation and/or testing in the buffer zone.

For human remains and associated artifacts discovered on federal land, the project archaeologist will stop testing in the vicinity of the discovery. The project archaeologist will immediately notify the USFS/Arapaho and Roosevelt archaeologist. The project archaeologist will also notify the relevant county coroner or sheriff. The discovery will be secured and protected until such time as appropriate disposition has been determined, in accordance with applicable local, state, and federal statutes. For Native American human remains on federal land, funerary objects, sacred objects, and objects of cultural patrimony, the USFS and FERC will meet the requirements of the Native American Graves Protection and Repatriation Act for all inadvertent discoveries and discovery situations on a case-by-case basis in accordance with 43CFR10. In accordance with 43CFR10, testing may resume at the location 30 calendar days after certification by the FERC Authorized Officer. All reasonable measures will be taken to resolve any issues regarding affiliation and disposition of discovered remains within this 30-day period. For all other human remains and associated artifacts, the procedures identified in the 1989 Guidelines, Colorado Inadvertent Burial Discovery Procedures, will be followed.

If the human remains are found on private or state lands, archaeologists will follow the requirements of Colorado Revised Statutes (CRS) regarding the discovery of human remains during an anthropological investigation (CRS 24-80-1302). These read as follows:

(1) Except as provided in section 24-80-1303 with regard to anthropological investigations, any person who discovers on any land suspected human skeletal remains or who knowingly disturbs such remains shall immediately notify the coroner of the county wherein the remains are located and the sheriff, police chief, or land managing agency official.

(2) The coroner shall conduct an on-site inquiry within forty-eight hours of such notification to attempt to determine whether such skeletal remains are human remains and to determine their forensic value. If the coroner is unable to make such determinations, the police chief, the sheriff, the coroner, or the land managing agency official shall request the forensic anthropologist of the Colorado Bureau of Investigation to assist in making such determinations. If it is confirmed that the remains are human remains but of no forensic value, the coroner shall notify the state archaeologist of the discovery. The state archaeologist shall recommend security measures for the site.

(3) Prior to further disturbance, the state archaeologist shall cause the human remains to be examined by a qualified archaeologist to determine whether the remains are more than one hundred years old and to evaluate the integrity of their archaeological context. Complete documentation of the archaeological context of the human remains shall be accomplished in a timely manner.

(4)

a. If the on-site inquiry discloses that the human remains are Native American, the state archaeologist shall notify the commission.
b. The remains shall be disinterred unless the landowner, the state archaeologist, and the chairman of the commission or his designee unanimously agree to leave the remains in situ.
c. Disinterment shall be conducted carefully, respectfully, and in accordance with proper archaeological methods and by an archaeologist who holds a permit issued

under sections 24-80-405 and 24-80-406. In the event the remains are left in situ, they shall be covered over.

d. Without the landowner's express consent for an extension of time, disinterment shall be accomplished no later than ten consecutive days after the state archaeologist has received notification from the coroner pursuant to subsection (2) of this section.
e. The archaeologist who conducts the disinterment will assume temporary custody of the human remains, for a period not to exceed one year from the date of disinterment, for the purpose of study and analysis. In the event that a period in excess of one year is required to complete such study and analysis, the commission shall hold a hearing and may, based upon its findings, grant an extension. During the period that the human remains are in the temporary custody of the archaeologist who conducted the disinterment, an archaeological analysis and report shall be prepared. At the same time, a physical anthropological study shall be conducted to include, but not be limited to, osteometric measurement, pathological analysis, and age, sex, and cause of death determinations. The cost of the disinterment, archaeological analysis, and physical anthropological study shall be borne by the state archaeologist except when the human remains are recovered from private lands. In the latter case, if no party can be identified who will bear the cost of such scientific study; the state archaeologist shall bear such costs.
f. Upon completion of the studies pursuant to paragraph (e) of this subsection (4), the state archaeologist shall consult with the commission regarding reinterment.

(5) Those remains which are verifiably non Native American and are otherwise unclaimed will be delivered to the county coroner for further conveyance to the Colorado state anatomical board.

7.) Describe considerations of level of effort and cost and why any proposed alternative studies would not be sufficient: Denver Water would be required to hire an archaeological contractor to conduct the cultural resource inventories. Contracting costs range from $20 per acre to $50 dollars per acre for the inventory and report.

Gross Reservoir Project Study Request No. 2

Title of Proposed Study: Provide Physical Description of Project Operation Facilities

1.) Goals, Objectives and Information to be Obtained: The goal of this study is to describe and spatially reference the existing infrastructure for the Moffat Collection System operated by the licensee. The physical description and location of all structures owned or operated by Denver Water is necessary in understanding project operations. The results of this study are critical to assessing how water is transported through the Moffat Collection System, and the potential effects to Forest Service administered aquatic resources.

2.) Relevant Forest Service Resource Management Goals: These following standards and guidelines were taken from the 1997 revision of the Arapaho-Roosevelt National Forests and Pawnee National Grasslands Land and Resource Management Plan. The additional management measures come from the Watershed Conservation Practices handbook (effective 05/05/2006).

Forest-wide Goals for Biodiversity, Ecosystem Health, and Sustainability

- ST 4: Establish an upward trend for threatened, endangered, or sensitive plant and animal species (TES) and maintain sensitive species through management activities that recognize TES habitat needs across all levels or scales
- ST 6: Bring all 6th level watersheds to a functional condition
    - None of the watersheds containing the Moffat Collection System are in a functional condition, primarily attributed to water depletions.

Watershed Name	Hydrologic Unit Code	Condition Class	Notes on Condition Class
Fraser River	140100010602	3 (non-functional)	partially due to Denver Water Department diversions
Vasquez Creek	140100010604	2 (functioning-at-risk)	due to water depletions
Saint Louis Creek	140100010606	2	due to cumulative effects of water diversions, roading and harvest
Ranch Creek	140100010608	2	due to cumulative effects of water diversions, roading and harvest
Fraser River Upper composite	140100010610	2	due to heavy past disturbance
Bobtail Creek	140100011002	2	due to flow disruptions by Denver Water Department
South Boulder	101900051002	2	due to water augmentation from

Creek			Moffat Tunnel; Historic dredge mining
Upper S. Boulder composite	101900051006	3	partially due to water augmentation
S. Boulder Middle composite	101900051014	2	n/a

- ST 7: Maintain or improve water quality, stream processes, channel stability, and aquatic management indicator species habitats, and riparian resources, while providing for municipal and agricultural uses

Operational Goals, Standards and Guidelines

- ST 9 (WCP Management Measure 4): Design and construct all stream crossings and other instream structures to provide for passage of flow and sediment, withstand flood flows, and allow free movement of resident aquatic life.
- ST 10 (WCP Management Measure 5): Conduct actions so that stream pattern, geometry, and habitats are maintained or improved toward robust stream health.
- ST 12 (WCP Management Measure 7): Cooperate with state, tribal, and local governments and holders of water rights to manage water resources to minimize damage to scenic and aesthetic values, fish and wildlife habitat, and to otherwise protect the environment.

4.) Existing Information and the Need for Additional Information: There is limited information on the licensee's infrastructure. There is limited information on the physical dimensions and diversion capacity of each diversion and maximum delivery capacity of distribution facilities at the local scale, and water transport through Moffat Collection System at the project scale. The information at these two scales is important in assessing the cumulative impacts of project effects as well as the site-specific effects of the diversion structures to aquatic dependent resources.

Some information exists as to the general location of each instream diversion structure and instream flow requirements for those stream segments with required flow releases.

- Gage records for South Boulder Creek: South Boulder Creek has a number of gages that are maintained by Denver Water. The gages appear to be non-operational during the winter months.
- Williams Fork Instream Flow Determination (Russel and Puffer, 1976)
- Metropolitan Denver Water Supply Systemwide/Site-specific Environmental Impact Statement
- Hydrological Summary for the Williams Fork River Basin (DWD 1975)
- Grand County Stream Management Plan (Tetra Tech et al. 2008)

There is no comprehensive source or compilation of information on the basic operation of Denver Water Department's Moffat Collection System. The Forest Service is primarily

interested in the infrastructure that may impact National Forest System Lands. Diversions from the west slope (Williams Fork Basin and the Fraser River Basin) are transported across the Continental Divide and released into South Boulder Creek. The flow of water through west slope infrastructure is unknown and needs to be assessed during this proceeding. Understanding the potential routes of water and all infrastructure associated with the project will provide the Forest Service with the necessary information to determine the need or type of mitigation necessary for the adequate protection and utilization of the Arapaho National Forest as required under the Federal Power Act and other statutes governing the management of Forest Service administered resources.

5.) NEXUS Between the Study and the Project: The diversions on approximately 35 west slope streams are the primary sources of water for Gross Reservoir. These 35 structures make up the Moffat Collection System which transports water across the Continental Divide to South Boulder Creek which flows directly into Gross Reservoir. Therefore, streams on the west slope are directly connected to the operations of Gross Reservoir. The results of this study will be used to inform the Forest on the operations of Denver Water on Forest streams.

6.) Study Methodology: The study is to include the following components: (a) physical description (height of structure, diversion capacity, any mitigation measures such as fish passage facilities, fish screens, priority bypass flow devices, or sluice gates to pass sediment) and location of all diversion structures (which includes all intakes, tunnels, ditches, pipelines, holding ponds, etc.), and (b) a flow diagram of all potential routes of water through the Moffat Collection System.

STUDY AREA

The proposed study area for describing the physical infrastructure includes all streams with diversions and distribution facilities for the Moffat Collection System. This includes 31 streams in the Upper Fraser River basin and four streams in the Upper Williams Fork River basin, as well as the receiving stream, South Boulder Creek (upstream of Gross Reservoir).

ANALYSIS

The analysis will depend on the results of the operational hydrology study for the Moffat Collection System.

CONSISTENCY WITH GENERALLY ACCEPTED PRACTICE

The expected product of this request is the physical description of existing facilities and their location in a GIS compatible database. The anticipated approach would be to collate existing information on all structures and then incorporate that information into a GIS compatible format. Collating and reporting information is a standard practice.

7.) Describe considerations of level of effort and cost and why any proposed alternative studies would not be sufficient: The Forest Service assumes that the information requested on physical structures is existing information. There would be minimal effort to collate that information. Additional effort is needed to transfer some of this information into a GIS

compatible format. Therefore, this is purely an office exercise. The estimated cost for a staff person (equivalent to a GS-11 in Federal Service) would be around $3,200 (see table below).

Staff Level	Role	Cost per day	Number of Days	Total Cost
GS-11, step 5	Collate information and draft report	$352	8	$2816
GS-12, step 5	Review product	$422	1	$422
Estimated Total Cost				$3238

REFERENCES

USDA Forest Service. 1997. Revision of the Land and Resource Management Plan. Arapaho and Roosevelt National Forests and Pawnee National Grassland, Fort Collins, Colorado.

Weedin, E.K. 1970. Amendatory Decision to Board of Water Commissioners City and County of Denver Right of Way. U.S. Department of the Interior Bureau of Land Management File 306 Document 158. Denver, Colorado, USA.

Tetra Tech et al. 2008. Draft Report Grand County Stream Management Plan Phase II: Environmental and Water Users Flow Recommendations. Grand County, Colorado, USA

USDA Forest Service. Forest Service Handbook 2509.25 Watershed Conservation Practices Handbook. 2006. R2 Amendment 2509.25-2006-2. Denver, Colorado.

Gross Reservoir Project Study Request No. 3

Title of Proposed Study: Perform IFIM- PHABSIM study on streams containing cutthroat trout

1.) Goals, Objectives and Information to be Obtained: The goal of this study is to quantify flow-habitat relationships over a range of discharges to assess the effects of project operations on resident trout habitat in the affected stream reaches. The objective of this study is to develop site specific flow-habitat relationships for each affected stream segment for resident trout. This study will use the hydrographs developed in the "Develop Unimpaired and Regulated Hydrology for Project-affected Streams" study plan to evaluate the relationship between available fish habitat and stream flows, during project operations. The Forest Service is primarily interested in reviewing flow-habitat relationships on the 11 streams that contain resident cutthroat trout where they occupy National Forest Systems Lands. The streams of interest to the Forest Service are listed below:

- Fraser River Basin
  - Cabin Creek
  - North Fork Ranch Creek
  - South Fork Ranch Creek
  - Middle Fork Ranch Creek
  - Hamilton Creek
  - Jim Creek
  - Vasquez Creek
  - Little Vasquez Creek
- Williams Fork River Basin
  - Bobtail Creek
  - Steelman Creek
  - McQueary Creek

2.) Relevant Forest Service Resource Management Goals: The following standards and guidelines were taken from the 1997 revision of the Arapaho-Roosevelt National Forests and Pawnee National Grasslands Land and Resource Management Plan. The additional management measures come from the Watershed Conservation Practices handbook (effective 05/05/2006).

