Moffat Collection System Project
Draft FERC Hydropower
License Amendment Application

Gross Reservoir Hydroelectric Project
FERC Project No. 2035

October 2009

DENVER WATER

1600 West 12th Avenue
Denver, Colorado 80204

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Draft FERC Hydropower License Amendment Application Gross Reservoir Hydroelectric Project FERC Project No. 2035

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APPLICATION FOR NON-CAPACITY-RELATED LICENSE AMENDMENT FOR MAJOR MODIFIED PROJECT (18 CFR §4.41)

FOR DENVER WATER'S GROSS RESERVOIR HYDROELECTRIC PROJECT FERC PROJECT NO. 2035

Through this application, the City and County of Denver, acting by and through its Board of Water Commissioners ("Denver Water") is seeking to amend its Federal Energy Regulatory Commission (FERC) hydroelectric license for Gross Reservoir (FERC Project No. 2035). Gross Reservoir was originally licensed by the FERC in 1950, with the reservoir and dam built soon after. Power generation was installed on site pursuant to a renewed license issued in 2001 and amended in 2004.

Denver Water is a municipal corporation that provides water to the City and County of Denver, Colorado, and surrounding suburbs. The changes at Gross Reservoir proposed in this amendment ("Proposed Project") are part of a water supply project ("The Moffat Collection System Project") being analyzed by the U.S. Army Corps of Engineers (Corps) for purposes of a Clean Water Act Section 404 Permit. The Corps is the lead agency in preparing the Draft Environmental Impact Statement (DEIS), as required by the National Environmental Policy Act (NEPA). The FERC and the Environmental Protection Agency (EPA) are cooperating agencies in the NEPA process, and Grand County is a Consulting Agency. The Corps' environmental analysis in the DEIS provides information required under Exhibit E of this license amendment application.

Gross Reservoir is a FERC-licensed hydroelectric project; therefore, Denver Water must seek the approval of the FERC for proposed changes to the dam, reservoir, hydroelectric project facilities, and surrounding area and facilities within the FERC Project Boundary. The proposed modifications to the Gross Reservoir hydroelectric project would not increase the total installed capacity of the project, would not result in an increase in the installed nameplate capacity of 2 megawatts (MW) or more, and would not increase the hydroelectric project's maximum hydraulic capacity by 15 percent or more. Thus, this amendment is a "non-capacity-related amendment" [18 CFR §4.201(b)]. Nonetheless, the changes in the physical features of Gross Reservoir and Dam would result in a significant change in the water surface elevation of the

impoundment and in the normal maximum surface area of the reservoir and would require a change in the FERC Project Boundary.

To prepare this license amendment application, Denver Water followed the three-stage agency consultation process (18 CFR §4.38) and is filing this application pursuant to 18 CFR §4.201 to revise the current license exhibits required in 18 CFR §4.41 for a major modified project. Under 18 CFR §4.201(c), this license amendment application is required to include only those exhibits that require revision in light of the nature of the proposed amendments.

The modifications proposed in this license amendment application include 1) Denver Water's Preferred Alternative in the Corps' DEIS (enlarging Gross Reservoir by an additional 72,000 acre-feet) and 2) an additional approximately 5,000 acre-feet of storage for an Environmental Pool that is described as a component of the mitigation in the Corps' DEIS. Thus, for purposes of this license amendment application, the **Proposed Project** is an enlargement of Gross Reservoir by approximately 77,000 acre-feet total, for a total storage capacity of approximately 119,000 acre-feet. This Proposed Project is contingent upon Denver Water and the City of Boulder and/or the City of Lafayette entering into an intergovernmental agreement (IGA) to contribute finances and water for the Environmental Pool prior to the submittal of Denver Water's final license amendment application to the FERC.

Absent an IGA for the addition of an Environmental Pool, Denver Water will apply for the Preferred Alternative in the Corps' DEIS without the Environmental Pool, which, for purposes of this license amendment application, is referred to as the **Alternative Proposed Project**. The Alternative Proposed Project is the enlargement of Gross Reservoir to store an additional 72,000 acre-feet, for a total storage capacity of approximately 114,000 acre-feet for Denver Water's water supply purposes. Both scenarios are presented in this draft application. The final license amendment application will ultimately propose either the Proposed Project (119,000 acre-feet) or the Alternative Proposed Project (114,000 acre-feet), depending on whether an IGA for an Environmental Pool can be reached.

Draft FERC Hydropower License Amendment Application Gross Reservoir Hydroelectric Project FERC Project No. 2035

INITIAL STATEMENT

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INITIAL STATEMENT

Before the Federal Energy Regulatory Commission Application for Amendment of License

(1) The City and County of Denver, acting by and through its Board of Water Commissioners (Denver Water), applies to the Federal Energy Regulatory Commission for an amendment of license for the Gross Reservoir (FERC Project No. 2035) water power project.

(2) Project No. 2035 is located in Boulder County, Colorado, on South Boulder Creek at Gross Reservoir.

Denver Water is located at 1600 W. 12th Avenue, Denver, Colorado, 80204. The business phone number is (303) 628-6000.

(3) The applicant is a municipal corporation of the State of Colorado and licensee for the water power project, designated as Project No. 2035 in the records of the Federal Energy Regulatory Commission, issued on the 16th day of March, 2001, and amended on the 1st day of October, 2004.

(4) The amendments of license proposed and the reasons why the proposed changes are necessary are as follows.

Denver Water proposes to raise Gross Dam in order to increase the storage capacity of Gross Reservoir. The proposed changes are necessary to increase Denver Water's water supply to meet demand and system reliability needs. The proposed enlargement of Gross Reservoir would store water diverted under Denver Water's existing water rights.

(5) The statutory or regulatory requirements of the state in which the project would be located that affect the project as proposed with respect to bed and banks and to the appropriation, diversion, and use of water for power purposes and the steps which the applicant has taken or plans to take to comply with each of laws cited are as follows.

The 2001 license application submitted by Denver Water in 1998 provides that Colorado is a prior appropriation state. Denver Water owns water rights that may be stored and released from Gross Reservoir in accordance with state law. Water delivered to Gross Reservoir comes from two different sources: West Slope diversions via the Moffat Tunnel and native flows in South Boulder Creek. The enlarged Gross Reservoir would store water diverted under the following existing water rights:

a) South Boulder Creek: Denver Water can store up to 113,078 acre-feet of water from South Boulder Creek under a decree entered in C.A. 12111, Boulder County District Court dated September 28, 1953.
b) Fraser River Diversion Project: Denver Water can store up to 113,078 acre-feet of water in Gross Reservoir from the Fraser River and its tributaries through the Moffat Tunnel under decrees entered in C.A. 657, Grand County District Court dated November 11, 1937, and April 15, 1946.
c) Cabin Meadow Creek Collection System: Denver Water transports water through the Moffat Tunnel for direct use or storage in its municipal water system, including Gross Reservoir, from the tributaries of the Fraser River into the Fraser River diversion project at Ranch Creek. Denver Water diverts from the Cabin Meadow Creek System pursuant to an agreement with the City of Englewood and Cyprus Climax Metals Company dated August 11, 1995, and under decrees entered in C.A. 657 dated November 11, 1937, Case No. W-750-78 dated January 17, 1980, and C.A. 1430 dated November 7, 1974.
d) Williams Fork Diversion Project: Denver Water diverts water from the Williams Fork River and its tributaries under the decree entered in C.A. 657 dated November 11, 1937. Denver Water transports this water for direct use or storage in its municipal water system, including Gross Reservoir

The Constitution of Colorado delegates specific authorities to home rule cities. Denver is a home rule city pursuant to Article XX of the Constitution of Colorado. Article XX provides that the City and County of Denver may: "maintain, conduct, and operate water works, light plants, [and] power plants …." Article X, Section 10.1.5 of the Charter of the City and County of Denver specifically authorizes Denver Water to generate and sell electric energy. Operation of the hydroelectric project and water supply facility is in compliance with Colorado state law and the Charter of the City and County of Denver. Denver Water currently holds all necessary water rights to fill the enlarged reservoir, and no new conveyance structures or changes to existing conveyance structures are needed.