Forest-wide Goals for Biodiversity, Ecosystem Health, and Sustainability

- Goal 4: Establish an upward trend for threatened, endangered, or sensitive plant and animal species (TES) and maintain sensitive species through management activities that recognize TES habitat needs across all levels or scales
- Goal 6: Bring all 6th level watersheds to a functional condition
  - None of the watersheds containing the Moffat Collection System are in a functional condition, primarily attributed to water depletions.

Watershed Name	Hydrologic Unit Code	Condition Class	Notes on Condition Class
Fraser River	140100010602	3 (non-functional)	partially due to Denver Water Department diversions

Vasquez Creek	140100010604	2 (functioning-at-risk)	due to water depletions
Saint Louis Creek	140100010606	2	due to cumulative effects of water diversions, roading and harvest
Ranch Creek	140100010608	2	due to cumulative effects of water diversions, roading and harvest
Fraser River Upper composite	140100010610	2	due to heavy past disturbance
Bobtail Creek	140100011002	2	due to flow disruptions by Denver Water Department
South Boulder Creek	101900051002	2	due to water augmentation from Moffat Tunnel; Historic dredge mining
Upper S. Boulder composite	101900051006	3	partially due to water augmentation
S. Boulder Middle composite	101900051014	2	n/a

- Goal 7: Maintain or improve water quality, stream processes, channel stability, and aquatic management indicator species habitats, and riparian resources, while providing for municipal and agricultural uses

Operational Goals, Standards and Guidelines

- ST 10 (WCP Management Measure 5): Conduct actions so that stream pattern, geometry, and habitats are maintained or improved toward robust stream health.
- ST 12 (WCP Management Measure 7): Cooperate with state, tribal, and local governments and holders of water rights to manage water resources to minimize damage to scenic and aesthetic values, fish and wildlife habitat, and to otherwise protect the environment.
- ST 50: Manage activities to avoid disturbance to sensitive species which would result in a trend toward federal listing or loss of population viability. The protection will vary depending on the species, potential for disturbance, topography, location of important habitat components and other pertinent factors. Special attention will be given during

breeding, young rearing, and other times which are critical to survival of both flora and fauna.

Forest Service Manual (FSM) on National Species Viability and TES Management Direction:
FSM 2670.22 states: Maintain viable populations of all native and desired nonnative wildlife, fish, and plant species in habitats distributed throughout their geographic range on National Forest System lands. A viable population is further defined by FSM 2670.5 as one that has the estimated numbers and distribution of reproductive individuals to ensure the continued existence of the species throughout its existing range (or range required to meet recovery for listed species) within the planning area.
FSM 2670.12 – U.S. Department of Agriculture Directives.

Departmental Regulation 9500-4 directs the Forest Service to:

1. Manage "habitats for all existing native and desired nonnative plants, fish, and wildlife species in order to maintain at least viable populations of such species."
2. Conduct activities and programs "to assist in the identification and recovery of threatened and endangered plant and animal species."
3. Avoid actions "which may cause a species to become threatened or endangered."

FSM 2670.22 - Sensitive Species states:

1. Develop and implement management practices to ensure that species do not become threatened or endangered because of Forest Service actions.
2. Maintain viable populations of all native and desired nonnative wildlife, fish, and plant species in habitats distributed throughout their geographic range on National Forest System lands.
3. Develop and implement management objectives for populations and/or habitat of sensitive species.

FSM 2670.31 - Threatened and Endangered Species

In part states: Identify and prescribe measures to prevent adverse modification or destruction of critical habitat and other habitats essential for the conservation of endangered, threatened, and proposed species. Protect individual organisms or populations from harm or harassment as appropriate.

4.) Existing Information and the Need for Additional Information:

- Grand County Stream Management Plan (TetraTech et al. 2008) – includes IFIM/PHABSIM analyses on the Fraser River, Colorado River, St. Louis Creek, and Vasquez Creek.
- U.S. Forest Service stream surveys for all streams containing native cutthroat trout (using Harig and Fausch methodology) collected in 1998-2002.

There is no information currently available that allows the Forest Service to assess the effects of project operations to resident trout habitat over a range of discharges for affected stream segments on National Forest System lands. Obvious effects of water diversions include the reduction in stream flow downstream of a diversion facility. The effect of a diversion depends on the quantity being diverted. In addition, water augmentation can alter the hydrology of the receiving stream and change the amount of available fish habitat depending on the amount delivered. Flow-habitat relationships are different for different stream types (step-pool streams, pool-riffle streams, etc.). Therefore, it is preferable to conduct independent studies to develop flow-habitat relationships for the affected stream reaches to assess the relative change in habitat availability over a range of flows. Instream flow studies are an accepted technique to assess the affects of project operations to hydrology and fish habitat in lieu of long-term population studies that establish relationships between project operations and fish populations. The requested instream flow studies will provide the Forest Service with the necessary information to determine the need for and type of mitigation necessary for the adequate protection and utilization of the Arapaho National Forest as required under the Federal Power Act and other statutes governing the management of Forest Service administered resources.

5.) NEXUS Between the Study and the Project: The diversions on approximately 35 west slope streams are the primary sources of water for Gross Reservoir. These 35 structures make up the Moffat Collection System which transports water across the Continental Divide to South Boulder Creek which flows directly into Gross Reservoir. Therefore, streams on the west slope are directly connected to the operations of Gross Reservoir. The results of this study will be used to assess the changes in fish habitat for resident cutthroat trout streams affected by project operations.

6.) Study Methodology: The most commonly used method to establish a flow-habitat relationship to cover a range of discharges is the Physical Habitat Simulation (PHABSIM) (Trihey and Wegner 1981; Milhous et al. 1984). This approach allows the end user to assess the effects of various flow scenarios on different fish species and life stages. In addition, PHABSIM is a component of the Instream Flow Incremental Methodology (IFIM) that facilitates negotiating a range of solutions (Bovee et al. 1998). It is also a robust method that facilitates additional analyses that may be of interest such as assessing the effects of different operation scenarios on invertebrate or riparian habitat. This method will be utilized on those streams containing native cutthroat trout. Flow-habitat relationships should be developed for stream containing resident cutthroat trout above and below the diversion structure. Flow-habitat relationships for the juvenile, adult and spawning life stages of resident cutthroat trout should also be developed for each study stream.

There should be approximately 12-16 transects upstream and downstream of each diversion structure for the 11 identified streams. The transect sites should capture representative habitat types for each stream and include habitat types important for fish (i.e. pools and pool tailouts, low gradient riffles, and glide or run habitats). The representative habitat types should be selected at least 10 channel widths (upstream and downstream) from the diversion structure.

STUDY AREA

The proposed study area for the development of flow-habitat relationships using IFIM PHABSIM includes those streams that contain resident cutthroat trout, which are:

- Fraser River Basin
  - Cabin Creek
  - North Fork Ranch Creek
  - South Fork Ranch Creek
  - Middle Fork Ranch Creek
  - Hamilton Creek
  - Jim Creek
  - Vasquez Creek
  - Little Vasquez Creek
- Williams Fork River Basin
  - Bobtail Creek
  - Steelman Creek
  - McQueary Creek

ANALYSIS

This study will develop a flow-habitat relationship for each of the 11 streams identified in "Study Area." The output from the models provided in the PHABSIM system will be study site specific Weighted Usable Area (WUA per 1,000 ft of stream) for each life stage at each simulated flow. WUA versus flow curves will be developed to aid in interpretation of the flow-habitat relationships.

CONSISTENCY WITH GENERALLY ACCEPTED PRACTICE

The proposed study methodology to develop flow-habitat relationships using the PHABSIM method is widely used to assess the effects of project operations that alter the hydrology of streams and fish habitat and is commonly applied in mountain streams.

7.) Describe considerations of level of effort and cost and why any proposed alternative studies would not be sufficient: Site-specific studies will only be needed on streams containing cutthroat trout. To conduct a PHABSIM of at least 12 transects on 11 streams will cost an estimated $15,000 per stream. Therefore, the estimated total cost is $165,000.

REFERENCES

Bovee, K.D., B.L. Lamb, J.M. Bartholow, C.D. Stalnaker, J. Taylor, and J. Henriksen. 1998. Stream habitat analysis using the Instream Flow Incremental Methodology. U.S. Geological Survey, Biological Resources Division, Technical Report USGS/BRD-1998-0004.

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Gross Reservoir Project Study Request No. 4

Title of Proposed Study: Perform R2Cross Instream Flow Studies for Non-Cutthroat Trout Streams

1.) Goals, Objectives and Information to be Obtained: The goal of this study is to quantify baseflows in project-affected streams. In The objective of this study is to develop site-specific baseflow needs using R2Cross methodology for the following streams in the Fraser River Basin. Of the remaining 24 streams affected by project operations, seven streams were chosen to be included in the R2Cross Instream Flow Study. The following streams were selected because they are of low fisheries value. In an effort to reduce the cost to the applicant, the Forest will accept the risks associated using the less robust methodology on these seven streams.

- North Trail Creek
- South Trail Creek
- Hurd Creek
- Little Cabin Creek
- East St. Louis Creek
- West St. Louis Creek
- Fool Creek

This information is needed to validate existing or develop new information for flow needs in the listed streams.

2.) Relevant Forest Service Resource Management Goals: These following standards and guidelines were taken from the 1997 revision of the Arapaho-Roosevelt National Forests and Pawnee National Grasslands Land and Resource Management Plan. The additional management measures come from the Watershed Conservation Practices handbook (effective 05/05/2006).

Forest-wide Goals for Biodiversity, Ecosystem Health, and Sustainability

- ST 4: Establish an upward trend for threatened, endangered, or sensitive plant and animal species (TES) and maintain sensitive species through management activities that recognize TES habitat needs across all levels or scales
- ST 6: Bring all 6th level watersheds to a functional condition
  - None of the watersheds containing the Moffat Collection System are in a functional condition, primarily attributed to water depletions (Table 1)

Table 1: Moffat Collection System 6th level watershed condition class determination

Watershed Name	Hydrologic Unit Code	Condition Class	Notes on Condition Class
Fraser River	140100010602	3 (non-functional)	partially due to Denver Water Department diversions
Vasquez Creek	140100010604	2 (functioning-at-risk)	due to water depletions
Saint Louis	140100010606	2	due to cumulative effects of

Creek			water diversions, roading and harvest
Ranch Creek	140100010608	2	due to cumulative effects of water diversions, roading and harvest
Fraser River Upper composite	140100010610	2	due to heavy past disturbance
Bobtail Creek	140100011002	2	due to flow disruptions by Denver Water Department
South Boulder Creek	101900051002	2	due to water augmentation from Moffat Tunnel; Historic dredge mining
Upper S. Boulder composite	101900051006	3	partially due to water augmentation
S. Boulder Middle composite	101900051014	2	n/a

- ST 7: Maintain or improve water quality, stream processes, channel stability, and aquatic management indicator species habitats, and riparian resources, while providing for municipal and agricultural uses

Operational Goals, Standards and Guidelines

- ST 10 (WCP Management Measure 5): Conduct actions so that stream pattern, geometry, and habitats are maintained or improved toward robust stream health.
- ST 12 (WCP Management Measure 7): Cooperate with state, tribal, and local governments and holders of water rights to manage water resources to minimize damage to scenic and aesthetic values, fish and wildlife habitat, and to otherwise protect the environment.
- ST 50: Manage activities to avoid disturbance to sensitive species which would result in a trend toward federal listing or loss of population viability. The protection will vary depending on the species, potential for disturbance, topography, location of important habitat components and other pertinent factors. Special attention will be given during breeding, young rearing, and other times which are critical to survival of both flora and fauna.

Forest Service Manual on National Species Viability and TES Management Direction:
FSM 2670.22 states: Maintain viable populations of all native and desired nonnative wildlife, fish, and plant species in habitats distributed throughout their geographic range on National Forest System lands. A viable population is further defined by FSM 2670.5 as one that has the

estimated numbers and distribution of reproductive individuals to ensure the continued existence of the species throughout its existing range (or range required to meet recovery for listed species) within the planning area.