In addition to this FERC license amendment, Denver Water must acquire a Clean Water Act Section 404 Permit from the Corps to discharge dredge or fill material resulting from project construction into waters of the United States. Clean Water Act Section 401 also requires that a water quality certification be acquired from the Colorado Department of Public Health and Environment (CDPHE). Denver Water will acquire construction-related permits from the CDPHE for air quality, stormwater discharge, and other related permits.

Draft FERC Hydropower License Amendment Application Gross Reservoir Hydroelectric Project FERC Project No. 2035

EXHIBIT A

PROJECT DESCRIPTION

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EXHIBIT A

PROJECT DESCRIPTION

Description of the Proposed Project and Alternative Proposed Project for Amendment

Table A-1 *Comparison of Gross Dam and Reservoir Features by Alternative* provides a summary of the proposed changes to Gross Dam and Reservoir that are described in this Exhibit A.

Table A-1
Comparison of Gross Dam and Reservoir Features by Alternative

Gross Dam and Reservoir Features	Existing	Proposed Project (with an Environmental Pool)	Alternative Proposed Project
Additional Storage Volume (acre-feet)	--	77,000 (72,000 + 5,000)	72,000
Approximate Storage Volume (acre-feet)	42,000	119,000	114,000
Normal Water Surface Elevation at Spillway Crest (feet msl*)	7,282 **	7,406	7,400
Surface Area (acres)	418	842	818
Dam Raise (feet)	--	131	125
Dam Height (feet)***	340	471	465
Dam Crest Length (feet)***	1,050	1,840	1,799
Dam Raise Volume, including Spillway (cubic yards)	--	930,000	860,000
Spillway Elevation (feet msl*)	7,282 **	7,406	7,400
Auxiliary Spillway	--	Added	Added
Outlet Works	Existing	No change	No change
Inlet	Existing	No change	No change

* msl – above mean sea level.
** Existing spillway crest includes 2 feet of flashboards.
*** The approximate dam height and dam crest length in the proposals are based on preliminary design work and may change once the final design is approved by the FERC.

(1) The physical composition, dimensions, and general configuration of any dams, spillways, penstocks, powerhouses, tailraces, or other structures proposed to be included as part of the project.

The existing hydroelectric project at Gross Reservoir includes the dam, the penstock, and the powerhouse. The existing powerhouse contains two horizontal Francis turbines, two synchronous generators, and associated mechanical and electrical equipment.

The current FERC license describes the current physical composition, dimensions, and general configuration of the dam and other structures appurtenant to the hydroelectric project, and these specifications are depicted in the Exhibit F drawings in the current license. The physical composition and dimensions of the existing dam and spillway are also described in Chapter 2, Section 2.3.2 *Project Components* of the Corps' DEIS.

General preliminary design drawings showing proposed changes to the dam and penstock for both the Proposed Project and the Alternative Proposed Project are included in Exhibit F, Sheets 1 through 6, of this license amendment application. No existing structures beyond the scope of the current license would be affected by the proposed amendment. All project design drawings and supporting reports will be submitted with final design.

Dam

Proposed Project: Under the Proposed Project, the dam crest would be raised by approximately 131 feet to a height of approximately 471 feet. Based on preliminary design, the length of the dam crest would increase by approximately 790 feet to 1,840 feet. The dam crest length will be determined during final design. The raised dam would have the same dam axis, arch radius, crest width, and downstream slope as the existing dam.