FSM 2670.12 - Secretary of Agriculture's Policy on Fish and Wildlife.
Departmental Regulation 9500-4 directs the Forest Service to:

1. Manage "habitats for all existing native and desired nonnative plants, fish, and wildlife species in order to maintain at least viable populations of such species."

2. Conduct activities and programs "to assist in the identification and recovery of threatened and endangered plant and animal species."

3. Avoid actions "which may cause a species to become threatened or endangered."

FSM 2670.22 - Sensitive Species states:

1. Develop and implement management practices to ensure that species do not become threatened or endangered because of Forest Service actions.

2. Maintain viable populations of all native and desired nonnative wildlife, fish, and plant species in habitats distributed throughout their geographic range on National Forest System lands.

3. Develop and implement management objectives for populations and/or habitat of sensitive species.

FSM 2670.31 - Threatened and Endangered Species
In part states: Identify and prescribe measures to prevent adverse modification or destruction of critical habitat and other habitats essential for the conservation of endangered, threatened, and proposed species. Protect individual organisms or populations from harm or harassment as appropriate.

The Endangered Species Act (ESA) of 1976 directs federal agencies to protect plant, animal and fish species. All National Forests have standards and guidelines that require that the Forests protect and manage habitat for the recovery and maintenance of viable and diverse habitat and populations of aquatic, terrestrial, and riparian dependent species. These standards and guidelines include requirements for the perpetuation and recovery of plants and animals which are listed as threatened or endangered (TES species) by the US Fish and Wildlife Service (USFWS) or National Marine Fisheries Service (NFMS) under the Endangered Species Act (ESA) and sensitive (TES species) by US Forest Service.

4.) Existing Information and Need for Additional Information:

- Grand County Stream Management Plan (Tetra Tech et al. 2008), which includes information about current instream flow requirements for some project-affected streams.
- Bureau of Sport Fisheries and Wildlife bypass flow recommendations (1970) for: Fraser River, Vasquez Creek, St. Louis Creek, Ranch Creek, Meadow Creek, Cabin Creek,

Hamilton Creek, Trail Creek, Hurd Creek, and Little Cabin Creek. These recommendations are not stipulations for Denver's right-of-way.

There is little information available that allows the Forest Service to assess the effects of project operations on aquatic habitats or determine baseflow needs on streams flowing through National Forest Systems Lands. The bypass flow provisions recommended by the Bureau of Sport Fisheries and Wildlife in 1970 used an unknown methodology, making it difficult to determine if they are adequate for the protection of habitat on Forest lands. One of the most obvious effects of water diversions is the reduction in streamflow downstream of a diversion. The effect of a diversion depends on quantity diverted and amount released below the diversion facility. In addition, water diversions alter the hydrology of the diverted stream and change the amount of available fish habitat depending on the amount of water diverted. Therefore, conducting independent studies to develop site-specific standards for habitat protection at critical riffle sites is preferred. The requested instream flow studies will provide the Forest Service with the necessary information to determine mitigation necessary for the adequate protection and utilization of the Arapaho-Roosevelt National Forest as required under the Federal Power Act and other statutes governing the management of Forest Service administered resources.

5.) NEXUS Between the Study and the Project: The diversions on approximately 35 west slope streams are the primary sources of water for Gross Reservoir. Most of the diversions on the Arapaho National Forest in Grand County, Colorado, make up the Moffat Collection System which transports the water across the continental divide to South Boulder Creek which flows directly into Gross Reservoir. Therefore, streams on the West Slope are directly connected to the operations of Gross Reservoir. The results of this study will be used to assess changes in fish habitat (East Slope supplementation or West Slope depletion) in the project- affected channels.

6.) Study Methodology: A commonly accepted methodology to use for instream flow studies is the R2Cross method. The Colorado Water Conservation Board (CWCB) Instream Flow Program developed a standard-setting method that uses three hydraulic parameters as criteria to determine the flows needed for habitat protection. Table 2 describes the hydraulic criteria for each of the three parameters: mean depth, percent of bankfull wetted perimeter, and mean velocity.

Table 2: R2Cross hydraulic criteria for protection of aquatic habitat (Espegren 1996)

Stream top width (ft)	Mean depth (ft)	Bankfull wetted perimeter (percent)	Mean velocity (ft/s)
1–20	0.2	50	1.0
21–40	0.2–0.4	50	1.0
41–60	0.4–0.6	50–60	1.0
61–10	0.6–1.0	> or equal to 70	1.0

The assumption with R2Cross is that a discharge to maintain habitat in the riffle is sufficient to maintain habitat in nearby pools for most life stages of fish (Nehring 1979). R2Cross also accounts for seasonal streamflow variability by establishing different streamflow requirements for summer and winter seasons. In the summer, the streamflow recommendations are based on

meeting all 3 hydraulic criteria; while the winter flow recommendations are determined by meeting 2 out of 3 criteria.

Critical riffle areas should be selected that are representative of natural riffle conditions. Using the definition as described by Bain and Stevenson (1999), "a riffle is a section of channel, usually between pools, that has a gravel to cobble bed material. The water surface is turbulent with little or no whitewater having average water velocities in the range of .6 ft/s to 1.6 ft/s." The selection of appropriate riffle areas for R2Cross methods includes those riffles that extend across the entire channel, are well defined, and maintain hydraulic control over a range of low to moderate flows. Unnatural alterations to channels can affect the hydraulic parameters at each site, which should be a consideration in selection of riffle areas (Parker and Armstrong 2001).

STUDY AREA

The proposed study area for both the development of baseflow recommendations and the validation of existing baseflows will include the following streams:

- North Fork Trail Creek
- South Fork Trail Creek
- Little Cabin Creek
- Hurd Creek
- East St. Louis Creek
- West St. Louis Creek
- Fool Creek

ANALYSIS

This study will develop baseflow recommendations for summer and winter flows based on the three criteria as recommended by CWCB. Flow recommendations are made based on the lowest flow which meets habitat retention criteria. As noted above, R2Cross is the primary methodology used by the Colorado Water Conservation Board for the State's instream flow program.

CONSISTENCY WITH GENERALLY ACCEPTED PRACTICE

The proposed study methodology to develop flow recommendations based on hydraulic criteria using the R2Cross method is widely used and applied in mountain streams.

7.) Describe considerations of level of effort and cost and why any proposed alternative studies would not be sufficient: Total cost to obtain the field data and conduct the hydraulic analyses should not exceed $ 15,000.

REFERENCES

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Nehring, R.B. 1979. Evaluation of instream flow methods and determination of water quantity needs for streams in the State of Colorado. Colorado Division of Wildlife, Fort Collins, CO.

Parker, G.W., and D.S. Armstrong. 2001. Preliminary assessment of streamflow requirements for habitat protection for selected sites on the Assabet and Charles Rivers, Eastern Massachusetts. U.S. Geological Survey Open File Report 02-340.

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Tetra Tech et al. 2008. Draft Report Grand County Stream Management Plan Phase II: Environmental and Water Users Flow Recommendations. Grand County, Colorado, USA

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Gross Reservoir Project Study Request No. 5

Title of Proposed Study: Develop Unregulated and Regulated Hydrology for Project-Affected Streams

1.) Goals, objectives and Information to be Obtained: The goal of this study is to quantify the effects of the Moffat Collection System (project) operations on the hydrology of affected streams by quantifying unregulated, existing and proposed flow regimes downstream of diversion points. The objective of this study is to develop average daily flow statistics for each diverted and augmented stream that supplies water to Gross Reservoir. A list of the streams is shown as attachment A. The results of this study are the cornerstone to assessing the effects of project operations to Forest Service administered aquatic resources; in particular project effects to stream channel conditions and fish habitat on affected streams (See Study Plan "Perform Instream Flow/Fish Habitat Studies" to quantify relationship between available fish habitat and stream flow during project operation).

2.) Relevant Forest Service Resource Management Goals: The following resource management goals were taken from the 1997 revision of the Arapaho-Roosevelt National Forests and Pawnee National Grasslands Land and Resource Management Plan (LRMP). Design criteria for the LRMP standards come from the Region 2 Watershed Conservation Practices Handbook or WCPH (FSH 2509.25-2006-2).

Forest-wide goals for Biodiversity, Ecosystem Health and Sustainability:
Goal 6- Bring all sixth-level watersheds to a functional condition.

None of the 6th level watersheds containing the Moffat Collection System are in functional condition (Class 1), often due to flow disruptions.

Watershed Name	Hydrologic Unit Code	Condition Class	Notes on Condition Class
Fraser River	140100010602	3 (non-functional)	partially due to Denver Water Department diversions
Vasquez Creek	140100010604	2 (functioning-at-risk)	due to water depletions
Saint Louis Creek	140100010606	2	due to cumulative effects of water diversions, roading and harvest
Ranch Creek	140100010608	2	due to cumulative effects of water diversions, roading and harvest
Fraser River Upper composite	140100010610	2	due to heavy past disturbance
Bobtail Creek	140100011002	2	due to flow disruptions by Denver Water Department
South Boulder Creek	101900051002	2	due to water augmentation from Moffat Tunnel; Historic dredge mining

Upper S. Boulder composite	101900051006	3	partially due to water augmentation
S. Boulder Middle composite	101900051014	2	n/a

Goal 7- Maintain or improve water quality, stream processes, channel stability and aquatic management indicator species habitats, and riparian resources while providing for municipal and agricultural uses.

Operational Goals, Standards and Guidelines for physical resources:
Standard 9 (WCPH Management Measure 4)- Design and construct all stream crossings and other instream structures to provide for passage of flow and sediment, withstand expected flood flows, and allow free movement of resident aquatic life.

Denver's diversion structures are small dams that cross the entire channel at right angles. These dams do not generally allow for passage of sediment or allow for free movement of resident aquatic life.

Standard 10 (WCPH Management Measure 5)- Conduct actions so that stream pattern, geometry, and habitats maintain or improve long-term stream health.

Out of 35 diversions, less than 1/3rd have bypass flow requirements. The bypasses are for minimum flow releases only. These minimum flow releases are subject to reduction or temporary discontinuation under certain conditions, with the location of bypass reductions at the discretion of Denver. Minimum bypass flows can be insufficient for channel maintenance.

Standard 12 (WCPH Management Measure 7)- Cooperate with state, tribal and local governments and holders of water rights to manage water resources to minimize damage to scenic and aesthetic values, fish and wildlife habitat, and to otherwise protect the environment.

> WCPH Design Criteria- Cooperate with water users and other interested parties to evaluate how to operate existing water use facilities to meet resource goals.

Standard 13 (WCPH Management Measure 8)- Manage water-use facilities to prevent gully erosion of slopes and to prevent sediment and bank damage to streams.

> WCPH Design Criteria - Do not flush or deposit sediment from behind diversion structures into the stream below. Deposit sediment in a designated upland site. Vegetate or otherwise stabilize spoil piles.
>
> WCPH Design Criteria - Mitigate water imports and water disposal (including reservoir releases) so that the extent of stable banks, channel pattern, profile and dimensions maintain or improve long-term stream health in each receiving stream reach.

WCPH Design Criteria – Maintain the extent of stable banks in each stream reach at 74% or more of reference conditions.

It is unclear how the diversion structures affect sediment regimes or how Denver disposes of sediment accumulating behind diversions. It is unknown if the extent of stable banks in reaches of Vasquez Creek and South Boulder Creek (both augmented) can be maintained with increased diversions from the existing Moffat collection system.

4.) Existing information and the Need for Additional information: There is limited information on project operational effects to stream hydrology at the project scale (inflow, outflow, and storage) and no information at the suggested time scale of inflow, quantity diverted, and outflow at each diversion. The two scales are important to conduct a cumulative effects assessment of project effects along with site specific assessments of the effects of each diversion to aquatic dependent resources (physical and biological).