Alternative Proposed Project: Under the Alternative Proposed Project, the dam crest would be raised by approximately 125 feet to a height of approximately 465 feet. Based on preliminary design, the length of the dam crest would increase by approximately 749 feet to 1,799 feet. The dam crest length will be determined during final design. The raised dam would have the same dam axis, arch radius, crest width, and downstream slope as the existing dam. A description of the Alternative Proposed Project is also provided in Chapter 2, Section 2.3.2.1 [*Project Components*] *Gross Reservoir* of the Corps' DEIS.

Service Spillway

Proposed Project: The existing spillway crest (including 2 feet of flashboards) is at elevation 7,282 feet above mean sea level (msl) and has a length of 160 feet. Under the Proposed Project, the spillway crest would be raised approximately 124 feet to elevation 7,406 feet msl and would be located near the center of the dam or an abutment.

Alternative Proposed Project: Under the Alternative Proposed Project, the service spillway crest would be raised approximately 118 feet to elevation 7,400 feet msl and would be located near the center of the dam or an abutment. The size and location of an auxiliary spillway, if needed, will be determined during final design.

Auxiliary Spillway

The size and location of the service spillway will be determined during final design. For either the Proposed Project or the Alternative Proposed Project, an auxiliary spillway may need to be constructed to convey flood flows in excess of the service spillway capacity, up to the Probable Maximum Flood (PMF). The auxiliary spillway may be located in a topographic saddle located approximately 1 mile south of Gross Dam or on the abutment of Gross Dam (see Exhibit G,

Preliminary Project Boundary Map). In the Corps' DEIS, the auxiliary spillway in the saddle south of Gross Dam is described as a concrete weir structure.

Inlet and Outlet Works

Proposed Project: There would be no change to the existing inlet works. Prior to final design, Denver Water will verify that the existing discharge valves are sufficient for the new hydrostatic conditions.

Alternative Proposed Project: There would be no change to the existing inlet works. Prior to final design, Denver Water will verify that the existing discharge valves are sufficient for the new hydrostatic conditions.

Penstock and Turbine Equipment

Proposed Project: The proposed dam raise under the Proposed Project would require some modification of an existing 66-inch-diameter penstock valve vault and, because the generating capacity would increase due to the new hydrostatic conditions, would also affect the hydroelectric equipment inside the powerhouse. An existing valve vault on the penstock upstream of the two turbines would be modified. The modifications would include replacing the 66-inch butterfly valve with a pressure reducing valve (PRV).

The existing 66-inch-diameter penstock is suitable for the higher pressure conditions that would exist after the dam is raised. However, the turbine equipment was not originally designed for an increase in dam height greater than 60 feet. After final design, Denver Water will evaluate modifications to extend the operating range of the turbine equipment for the proposed new higher head conditions to determine whether such efficiency improvements would be economical. Refer to item (5), below, for details.

Alternative Proposed Project: Same as the Proposed Project.

(2) The normal maximum surface area and normal maximum water surface elevation (mean sea level) [and] gross storage capacity of any impoundments to be included as part of the project.

The existing Gross Reservoir stores 41,811 acre-feet of water and has a maximum surface area of 418 acres at its maximum water surface elevation of 7,282 feet msl (service spillway elevation with flashboards).

Proposed Project: Gross Reservoir would be expanded to approximately 119,000 acre-feet of storage and would have a maximum surface area of 842 at its maximum water surface elevation of 7,406 feet msl.

Alternative Proposed Project: Gross Reservoir would be expanded to approximately 114,000 acre-feet of storage and would have a maximum surface area of 818 acres at its maximum water surface elevation of 7,400 feet msl.

(3) The number, type, and rated capacity of any proposed turbines or generators to be included as part of the project.