Existing Information:

Some information exists regarding unregulated flow regimes systemwide and instream flow requirements for those stream segments with required flow releases. Much water yield work was done for water supply planning purposes within the past two decades. Some of the major water supply related documents include NEPA work done by the Denver Water Department for the Williams Fork Collection system, such as:

Existing information on water availability (not exhaustive):
Upper Colorado River basin Study Phase II Final Report (Hydrosphere 2003)
Fraser River basin Phase I- Feasibility Study Final report (CH2M Hill 1989)
Hydrologic data: Metropolitan Denver Water Supply Systemwide/Site-specific (EIS 1986),
Hydrologic Summary for the Williams Fork River Basin (DWD 1975)

Other studies have looked at how much water should be retained in streams below diversions in terms of minimum and channel maintenance (flushing) flows. The Colorado Water Conservation Board (CWCB) holds Instream Flow (ISF) water rights on many streams on the Arapaho NF. The CWCB ISF's are generally determined by the R2 Cross method. The Routt National Forest completed a ISF study using R2 Cross methods for the Williams Fork collection system in the late 1970's. In other cases, we have information to quantify the flow volume needed to maintain the physical channel conditions below diversions. Instream flow studies are currently being conducted on 5 streams affected by Moffat Firming: Fraser, Williams Fork, Vasquez, St. Louis and Ranch Creeks pursuant to the Grand County stream management plan.

Existing information on instream flows:
Grand County Stream Management Plan Phase II (Tetra Tech et. al. 2008)
Colorado Water Conservation Board Instream Flow water rights
Williams Fork River Instream Flow Determination (Russel and Puffer, Routt National Forest, late 1970's)

There is no comprehensive source or compilation of information on the hydrology of project affected reaches to assess the effects of project operations to aquatic dependent resources. The Forest Service is primarily interested in project operational effects to the hydrology of the 35 streams with project diversions on or affecting National Forest System Lands (see attached list). A subset of these 35 streams have populations of Colorado cutthroat trout, Regional Forester sensitive fish species, or greenback cutthroat trout, listed as threatened under the Endangered Species Act. Diversions from the West Slope (Williams Fork basin and the Fraser River basin) are transported across the Continental Divide and released into South Boulder Creek. The effects of the large input of West Slope water to the aquatic dependent resources (fish, riparian vegetation, channel morphology, etc.) of South Boulder Creek are unknown and need to be assessed during this proceeding. Understanding project operational effects to the hydrology of South Boulder Creek and the 35 affected stream reaches on the West Slope will provide the Forest Service with the necessary information to determine the need for and type of mitigation necessary for the adequate protection and utilization of the Arapaho National Forest as required under the Federal Power Act and other statutes governing the management of Forest Service administered resources.

5.) NEXUS Between the Study and the Project: The diversions on 35 West Slope streams are the primary sources of water for Gross Reservoir. Most of the Moffat Collection System diversions are on the Arapaho National Forest in Grand County, Colorado. The Moffat tunnel transports West Slope water under the Continental Divide to South Boulder Creek which flows directly into Gross Reservoir. Therefore, streams on the West Slope are directly connected to the operations of Gross Reservoir. The results of this study will be used to assess changes in streamflow (East Slope supplementation or West Slope depletion) in the affected channels. The results of this study will be used to inform the Forest on the effects of Denver Water operations on forest streams.

6.) Study methodology:

STUDY AREA

The proposed study area includes most streams diverted into the Moffat Collection System. This includes 31 streams in the Fraser River basin and 4 streams in the Williams Fork River basin, as well as the receiving streams, Vasquez and South Boulder Creek (upstream of Gross Reservoir).

METHODOLOGY

Depending on available existing information, several different methodologies may be needed to understand the regulated and unregulated hydrology of these watersheds.

The study is to include the following components for unregulated, existing and proposed hydrologic conditions: (a) hydrographs in cubic-feet-per-second (cfs) in a daily time step (inflow, amount diverted, and outflow) for 35 project diversions, Vasquez (augmented portion) and South Boulder Creeks for wet, average, and dry years (based on Berthoud Pass SNOTEL site snow water equivalency on April 1st between 1979-2007) and b) tables showing the rates of inflow, diversion and outflow in cfs at each diversion for wet, average, and dry years. The

following years should be evaluated: 1980 for wet (75th percentile), 1991 for average (50th percentile) and 1999 for dry (25th percentile).

Historical flow data (reference time series) are needed to conduct additional hydrologic based analyses such as flood frequency and the creation of hydrologic alteration statistics. Project operation and stream gage information within the project area may be available for some affected stream reaches. However, some streams may have insufficient measured information. For these streams, simulated hydrographs can be created using other accepted methodologies. There are three basic approaches to creating the reference time series as listed by Hughes et. al. (1997).

- Observed rainfall-runoff time series.
- Extrapolation of observed flow records of nearby unregulated watersheds.
- Using suitable runoff simulation models.

The last two will probably be used the most in this study. Additional references of accepted methodology are: Vogel and Fennessey (1995) and Kircher et al (1985).

ANALYSIS

The results generated in the study should be analyzed in accordance with the approaches developed by Richter et al. (1996, 1997, and 1998). Statistics should be generated that address the 5 groups identified by Richter in the development of the Indicators of Hydrologic Alterations (IHA) analysis.

1. Magnitude of monthly discharge conditions
2. Magnitude and duration of annual extreme discharge conditions
3. Timing of annual extreme discharge conditions
4. Frequency and duration of high and low flow pulses
5. Rate and frequency of hydrograph changes

These statistics should be evaluated for the project-affected reaches. In addition, a flood frequency analysis should be performed to predict channel-forming discharges of the diverted streams.

CONSISTENCY WITH GENERALLY ACCEPTED PRACTICE

The proposed study methodology to collate and report existing hydrologic information or create hydrographs at each diversion and for Vasquez & South Boulder Creeks is widely used and accepted in the scientific and engineering communities.

7.) Describe considerations of level of effort and cost and why any proposed alternative studies would not be sufficient: If the information is readily available based on project data, the estimated cost to compile and report the information is about 10 days effort for a GS-11 ($352 per day). Therefore, costs could be as low as $3,520 for existing information. If the data is not readily available and one has to construct simulated hydrographs based on the methods above, the costs could run as high as $26,750 based on government salary rates at the GS-11 and GS-12 levels and about 75-days to conduct the analysis and prepare the report.

Staff level	Role	Cost per day	Number of Days	Total Cost
GS-11, step 5	Conduct analysis	$352	70 (~ 2 days per diversion and stream)	$24,640
GS-12, step 5	Review final report	$422	5	$2,110
Estimated Total Cost				$26,750

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Attachment A- Study stream list

Diverted Streams
I. Fraser basin Collection System (31 creeks)

West Side (from west to east towards Moffat Tunnel):

1. Mainstem St. Louis Creek
2. Iron Creek
3. Byers Creek
4. Short Creek
5. West St. Louis Creek
6. East St. Louis Creek
7. Fool Creek
8. King Creek
9. West Elk Creek
10. West Fork Main Elk Creek
11. Main Elk Creek
12. East Elk Creek
13. Vasquez Creek
14. Little Vasquez Creek

East Side (from south to north towards Ranch Creek):

15. Mainstem Fraser River
16. Jim Creek
17. Buck Creek
18. Cub Creek
19. Wolverine
20. South Fork Ranch Creek
21. Middle Fork Ranch Creek
22. Ranch Creek
23. Dribble Creek
24. North Fork Ranch Creek

Cabin-Meadow extension of East Side (from North Fork Ranch Creek to Meadow Creek):

25. Little Cabin Creek
26. Cabin Creek
27. Hamilton Creek
28. Hurd Creek
29. South Trail Creek
30. North Trail Creek
31. Meadow Creek

II. Williams Fork Collection System (4 creeks)

South Side (from south to north):

32. Bobtail Creek
33. Steelman Creek

North Side (from south to north):

34. McQuery Creek
35. Jones Creek

Augmented Streams

1. Vasquez Creek
2. South Boulder Creek

Gross Reservoir Project Study Request No. 6

Title of Proposed Study: Aquatic, Riparian and Wetland Habitat Loss due to Inundation.

1.) Goals, Objectives and Information to be Obtained:

The Forest Service (Forest) is concerned about losing stream, riparian and wetland resources to rising reservoir waters if the proposal is approved.

The goal of the "inundation" study is to inventory aquatic, riparian, and wetland resources on Forest lands within the proposed reservoir enlargement area. Study objectives include measurement, classification and mapping of A) stream habitat B) riparian vegetation communities and C) wetlands (riparian and isolated) that are proposed for inundation. For each resource listed in A-C, the Forest asks for detailed classifications of habitat and/or vegetation communities and the area of each class proposed for submergence under the expanded reservoir.

Information to be obtained from this study includes the location, type, and area of Forest stream habitat, riparian vegetation and wetlands proposed for inundation by an enlarged Gross Reservoir.

2.) Relevant Forest Resource Management Goals:

The following resource management goals were taken from the 1997 revision of the Arapaho-Roosevelt National Forests and Pawnee National Grasslands Land and Resource Management Plan (LRMP). Design criteria for the LRMP standards come from the Region 2 Watershed Conservation Practices Handbook or WCPH (Forest Service Handbook 2509.25-2006-2).

Operational Goals, Standards and Guidelines for physical resources:

Standard 7 (WCPH Management Measure 3)- In the water influence zone next to perennial and intermittent streams, lakes, and wetlands, allow only those actions that maintain or improve long-term stream health and riparian ecosystem condition.

> WCPH Design Criteria- Allow no action that will cause long-term change to a lower stream health class in any stream reach. Allow no action that will cause long-term change away from desired condition in any riparian or wetland vegetation community.

Standard 10 (WCPH Management Measure 5)- Conduct actions so that stream pattern, geometry, and habitats maintain or improve long-term stream health.

Standard 11 (WCPH Management Measure 6)- Maintain long-term ground cover, soil structure, water budgets, and flow patterns of wetlands to sustain their ecological function.

> WCPH Design Criteria- Avoid any loss of rare wetlands such as fens and springs. Avoid long-term reduction in organic ground cover and organic soil layers in any wetland (including peat in fens).

Standard 12 (WCPH Management Measure 7)- Cooperate with state, tribal and local governments and holders of water rights to manage water resources to minimize damage to scenic and aesthetic values, fish and wildlife habitat, and to otherwise protect the environment.

> WCPH Design Criteria- Cooperate with water users and other interested parties to evaluate how to operate existing water use facilities to meet resource goals.

The Forest Service Manual (FSM 2526) directs the Forest to, "Delineate and evaluate riparian areas prior to implementing any project activity. Determine geographic boundaries of riparian areas by onsite characteristics of water, soil, and vegetation". It provides further direction to, "Give special attention to land and vegetation for approximately 100 feet from the edges of all perennial streams, lakes, and other bodies of water. This distance shall correspond to at least the recognizable area dominated by the riparian vegetation (36 CFR 219.27e). Give special attention to adjacent terrestrial areas to ensure adequate protection for the riparian-dependent resources".

The Forest Service Manual (FSM 2527) directs the Forest to, "Analyze proposed actions affecting floodplains or involving new construction in wetlands to assess the specific flood hazards; quantify floodplain or wetland values of the areas; determine the impacts of the proposal on those hazards and values; formulate and evaluate land and resource management options; come up with a practicable alternative action or location; and determine whether the "no action" option is practicable". Further direction is provided to "Modify plans, activities, and designs to minimize impacts of the action and to mitigate its effects on the natural and beneficial values of the floodplain or wetland in all actions where an alternative to an action in or affecting the floodplain or new construction in a wetland is not practicable".

4.) Existing Information and the Need for Additional Information:

There is limited information on the extent and types of stream, riparian and wetland habitat that would be lost to inundation. The information is important to determine the loss of stream, riparian and wetland habitat from Forest lands that will be incurred if Gross Reservoir is enlarged.

A) Stream habitat- Existing information regarding stream habitat includes Colorado Division of Wildlife (CDOW) surveys from 1998 on South Boulder, Winiger and Forsythe Canyon creeks. The CDOW surveys contain qualitative information on stream habitat and fish abundance estimates.

B) Riparian vegetation communities - At least one research paper has been published that included information on riparian communities along South Boulder Creek above and below Gross Reservoir.

- Merritt, D. M., and E. E. Wohl. 2006. Plant dispersal along rivers fragmented by dams. River Research and Applications 22:1-26.

C) Wetlands- The US Fish and Wildlife Service National Wetlands Inventory (NWI) may have information on wetlands around Gross Reservoir. The NWI website "wetlands mapper" shows the area around Gross Reservoir as a non-digital inventory, with wetland data available by hardcopy only (http://www.fws.gov/wetlands/). United States Geological Survey 1:24,000 scale topographic quadrangles may have general delineations of wet zones in the study area as well.

5.) NEXUS Between The Study And The Project:

The study will examine areas that would be inundated by an enlarged Gross Reservoir, so the study would be directly connected to the effects of the project. The results of this study will be used to inform the Forest the loss of stream, riparian and wetland habitats on National Forest lands.

6.) Study Methodology:

A) **STREAM HABITAT**

A hierarchical based approach developed by Hawkins et al. (1993) will be used to assist in the identification of individual habitat units in the field. At the broadest level, Level I categorizes habitats as "fast water" and "slow water". Level II fast water is subdivided into two categories: turbulent and non-turbulent; slow water is also subdivided into two categories: scour pool and dammed pool. Level III categories are those categories that further describe the slow and fast water units. Figure 1 shows the relationship between the three levels (see Figure 1).

Habitat mapping will be conducted by a pair of fishery biologists working as team. The drainages to be included in the habitat mapping study are: South Boulder Creek on Forest land upstream of reservoir, Winiger Gulch, and Forsythe Canyon. Each drainage will be mapped working in an upstream direction where possible. Data will be recorded onto standardized datasheets. Aquatic habitats will be visually delineated based on the framework provided by Hawkins et al. (1993) and McCain et al. (1990); each habitat unit will be uniquely identified. They will be identified at the finest scale (i.e. Level III) and recorded. All aquatic habitats identified will be spatially referenced using a combination of a GPS (UTM, WGS 84 datum) and hip chain methodology. Other parameters recorded for each aquatic habitat will include: mean width, mean depth, maximum depth, substrate composition (including spawning gravel characterization), riparian vegetation, woody debris, and cover.

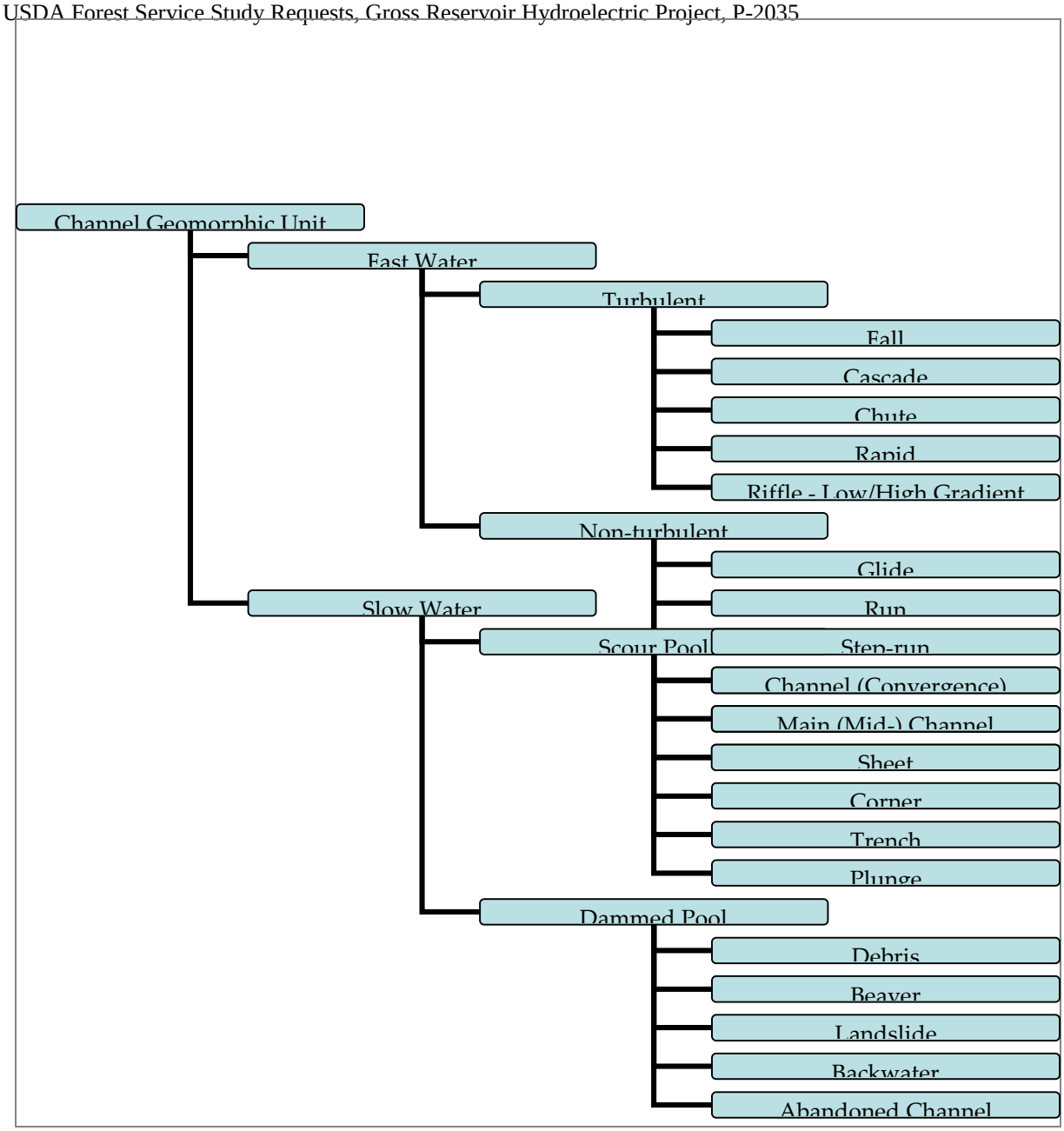

Figure 1. Three-tiered habitat mapping classification system adapted from Hawkins et al. (1993) and McCain et al. (1990).

During the habitat mapping, the location of spawning gravel deposits will be mapped using a GPS. The length and width of each spawning gravel deposit will be measured to the nearest tenth of a foot following the approach provided by Johnson and Kier (1998).

Describing and measuring each habitat type is labor intensive; an average of 0.75 miles can be covered each day by trained surveyors.

STREAM HABITAT ANALYSIS

All habitat data (including spatial referencing) will be entered into a spreadsheet and will be quality checked. Once the data is cleared, it will be entered into a database. The database format will allow the user to query specific information on a number of scenarios. The relative

abundance of each habitat unit will be used to determine the potential changes in stream habitat availability caused by inundation.

Consistency with generally accepted practice
Habitat classification and inventories are a common approach in determining the availability and importance of certain habitats to fish. The hierarchical based approach is widely used and applied in mountain streams.

B) **RIPARIAN VEGETATION COMMUNITIES**

The study is to include the following components: (1) delineation of riparian areas that would be inundated by reservoir enlargement, using inundated channel length and regularly spaced transects, perpendicular to the channel, to estimate riparian width, and (2) riparian vegetation plots within the area proposed for inundation to classify the riparian plant communities.

Aerial photography is often used to delineate aerial extent of riparian areas. However, the riparian zones along South Boulder Creek and other tributaries to Gross Reservoir are narrow and much of the riparian vegetation occurs as an understory to coniferous forest. Therefore, riparian width along the reach will be estimated using systematically placed transects oriented perpendicular to the channel, extending across the width of the riparian zone on either side of the channel.

Transects should be located along the entire reach to be inundated (main channel and tributaries). Transect should be systematically placed from the upstream extent of the proposed inundated area along South Boulder Creek and tributaries every 50 meters down the channel to the current termination of the South Boulder Creek in Gross Reservoir (e.g., 40 transects in 2 km of inundated stream).

Vegetation should be measured in 1x2m plots positioned systematically along selected channel cross sections within the study area. At least 6 vegetation plots should be located systematically (at set intervals) along the transect length within the riparian zone: plot nearest that channel along the lowest extent of perennial vegetation. Percent cover of all vascular plant species should be measured in each plot. Estimates of cover should be made using cover-classes (e.g., Braun-Blanquet cover-class sclale; Mueller-Dombois and Ellenberg 1974).

Riparian areas should be categorized into coarse plant physiognomic classes (e.g., herbaceous-gramminoid meadow, shrubland, deciduous forested, and coniferous forested). Total length of each physiognomic class should be measured along each transect. Average length along transects occupied by each physiognomic class should then be converted to proportions and area of each physiognomic class along the entire reach estimated. Total riparian area of the proposed inundated area should be calculated. The boundary of the riparian zone should be recorded using geographic positioning systems (GPS) and projected using geographic information systems (GIS).

RIPARIAN VEGETATION STUDY AREA

The proposed study area includes the length of South Boulder Creek that would be inundated by the enlarged reservoir. It would also include other Forest Service tributaries to Gross Reservoir that would be inundated such as Winiger Gulch and Forsythe Canyon. Perennial, intermittent, and ephemeral tributaries that support riparian vegetation would be included.

RIPARIAN VEGETATION ANALYSIS

Vegetation plots should be classified into plant associations using conventional methods. One such method is to utilize the dichotomous key to the wetlands and riparian plant associations of Colorado in Carsey et al. (2003). Once all plots are classified into one of the associations in this guide, an assessment of frequency of various plant associations within each physiognomic class can be determined. When combined with the global and state ranks of conservation status, assessments may be made of the following: 1) the types of plant associations and associated habitat lost due to inundation, 2) the species composition and species richness of those associations, 3) the occurrence and frequency of rare and listed species, as well as other species of interest, 4) an approximation of the proportions of each physiognomic class occupied by each plant association, and 5) an assessment of the aerial loss of plant associations and their conservation status.

Data to be provided to the Forest Service: Cross-section end points and plot locations (recorded using global positioning system (GPS)) including a GIS cpverage (e.g. shapefile or geodatabase), a spreadsheet matrix of percent cover of each species in each plot, plant associations that each plot was classified into, percent length of each cross section falling into each physiognomic class, and a detailed description of methods used to locate cross sections and plots along cross sections

Consistency with generally accepted practice

Inventories are a common approach in determining the amounts and composition of riparian habitats. The proposed vegetation classification is commonly used and is based upon published works.

C) **WETLANDS**

The study is to include the following components: (1) Inventory of wetlands that would be inundated by reservoir enlargement, using aerial photography and/or field surveys along the entire the entire length of canyon proposed for inundation and within the proposed inundation area, followed by 2) Wetland determination from data collected on vegetation (plots), hydrology and soil (soil pits) within the wetland area 3) wetland classification following Cowardin et al 1979 and 4) jurisdictional determination. It is recognized that there is overlap between the riparian vegetation and wetland studies. It is the intention of the wetland study to identify and classify both riparian and non-riparian wetlands.

WETLAND STUDY AREA

The study area is any Forest land between the current and proposed high water line of Gross Reservoir subject to inundation.

WETLAND ANALYSIS

1) Location of wetlands

The entire length of South Boulder Creek and tributaries should be walked by at least two observers. The observers should inspect the entire valley bottom from the creek (valley low point) to the elevation of the proposed future reservoir level. Any wetlands should be recorded using GPS.

Aerial photography is often used to delineate wetland areas. However, the wetlands around Gross Reservoir may be too small to identify from air photos and, a ground survey would be more suitable. Air may be useful to initially identify location of some wetlands, and could be used to supplement, but not replace ground surveys. If air photos are reviewed to identify wetland areas, use the largest-scale, most recent color or color infrared stereopairs available, but no smaller than 1:24,000 scale

2) Wetland determination, delineation and mapping

In the field, complete the "data form for routine wetland determination" which is Appendix B in the Army Corps of Engineers (Corps) Wetlands Delineation manual (Corps of Engineers 1987). Collect data on wetland parameters of vegetation, hydrology and soils. A site is determined to be a wetland if at least one positive indicator of each wetland parameter is observed (i.e. hydrophytic vegetation or hydric soils etc.). If the site is determined to be a wetland, then delineate the wetland perimeter, measure the wetlands dimensions (if practical) with a measuring tape and map using high precision GPS capable of sub-meter accuracy. Take photos of representative vegetation and any soil pits.

3) Jurisdictional determination

Wetlands within the inundated area may be jurisdictional or non-jurisdictional. Receive jurisdictional determinations for each wetland from the Corps and include jurisdictional determination for each wetland into the final wetland report.

4) Vegetation measurements

Vegetation plots should be established within each wetland identified at a concentration of one 0.5mx0.5m vegetation plot per $25m^2$ or no fewer than three plots per wetland. Plots should be located within each wetland using randomly selected x-y coordinates that fall within the wetland boundary. Percent cover of all vascular plant species should be measured in each plot. Estimates of cover can be made using cover-classes (e.g., Braun-Blanquet cover-class sclale; Mueller-Dombois and Ellenberg 1974). Plant associations should be classified using Carsey et al. (2003).