The two existing horizontal Francis turbines and two synchronous generators have a total rated hydraulic capacity of 7,598 kilowatts (kW). For either the Proposed Project or the Alternative Proposed Project, the new rated hydraulic capacity would be 8,100 kW. Table A-2 *Comparison of Existing and Proposed Turbines and Generators* compares the ratings of the Proposed Project and the Alternative Proposed Project with those of the existing project.

Table A-2
Comparison of Existing and Proposed Turbines and Generators

	Existing Project	Proposed Project	Proposed Increase	Alternative Proposed Project	Proposed Increase
Number and Type of Unit	Two horizontal Francis units	No change	None	No change	None
Total Generator Nameplate Capacity (kW*)	8,100 kW (4,050 kW each)	No change	None	No change	None
Total Hydraulic Capacity (kW*)	7,598 kW (3,799 kW each)	8,100 kW (4,050 kW each)	502 kW	8,100 kW (4,050 kW each)	502 kW
Rated Flow (cfs**)	315 cfs (157.5 cfs each)	No change	None	No change	None
Rated Head (feet)***	320 feet	451 feet	131 feet	445 feet	125 feet

* kW – kilowatts
** cfs – cubic feet per second
*** The rated head would increase due to the proposed higher elevation of Gross Dam.

(4) The number, length, voltage, and interconnections of any primary transmission lines proposed to be included as part of the project.

Denver Water is proposing no changes to the existing primary transmission lines under either the Proposed Project or the Alternative Proposed Project.

(5) The description of any additional mechanical, electrical, and transmission equipment appurtenant to the project.

Under either the Proposed Project or the Alternative Proposed Project, a PRV would be installed where the existing isolation butterfly valve is located in the valve vault on the penstock upstream of the inlet piping to the two turbines. The valve vault would be modified to allow installation of the PRV. The PRV would be either a cone valve or a special type of valve such as a non-cavitating-type butterfly valve. Pressure reduction across the PRV would only occur when hydraulic conditions are outside the operating range of the turbine units, as could occur at the

higher reservoir elevations made possible by raising the dam under either the Proposed Project or the Alternative Proposed Project. The PRV would be used to lower the inlet pressure to the turbine units under head conditions that exceed 380 feet of net head. The expected maximum pressure reduction for the PRV is 71 feet of water (28 pounds per square inch [psig]) for the Proposed Project and 65 feet of water (also 28 psig) for the Alternative Proposed Project. Automatic controls would be designed and installed to regulate the inlet pressure to stay within the turbine operating range.

Denver Water will evaluate modifications of the existing hydroelectric turbine equipment to extend the operating range of the turbine equipment at higher operating heads. The turbine equipment manufacturer, Alstom, will be asked to perform an analysis to determine what modifications can be made to extend the operating range for the conditions proposed under the Proposed Project or the Alternative Proposed Project. The analysis will include:

- Thorough analysis of all components to determine the higher stresses due to the higher operating head
- Recommendations for replacing or modifying the components to allow for operation at higher heads up to the maximum value
- Cost estimates for providing the new components
- A final recommended operating range for the modified units.

A preliminary review indicates that the existing hydroelectric turbine equipment is capable of operating at head conditions that somewhat exceed current conditions (320 feet rated head). The manufacturer's hill chart indicates that the units could possibly operate without modification to 380 feet of head. The extent of the turbine modifications and the cost to perform the work will not be known until the manufacturer completes the analysis. For purposes of this license amendment application, no turbine modifications are proposed. The goal would be to increase energy production by implementing only the most cost-effective turbine modifications.

Regardless of what modifications are recommended by Alstom, the generators would have the same nameplate rating of 8,100 kW.

Denver Water has considered the alternative of increasing capacity. However, a capacity increase above the existing nameplate rating would require major modifications to the powerhouse and complete replacement of the powerhouse equipment. The electrical switchyard equipment would also have to be modified or replaced. The cost to increase the capacity of the equipment above 8,100 kW would greatly exceed the cost of modifying the turbine equipment as described above.