5) Detailed report

Prepare a report on the location, area and classification of each type of wetland proposed for inundation including maps and photos of each wetland. Include data forms used in wetland determinations in the report. Plant associations represented should be listed along with a

frequency of occurrence and global and state conservation status rankings. Total delineated wetland area should be provided. Total area of wetland types (Cowardin et al. 1979) should also be provided. All vegetation inventory data will also be provided to the Forest.

Consistency with generally accepted practice
The Corps wetland delineation procedure is a common approach used for identifying wetland habitats. The proposed wetland classification system is commonly used and is based upon published works.

7.) Describe considerations of level of effort and cost and why any proposed alternative studies would not be sufficient:

A) Stream Habitat

There are approximately 2.1 stream miles to be included in the mapping study. A team of two trained fishery biologists (a combination of GS-9 and GS-11) would be able to map 2.1 miles of stream in approximately 2.5 days. This estimate is based on the general salary of both a GS-9 and GS-11 at different step levels. The estimate for the total number of days includes both the field data collection as well as the data entry.

Staff Level	Cost Per Day	Number of Days	Total Cost
GS-9, step 1	$232	15	$3480
GS-11, step 5	$352	10	$ 3520
		Total Estimated Cost	$ 7000

B) Riparian Vegetation Communities

Staff Level	Cost Per Day	Number of Days	Total Cost
GS-9, step 1	$232	10	$2328
GS-11, step 5	$352	20	$ 7040
		Total Estimated Cost	$ 9368

C) Wetlands

The level of effort and cost for the wetland inventory is directly related to the number and size of wetlands existing in the study area. Most likely, the Corps is already aware of the location, area and types of wetlands at risk but in the absence of such information, an air photo review of the study area could be completed in 2 days. A field team consisting of a soil scientist and a botanist (both GS-11 grade) would be able to make approximately two wetland determinations and maps per day. Another 2-day field review with the Corps may be needed for jurisdictional determinations. A final report could be completed in two days. Assuming 10 wetlands of < 1-acre area each are located via air photos and investigated in the field, including a 2-day Corps

field review, the wetland study could take approximately 20 person-days at $352 per day or $7040.

Staff Level	Cost Per Day	Number of Days	Total Cost
GS-11, step 5	$352	20	$ 7040
		Total Estimated Cost	$ 7040

References

Stream Habitat

Hawkins, C. P., J. L Kershner, P. A. Bisson, M. D. Bryant, L. M. Decker, S. V. Gregory, D. A. McCullough, C. K. Overton, G. H .Reeves. R. J. Steedman, and M. K. Young. 1993. A hierarchical approach to classifying habitats in small streams. Fisheries. 18(6): 3-12.

Johnson, J. and W. Kier. 1998. A preliminary assessment of the salmon habitat potential of Butte Creek, a tributary of the Sacramento River, between Butte Head Dam and the Centerville Diversion Dam, Butte County, California. Prepared for Institute for Fisheries Resources, San Francisco, CA by William M. Kier Associates, Sausalito, CA. January 1998.

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Cowardin, L. M., Carter, V., Golet, F. C. and LaRoe, E. T. 1979. Classification of wetlands and deepwater habitats of the United States. Performed for the US Department of the Interior Fish and Wildlife Service, Office of Biological Services. FWS/OBS-79/31, Washington D.C. 20240.

Gross Reservoir Project Study Request No. 7

Title of Proposed Study: Denver Water FERC Amendment for Gross Reservoir, Roosevelt National Forest, Project Area Sensitive and Rare Plant Survey

1.) Goals, Objectives and Information to be Obtained: The following is a process to complete sensitive plant surveys for the project area. The objective of this process is to make sure that presence of rare plants and plant communities, and the effects of disturbance on and mitigation for rare plants and plant communities, can be determined in the most efficient manner and is performed to adequate industry standards. "Rare plants" for this study is defined as comprising 1) plants listed or proposed for listing under the Endangered Species Act, 2) the most current Forest Service Region 2 list of Sensitive Plants, and 3) all other rare Plants of Local Concern, all three groups of which are as identified by the Forest that could occur in the project area or that could be impacted by proposed project activities, even if occurring outside the project area (e.g., riparian plants potentially impacted by downstream water depletions or changes in reservoir/downstream hydrology flow rates, levels, or timing; rare plants occupying off-site borrow pits; etc.). "Rare plant communities" include those identified by the Forest that could occur in the project area or that could be impacted by proposed project activities, even if occurring outside the project area. Note that these definitions do not necessarily include plants that are otherwise tracked by the Colorado Natural Heritage Program. The most current lists of rare plants and communities to survey must be derived in concert with the Forest.

2.) Relevant Forest Service Resource Management Goals: The Arapaho and Roosevelt National Forests and Pawnee National Grassland (Forest) has goals to maintain viable populations of all native and desirable non-native plants and plant communities. When feasible, the Forest attempts to avoid or minimize impacts to rare plants or communities resulting from management actions. Management options that could cause local extirpation of rare plants or communities are generally avoided.

The Forest Service has specific policy direction regarding Sensitive species, including:

- Develop and implement management practices to ensure that species do not become threatened or endangered because of Forest Service actions.
- Maintain viable populations of all native and desired nonnative wildlife, fish, and plant species in habitats distributed throughout their geographic range on National Forest System lands.
- Develop and implement management objectives for populations and/or habitat of Sensitive species (Forest Service Manual 2670.22).
- Assist States in achieving their goals for conservation of endemic species.
- As part of the National Environmental Policy Act process, review programs and activities, through a Biological Evaluation (BE), to determine their potential effect on Sensitive species. On this Forest, a Specialist's Report also assesses impacts to all pertinent listed and proposed species via a Biological Assessment (BA) as part of the specialist's report or as a stand-alone document, as well as to all other pertinent rare plants and plant communities that are not Sensitive.
- Avoid or minimize impacts to species whose viability has been identified as a concern.
- If impacts cannot be avoided, analyze the significance of potential adverse effects on the

population or its habitat within the area of concern and on the species as a whole. (The Forest Service line officer, with project approval authority, makes the decision to allow or disallow impact, but the decision generally must not result in loss of species viability or create significant trends toward Federal listing.)

- Establish management objectives in cooperation with the States when projects on National Forest System lands may have a significant effect on Sensitive species population numbers or distributions. Establish objectives for Federal candidate species, in cooperation with the FWS or NMFS and the States (Forest Service Manual 2670.32).

4.) Existing Information and the Need for Additional information: A rare plant survey was conducted in the Gross Reservoir area in June, July and August, 2001 (Brune 2001, Shapins Associates 2002). The survey was conducted to identify rare plants and plant associations that could be impacted by implementation of the *Recreation Management Plan* or by power lines associated with Denver Water's Gross Reservoir Hydroelectric Project, FERC Project Number 2035-006. The survey found no listed plants, one Sensitive plant, five rare plants of Local Concern, and one rare "plant association".

Although the survey was substantial, it and the 2002 report are inadequate to meet assessment needs and plant protection formulation for the proposed re-licensing project associated with this study request. Although the 2001 report has not been made available to the Forest for review, the 2002 report did not address all listed, Sensitive and rare Plants of Concern to the Forest, and no list of target rare plants and communities was disclosed. There are numerous rare plant species and communities of concern to the Forest that were not surveyed. For example, numerous new species have been added to the rare plant list since 2001, and Forest notes accompanying the 2002 report indicate that potentially-occurring rare willows, including Sensitive species, were not considered in the original survey. Also, it is likely that the 2001 effort may not have surveyed all areas that could be impacted by the proposed project under consideration for this study request as it focused only on areas potentially impacted by the *Recreation Management Plan* and related activities. The survey did not survey for rare plants did not occur for all riparian areas within this project area, but it that may not be necessary, depending upon re-licensing scope. Shortcomings or information gaps in survey methods and results, as well as recommendations for resurveys, were not identified in the 2002 report. Shapins Associates (2002) states that all rare plant sites encountered could be avoided for the project under which the survey occurred, but it is unknown if implementation of avoidance measures actually occurred. It is also unknown how the observed sites could be impacted by the proposed new project under this study request. No final report of effects analysis for the plants encountered has been presented to the Forest for review.

At this time, no plant species listed under the Endangered Species Act (ESA) are known or suspected to within the project area. However, two listed species that could be impacted by water depletions or changes in hydrology could occur in upstream corridors leading to reservoir inlets or downstream of the project area. There is medium to high potential of existence of additional undocumented sites of observed rare plants. There are roughly six additional Sensitive plants, five plants of Local Concern, and several rare plant communities that could occur in the project area that were not surveyed or that were under-surveyed.

Large-sized project areas can be stratified by (1) intensity and/or duration of disturbance; and (2) the likelihood of rare plant occurrence. This information can be used to determine the intensity of survey needed to meet policy requirements for rare plants. Several of the un-surveyed Sensitive plant species are associated with riparian habitats that can be impacted due to changes in water flows and timing of flows. Upland species for the proposed project may be in locations that could be impacted by disturbance, restoration, or on-going maintenance activities.

A new survey and results analysis are needed to meet Forest Service direction in completing a Specialist's Report, including a Biological Evaluation for Sensitive plants that are on the Forest Service Region 2 Sensitive Species List, Biological Assessment for listed plants, and assessment of impacts to other rare plants of Local Concern and rare plant communities. The Forest Service is required to assess potential affects of the project proposal to rare plant species. An appropriate updated list of target species needs to be formulated. An intuitive controlled survey is needed for this assessment. A re-survey of certain wetland areas surveyed by Brune (2001) may not be necessary. However, other riparian areas already surveyed by Brune and areas not surveyed may need to be surveyed. Numerous upland areas not surveyed may also need to be surveyed.

5.) NEXUS Between the Study and the Project: Results of the proposed survey will allow the Forest Service to assess presence of, and impacts to, rare plants and plant communities, and whether or not potential effects to Sensitive plant species would lead toward Federal listing under the Endangered Species Act. Results would allow the Forest to determine if proposed actions would be in compliance with the Forest Plana and Forest Service policy regarding listed, Sensitive, and rare plants. Avoidance or mitigation measures to reduce adverse impacts for rare plants or communities may become part of License requirements.

6.) Study methodology: The presented methods and guidelines are standard operating procedure for the Forest Service project assessments. This Forest holds contractors to the same level of qualification, performance and documentation standards as efforts conducted internally by the Forest. "Types of Surveys" Guidelines at the end of this document (Attachment A) are consistent with literature provided on plant survey intensity levels and the article "Rare Plant Surveys: Techniques for Impact Assessment" by James R. Nelson, from the Natural Areas Journal (Vol. 5, No. 3)).

7.) Describe considerations of level of effort and cost and why any proposed alternative studies would not be sufficient: Anticipated workloads and cost vary greatly as a function of vendors and frequency of rare plants encountered. Vendor costs range from $300 to $1200 per day, inclusive of travel and field costs. It is estimated that there would be 10-16 field-person days (2 people for 5-7 days or 4 people for 3-4 days, depending upon what was encountered) to survey all areas of suitable habitat for target species and 4 days of report writing.

The project area has been rated for likelihood of rare plant occurrence (high, moderate and low). There are known occurrences of rare plants in the project area; these may need additional re-surveys. Potential for additional undocumented target plants to occur is medium to high, depending upon target species. As a general rule, riparian areas have a high potential to support rare plants.

Under the Intuitive Controlled level of survey, the surveyor gives the area a closer look by conducting a complete survey through a specific area of the project that may contain rare plants after walking through the project area and perimeter or by walking more than once through the area. Most of the project area is examined. Estimated Rate/Day: 15-100 acres per day.

Refer to the background information on each plant that indicates its phenology to determine the best survey dates for the various species likely to be found in each area. In cases where two or more plants may be present in the same area, but they cannot be identified at the same time, more than one visit may be required to that area.

Sensitive plant survey and report specification guidelines:

The following guidelines are intended to assist project proponents and botanical vendors/consultants to determine how field surveys should be conducted and what information should be included in the survey report for the Forest Service.

Cooperation with the Forest

Because a previous survey has been conducted, it is possible that not all target species or areas would need to be surveyed. To ensure adequacy and efficiency of surveys and results, and that minimum standards have been fulfilled that meet Forest Service requirements, the following shall occur in the survey planning phase, well prior to field surveys:

1. Work with Forest Botany Representative to derive pertinent target rare species and rare plant community lists and habitats to be looked for in survey efforts, in consideration that a previous survey limited in species and areas has been conducted.
2. Work with Forest Botany Representative to derive pertinent survey intensities and protocols, including survey timing.
3. Allow Forest Botany Representative to review all survey crew and report preparer's qualifications. If surveyors or report preparers change, notify Forest Botany Representative prior to effective change date and allow review of qualifications.
4. Work with Forest Botany Representative to review current Forest information that can be relayed to Vendor/Contractor. The Forest may be aware of sites not known to outside sources or the Colorado Natural Heritage program.

Guidelines

1. To ensure that the quality of work done by **contract botanists** meets Forest Service standards the following list of qualifications are recommended. These **qualifications** will ensure a high degree of confidence in the quality of the work and will certainly provide us with valuable information on rare or other target plants:
    a. A degree in botany, plant ecology, or related natural resource field or under the close supervision of such a qualified individual. Coursework in plant

ecology and plant taxonomy required, additional coursework in soils, agrostology, and biological ecosystems would be desirable.

b. Skills in plant identification use of plant taxonomic keys, and use of vegetation habitat guides. Strong knowledge of the flora of the area to be assessed is preferred.

c. Skills related to the art and science of conducting rare plant surveys, including knowledge of conservation biology. A demonstrated commitment to the preservation of natural diversity. Knowledge related to Forest Service methodology in conducting rare plants surveys.

d. Knowledge of agency procedures, including the procedures for completing the Biological Evaluation/Specialist's Report process. Ability to coordinate work with agency specialists. Ability to complete technical and analytical reports, such as biological evaluations, field review reports, and rare plant status reports, as required.

e. Ability and willingness to apply professional integrity to the rare plant survey process. Adherence to Forest Service guidelines for conducting rare plant surveys, such as following windows for timing of surveys (generally May - September) when species can be identified with the greatest accuracy. Willingness to fully and accurately disclose results of survey.

f. Ability to collect geospatial data and use of GPS in the field.

2. Project personnel (i.e. proponent or Forest Service project coordinator) shall:

   a. Inform potential consultants as to the full scope of work planned for the project.

   b. Provide a map of sufficient scale of the entire project area showing all areas of impact from direct and indirect land disturbance activities.

   c. Where needed, have the project areas fully surveyed and flagged before the botanical contractor begins work.

3. Botanical surveys shall be conducted in a manner that provides the highest probability of locating any rare plant species that may be present. Specifically, rare plant surveys shall be:

   a. Conducted at the proper time of year when Sensitive species are identifiable. This should coincide with known flowering periods and/or periods of phenological development necessary for identifying species of concern.

   b. Conducted using systematic field techniques in all suitable habitats that may

be impacted by project activities. In addition the surveyor needs to be aware of microsites within the project area that may contain suitable habitat for Sensitive species.

4. Botanical survey reports shall be submitted to the Forest Service for review and approval. **It is suggested that t**he report format follow the most current Forest Service Region 2 template as modified by the Forest, but any format can be accepted as long as all requirements and discussions in the template have been adequately addressed**.** The original report shall be submitted to the project proponent, with a copy of the report going to the Forest Botany Representative. The following information should be included:

    a. A description of the proposed project, including legal descriptions. Also, a description of all ground-disturbing activities that may affect plant species or habitats. Include a good quality, legible topography map (scale 1:24,000) of the project area with the botanical survey area clearly marked. Highlighting the survey boundaries often helps delineate the area.

    b. A detailed description of survey methodology. Include the names of all botanist(s)/technicians conducting the field work and the date of the field survey(s). The intensity of the botanical survey will vary according to the habitat encountered and degree of disturbance anticipated during project activities.

    c. In areas of potential habitat, botanical surveys should cover the entire area proposed for disturbance as well as an additional area to address the indirect effects associated with the project.

    d. A narrative description of the vegetation communities and/or habitats found within the project area. Mention should be made of the dominant and co-dominant species (e.g., Ponderosa pine/Idaho Fescue-Bluebunch Wheatgrass). Also, it should be specified whether this description is for community types (existing plant communities) or whether a guide has been used to describe plant associations (climax natural plant communities).

    e. A description of soil types, land use patterns or past disturbances, and any small inclusion communities or microniches within the overall landscape (riparian areas or wetlands, woody draws, rock outcrops, clay downwashes, sandhill, etc.).

    f. A list of all target plant species and communities that may have habitat within the project area or areas potentially impacted by proposed project activities (i.e., all the target plants, communities, and habitats searched). Habitat requirements for the species should accompany the list to provide rationale for the species having the potential for occurring in the project area.

g. A complete floristic list of all plant species identified during the field survey.

h. A determination of whether the project area is likely to contain any rare plant species/communities or habitat for rare plant species. If the project impacts any unique or unusual habitat types, this should also be mentioned. This may include riparian/wetland areas, or pristine woody draw situations, or any microniche containing an unusual community of unique species, whether they are officially listed as rare or not.

i. The survey report should document any pre-field scoping done with the Colorado Natural Heritage Program for any documented known occurrences of rare plants/communities in the project area and general vicinity. If scoping for rare plants/communities included information from agency specialists, the scientific community, or known botanical experts for this area, this should also be mentioned.

j. The report should include any recommendation the contractor feels would enhance project implementation or avoid unnecessary disturbance to the target communities. This may include recommendation for preserving certain plants or communities, avoiding specific target plant species (including noxious weeds), enhancing habitat for observed wildlife species, etc. It may also include reclamation recommendations.

k. Photographs of the habitats searched have proved extremely useful in the past and have helped clarify certain problem situations after field season has ended.

l. Bibliography of literature or references cited.

m. The Forest's customized Rare Plant/Community Survey Form shall be completed in the field at time of survey for all field work. The originals shall be submitted to the proponent with color copies submitted to the Forest Service with the botanical survey report.

5. If any Sensitive or other target species or communities are found, the report shall contain:

a. An assessment of the population (size, vigor, number of reproducing individuals, etc.), habitat condition, and acreage occupied by the population.

b. Geospatial map showing location relative to project area. All rare plant or community sites shall be GPS'd in the field in UTM, NAD 83.

c. An assessment of potential impacts to the population by proposed project activities.

d. A discussion of the importance of this population with consideration of nearby populations and total species distribution.

e. Any observations of the response of the population to past management activities or land use disturbance.

f. Recommended mitigation measures to reduce or avoid impacts to the population.

g. Collections of target species will be allowed only when such actions do not jeopardize the continued existence of the population and in accordance with applicable state and federal regulations, and with prior approval from the Forest if on USFS lands.

h. When a target species is located, The Forest's customized Rare Plant Occurrence Form shall be completed in the field at time of observation. The original shall be submitted to the proponent with color copies submitted to the Colorado Natural Heritage Program and the Forest Service with the botanical survey report.

i. Photographs of the target plant encountered and their occupied sites have proved extremely useful in the past and have helped clarify certain problem situations after field season has ended.

j. Contractors are encouraged to keep in close communication with the Forest Botany Representative during project work on the National Forest. Contractors should notify the Forest Botany Representative immediately if any Sensitive species are located or if any unusual species are discovered. In addition, contractors are encouraged to work with the Forest Botany Representative if plant species found on projects are difficult to identify due to time of season or phenology stage of the species. Specimens of problem species are often submitted to a University herbarium for assistance in identification.

Literature Cited

Brune, Rick. 2001. *A Vegetation Survey of the Gross Reservoir Area*. Prepared for Don Kennedy, Environmental Planning, Denver Water Dept., Denver, CO.

Shapins Associates. 2002. *Article 410 (Plan to Protect Rare & Sensitive Plant Species). In*: Gross Reservoir Recreation Management Plan 2002 Draft. Gross Reservoir Hydroelectric Project, FERC Project Number 2035-006.

Attachment A

Types of Surveys

Field Check: The surveyor gives the area a quick field visit but does not walk completely through the project area. The entire project area has not been examined. Estimated Rate/Day: Varies

Cursory: The surveyor gives the area a quick "once over" by walking through the project area. The entire project area has not been examined. Estimated Rate/Day: Varies

Limited Focus: The surveyor closely checks one or more habitat-specific locations within the project area but does not examine the rest of the area. Estimated Rate/Day: 100-500 acres per day.

General: The surveyor gives the area a closer look by walking through the project area and perimeter or by walking more than once through the area. A significant portion of the project area is examined. Estimated Rate/Day: 100-160 acres per day.

Intuitive Controlled: The surveyor has given the area a closer look by conducting a complete survey through a specific area of the project after walking through the project area and perimeter or by walking more than once through the area. Most of the project area is examined. Estimated Rate/Day: 15-100 acres per day.

Complete: The surveyor has walked throughout the area being examined until all of the area has been examined. Estimated Rate/Day: 10-50 acres per day.

Gross Reservoir Project Study Request No. 8

Title of Proposed Study: Special-Status Terrestrial Wildlife Species and Habitats, Including Amphibians and Invertebrates. Plants, natural communities, and fish are covered in other study requests.

1.) Goals, Objectives and Information to be Obtained:

The purpose of the study is to assess the potential for effects to special-status wildlife species, including amphibians, and their habitats, based on known occurrences and/or the likelihood of occurrence, and the scope of project activities. Assessments may include field evaluations of habitat suitability and surveys for species that could be affected by project activities. Study results should be used in analyses of impacts of project activities on special-status species.

Analysis of effects to special-status species should include ESA-listed (endangered, threatened, and candidate) taxa; USFS sensitive species based on the current Region 2 list, and management indicator species (MIS) for the Arapaho and Roosevelt National Forests and Pawnee National Grassland (ARP); all categories currently tracked by the Colorado Natural Heritage Program (CNHP), including plants, birds, mammals, fish, invertebrates, and natural communities (plants, natural communities, and fish are covered in other study requests); species of local concern specific to the project, if any, and migratory birds not included in the above categories. Determining the need for on-the-ground studies should be based on (1) defining the proposed action, (2) evaluating the potential for impact, and (3) tailoring any studies to the scope of potential impacts.

The Forest Service recommends completion of a Biological Report addressing potential effects to federally listed or proposed species; Forest Service Region 2 sensitive species (Forest Service Manual 2672.4 – Biological Evaluations, Region 2 Supplement 2600-2007-1 June 8, 2007); MIS; and, as applicable to the project, CNHP-tracked species, local species of concern, and migratory birds not included in other categories. This analysis should include identification of resource protection and/or mitigation measures, if needed, to reduce or eliminate negative impacts and effects. If requested, the Forest Service will provide additional information and examples to assist in completion of the Biological Report.

Analysis should also include an assessment of project impacts to the following habitats and/or components which provide habitat for special-status species, and/or are covered by Forest Plan Standards and Guidelines:

- cover types *
- forested and open corridors *
- effective habitat *
- interior forests *
- old growth, developing old growth, identified old growth development areas, and other forest structural stages *
- streams and stream crossings
- other important habitats that are defined by animals or vegetation in the project area, for example winter range or production areas

Most habitats indicated by "*" are mapped and available as GIS layers.

2.) Relevant Forest Service Resource Management Goals:

Management goals and objectives for public lands administered by the USFS are derived from the 1997 Revision of the Land and Resource Management Plan for the Arapaho and Roosevelt National Forests and Pawnee National Grassland (USDA Forest Service 1997; Forest Plan) and the Forest Plan is developed from a variety of sources, including the National Forest Management Act (NFMA), as amended, the Endangered Species Act of 1974, as amended, the Forest Service Manual (FSM), and local forest planning documents, including the Forest Plan. The NFMA includes direction to preserve and enhance the diversity of plant and animal communities, including endemic and desirable naturalized plant and animal species, so that their diversity is at least as great as that which would be expected in a natural forest (36 CFR § 219.26 and § 219.27). The NFMA also requires the maintenance of plant and animal diversity commensurate with the overall multiple-use objectives of the USFS. The FSM requires review of projects that may affect species listed as Sensitive, and preparation of a Biological Evaluation to ensure that activities do not increase the likelihood of future Endangered Species listing. The Forest Plan identifies MIS.

The USDA Forest Service also has specific policy direction regarding sensitive species (USDA Forest Service Manual [FSM] 2670), habitat management (FSM 2620) and cooperative relations with state and other federal agencies (FSM 2610), including but not limited to:

- Develop and implement management practices to ensure that species do not become threatened or endangered.
- Maintain viable populations of all native and desired nonnative wildlife, fish, and plant species in habitats distributed throughout their geographic range.
- Develop and implement conservation strategies for sensitive species and their habitats, in coordination with other Forest Service units, managing agencies, and landowners, and coordinate management objectives to conserve sensitive species with state and federal agencies, tribes and other cooperators as appropriate (FSM 2670.22).
- Assist States in achieving their goals for conservation of endemic species.
- As part of the National Environmental Policy Act process, review programs and activities, through a biological evaluation, to determine their potential effect on sensitive species.
- Avoid or minimize impacts to species whose viability has been identified as a concern.
- If impacts cannot be avoided, analyze the significance of potential adverse effects on the population or its habitat within the area of concern and on the species as a whole.

In addition, the USFWS is required under the authority of the Endangered Species Act to review and provide comment on federally authorized projects that may affect listed or proposed species.

4.) Existing Information and Need for Additional Information:

Wildlife surveys were conducted in the 1990's for the Winiger Ridge Ecosystem Pilot Area Vegetation Management Project and for the Gross Reservoir Hydroelectric FERC Relicensing project. However, both the USFS Region 2 Sensitive Species List and the ARP MIS list have

changed since those surveys, and CNHP species tracking is updated each year. Therefore, updated information is needed.

Additional site-specific information is necessary to evaluate the effects of inundation and any associated ground-disturbing activities, including but not limited to vegetation removal, new temporary or permanent roads including changes in traffic patterns, and relocation of recreation facilities including roads and/or trails, on special status species and habitats. Where new ground-disturbing activities are proposed, additional information to evaluate the effects of those activities may also be required when existing site-specific information on the condition of habitats and the occurrence of special-status species is lacking or out-of-date.

Evaluations of proposed ground-disturbing activities would address habitat suitability for special-status species, the scope of the proposed activity, and the degree to which special-status species rely on habitats affected by the proposed activity. The need for additional site-specific information will be contingent on the potential for effects to special-status species and habitats.

Additional information is also needed regarding the potential for changes to riparian habitats on the West Slope as a result of increased depletions and/or changes in timing of water flows, and the potential for changes to riparian habitat on the East Slope as a result of changes to water flow amounts and/or timing. Many special-status species inhabit riparian habitats and associated streams, and could be affected. If the project will result in changes to water flow amount and/or timing downstream from Gross Reservoir, an assessment of impacts to downstream Threatened and Endangered species in the Platte River will be needed.

5.) NEXUS Between the Study and the Project:

As discussed above, various laws and regulations require analysis of special-status species potentially affected by the proposed project. In order to properly assess impacts to special-status species, field surveys are needed commensurate with expected impacts of the proposed action to these species and their habitats. As discussed above and below, potential impacts include new inundation around Gross Reservoir, changes in amount and/or timing of water flows, and ground-disturbing activities such as vegetation removal, new temporary or permanent roads if any are proposed, and relocation of recreation facilities.

6.) Study Methodology:

All areas within the Project Boundary that are subject to ground-disturbing activities related to project operations or maintenance, new inundation including associated vegetation removal and proposed new roads if any, and/or changes in water flow amount and/or timing should be assessed for their potential to support special-status wildlife. Special-status species and habitats are defined as those listed by the USFWS, USFS, and/or CNHP.

Wildlife assessments should review the habitats present in the area subject to ground disturbance, new inundation, and/or water flow changes, in relation to species distributions, habitat requirements and life history information. Species information should be obtained from the best available science, including Species Conservation Assessments prepared for the Forest Service

Rocky Mountain Region (USDA Forest Service 2008). This information should be used to assess (1) the availability of appropriate habitat within the proposed activity area and (2) the potential for each species to be affected by the proposed activity. Wildlife assessments should be conducted by individuals with: (1) experience conducting wildlife surveys, (2) knowledge of wildlife taxonomy and wildlife community ecology and classification, and (3) familiarity with the wildlife of the area, (4) familiarity with appropriate state and federal statutes related to wildlife, and (5) experience with analyzing impacts to wildlife and wildlife communities. Survey methods will vary greatly by species, and should be based on accepted protocols for each species if available. Survey techniques are discussed for some species in Species Conservation Assessments.

If special status species or habitats are documented or likely to occur in the study area, or may be affected by water flow changes, project effects on each species should be assessed with consideration of the size of the affected area, the timing and duration of disturbance, the type of activity, the reliance of the individual species on a given habitat, and the degree to which such habitats are disturbed or otherwise affected. If warranted, these considerations should be incorporated into management and/or mitigation efforts developed in consultation with the resource agencies.

7.) Describe considerations of level of effort and cost and why any proposed alternative studies would not be sufficient:

Anticipated workloads and cost vary greatly, depending on different survey protocols for special-status species and varying costs for contractors/consultants. Survey protocols for some species, particularly Threatened or Endangered, are intensive and costly and require specific surveyor qualifications to be acceptable to the USFWS. Consultant costs may range from $300 to $1200 per day, inclusive of travel and field costs. Level of effort and cost for initial field studies for this study would be based on these factors. The level of effort required to evaluate future areas of ground disturbance will be evaluated at the time such activities are proposed or specifically defined and located on the ground.

No alternative studies have been proposed.

Data Analysis and Reporting

Study reporting should include study objectives, study area, methods, survey results, assessment of project effects on special-status species and habitats, and recommendations for resource protection measures, if warranted. The report should also include species summaries (e.g., life history, habitat requirements, current status and threats) for special-status species documented or with potential to occur within the study area.

References

USDA Forest Service. 1997. 1997 Revision of the Land and Resource Management Plan. Arapaho and Roosevelt National Forests and Pawnee National Grassland.

USDA Forest Service. 2008. Species conservation program: species conservation assessments. http://www.fs.fed.us/r2/projects/scp/assessments/index.shtml

Gross Reservoir Project Study Request No. 9

Title of Proposed Study: Invasive Plant Species Evaluation

1.) Goals, Objectives and Information to be Obtained:

Several Colorado-listed noxious weed species are documented to occur in the project area, including at least nine species within the FERC boundary and four or more outside the boundary but within fairly close proximity. Information needed includes further surveys for noxious weed or other potentially invasive plant infestations where new inundation or ground disturbance are expected, and evaluation of the potential for project activities to introduce or spread noxious weeds or other invasive plants, including recommendation of mitigation measures to reduce introduction and/or spread. The term "noxious weeds" generally refers to species listed as such by the State of Colorado. Invasive plants include listed noxious weeds as well as other nonnative plant species with the potential to invade local ecosystems.

2.) Relevant Forest Service Resource Management Goals:

This study is consistent with relevant agency resource management goals. Management goals and objectives for public lands administered by the Arapaho and Roosevelt National Forests and Pawnee National Grassland (ARP) are derived from the 1997 Revision of the Land and Resource Management Plan for the Arapaho and Roosevelt National Forests and Pawnee National Grassland (USDA Forest Service 1997; Forest Plan).

Forest Plan direction includes the following Goal:

- Manage undesirable vegetation, including noxious weeds, using an integrated pest management approach.

Forest Plan direction includes the following Standards:

- Control undesirable nonnative and noxious plants throughout the Forests, with priority given to new species (new to Colorado or the ARP), and to wilderness areas.
- Use only certified "noxious weed-free" hay or straw for feed or revegetation projects anywhere on the ARP
- For all proposed project or activities, determine the risk of noxious weed introduction or spread, and implement appropriate mitigation measures.

The ARP developed a Noxious Weed Management Plan which was finalized in April 2003. Noxious weed management activities conducted on National Forest lands must be consistent with this Plan.

Activities on National Forest lands must adhere to the Weed Free Forage Products Order, USFS Rocky Mountain Region Special Order Number R2-2005-01 which can be found at http://www.fs.fed.us/r2/news/weed_free_order/WEED_FREE_ORDER_06202005.shtm

In addition, the Colorado Noxious Weed Act §§35-5.5-101 – 119 C.R.S (2003) states that noxious weed management is in the public interest, finding that "certain undesirable plants constitute a present threat to the continued economic and environmental value of the lands of the state and if present in any area of the state must be managed."

4.) Existing Information and Need for Additional Information:

After the 2001 FERC Relicensing for Gross Reservoir, Denver Water created a Weed Management and Pesticide Use Plan which was reviewed by the USFS and Boulder County and submitted to FERC in 2005 (Denver Water 2005). This document contains a detailed history of noxious weed surveys, lists and maps of Colorado-listed noxious weed species found in and near the Gross Reservoir area, and general plans for weed management activities to be conducted by the Forest Service and Denver Water in the area.

Since 2005, Denver Water has submitted an annual Noxious Plant Monitoring Report, reviewed by the USFS and Boulder County. Invasive plant inventories were conducted in the Gross Reservoir vicinity from 1998 through 2001. The USFS has added new infestations as they have been discovered but has not conducted any further specific surveys in the area. Denver Water and the USFS have treated priority weed species each year, with efforts depending on available resources.

The Weed Management and Pesticide Use Plan does not reflect an infestation of leafy spurge *(Euphorbia esula)*, a Colorado List B species and a high priority species for the USFS and Boulder County, along Gross Dam road near the railroad crossing, about a mile or less from the FERC boundary. In addition, an infestation of orange hawkweed, a Colorado List A species and high priority for the USFS and Boulder County, was found since 2005 about two miles west of the western FERC boundary.

Additional site-specific noxious weed occurrence information is necessary to evaluate the effects of inundation and any associated ground-disturbing activities, including but not limited to vegetation removal, new temporary or permanent roads, and relocation of recreation facilities including roads and/or trails, on noxious weed infestation, spread, and management. Existing inventories provide baseline information; however the information is somewhat outdated because invasive plants spread continuously, and these inventories did not focus on areas to be affected by new inundation and ground disturbance for the current project.

Evaluation of project effects on the invasive plant situation should include, at a minimum, historic and newly gathered information regarding noxious weed occurrences (including maps), the potential for project activities to introduce or spread noxious weeds, mitigation measures to reduce the potential for introduction and spread, and recommendations for follow up treatment and monitoring after project implementation. Appropriate mitigations to reduce or eliminate new infestation or spread include, but are not limited to, survey for and treatment of noxious weeds in areas proposed for new ground disturbance and/or inundation prior to these activities occurring, measures regarding use of clean equipment on National Forest lands, reclamation and revegetation of disturbed areas, and use of certified weed-free materials such as straw for revegetation (required on National Forest lands by Special Order, see #2 above).

5.) NEXUS Between the Study and the Project:

Multiple occurrences of noxious weeds are documented in and near the project area and have the potential to be spread further by project activities, particularly ground-disturbing activities. Newly disturbed ground will create areas susceptible to new invasion or spread of existing species, and equipment brought in to perform such activities has the potential to spread existing infestations and/or bring in noxious weed species that do not currently occur in the area.

6.) Study Methodology:

The Forest Service has established protocols for noxious weed surveys which should be followed for data compatibility. The Forest Service has provided Denver Water with field survey forms and data requirements in the past and will provide updated specifications on request. Data should be collected using GPS technology which can be loaded into the Forest Service Invasive Plants database. Surveys should be conducted at all locations planned for inundation and/or temporary or permanent ground disturbance, prior to beginning project implementation. Surveys should be conducted as soon as possible to allow time for evaluation of data and one or more treatments of weed infestations prior to project implementation. Surveys should be conducted at appropriate times of the year for the best detection probability based on noxious weed species known to occur in and near the area and other species with potential to occur.

Surveys should be conducted by individuals familiar with noxious weeds on USFS and Colorado lists, including the ability to recognize these species at various life stages. Surveyors should be familiar with GPS technology and have experience with noxious weed surveying and mapping. Surveyors should be familiar with local native plant communities, which facilitates recognition of plant species out of place in the area.

7.) Describe considerations of level of effort and cost and why any proposed alternative studies would not be sufficient:

Depending on the extent of inundation and ground-disturbing activities, several days to several weeks may be needed for surveys, especially considering the rough terrain to be inundated. Additional time will be required to download GPS data, and prepare maps and reports. No alternative studies have been proposed.

References

Denver Water. 2005. FERC article 406 USFS conditions 107 and 108, weed management plan and pesticide use plan, Gross Reservoir Hydroelectric Project, P-2035-046. 10 pages plus appendices.

USDA Forest Service. 1997. 1997 Revision of the Land and Resource Management Plan. Arapaho and Roosevelt National Forests and Pawnee National Grassland.

Document Content(s)