(6) All lands of the United States, including lands patented subject to the provisions of section 24 of the Act, 16 U.S.C. 818, that are enclosed within the project boundary described [under Exhibit G], identified and tabulated by legal subdivisions of a public land survey, by the best available legal description. The tabulation must show the total acreage of the lands of the United States within the project boundary.

All lands of the United States enclosed within the proposed expansion of the FERC Project Boundary under either the Proposed Project or the Alternative Proposed Project are shown in

Exhibit G. Approximately 15 acres of additional undeveloped property and approximately 1.1 additional acres of U.S. Forest Service land would need to be incorporated into the proposed FERC Project Boundary. Parcels proposed to be included in the FERC Project Boundary, including both federal and private lands, are identified by land ownership and tabulated by legal subdivision in Table A-3 *Land Ownership within Proposed FERC Project Boundary*. The total acreage of the lands of the United States within the proposed FERC Project Boundary is 1,013.30 acres.

Table A-3
Land Ownership within Proposed FERC Project Boundary

National Forest Lands (Roosevelt National Forest)	
Location	**Acres**
Section 18, T1S, R71W	
S ½ Lot 15	22.78
S ½ Lot 16	19.23
S ½, SE ¼, SW ¼	20.00
S ½, SW ¼, SE ¼	20.00
Section 19, T1S, R71W	
NE ¼ Lot 6	11.34
N ½, NE ¼, NW ¼ Lot 6	20.00
SE ¼, NE ¼, NW ¼ Lot 6	10.00
W ½, E ½	160.00
Lot 5	30.94
Lot 8	31.05
Lot 9	38.32
SE ¼, SW ¼	40.00
S ½ Lot 10	22.73
Lot 11	45.16
Lot 12	23.77
Lot 13	7.68
Section 30, T1S, R71W	
Lot 10	15.36
Lot 11	9.57
Lot 12	43.52
Lot 13	24.71
Lot 14	42.63
Lot 15	45.63
Lot 16	42.41
Lot 17	27.16
Lot 18	30.38
Tracts in T1S, R71W	
Tract 63	38.74

National Forest Lands (Roosevelt National Forest)	
Tract 62	39.13
Tract 64	38.80
Location	**Acres**
Section 24, T1S, R72W	
SE ¼, Lot 8	9.86
NE ¼ Lot 8*	1.00
NE ¼ Lot 11	9.93
Section 25, T1S, R71W	
Lot 7	34.24
Lot 8	37.23
U.S. Forest Service Total Acreage	**1,013.30**
Denver Water Property	
Location	**Acres**
Tracts in T1S, R71W	
Tract 49	42.62
Ellis Lode Survey No. 18788	39.77
Resumption Placer Survey No. 480am	47.37
N ½ Tract 109	40.00
NW Corner Tract 108	2.87
N ½ Tract 107	40.00
Tract 44	133.79
Tract 47	160.00
Tract 45	160.00
Tract 48	80.00
NE ¼, SW ¼ Section 30*	10.00
NE ¼, N ½ Tract 109*	2.00
NE ¼, S ½ Tract 107*	3.00
N ½ Tract 65*	16.91
N ¼ Tract 104*	3.27
W ¼ Tract 103*	16.95
N ½ Tract 54*	3.00
Denver Water Property Total Acreage	**801.55**
TOTAL ACREAGE WITHIN PROPOSED FERC PROJECT BOUNDARY	**1,814.85**

* Proposed property addition to the existing FERC Project Boundary.

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Draft FERC Hydropower License Amendment Application Gross Reservoir Hydroelectric Project FERC Project No. 2035

EXHIBIT B

PROJECT OPERATION AND RESOURCE UTILIZATION

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EXHIBIT B

PROJECT OPERATION AND RESOURCE UTILIZATION

(1) A description of each alternative site considered in selecting the proposed site.

Alternative sites were considered in the Corps' NEPA analysis for purposes of locating the water supply project through reasonable and practicable alternatives. These alternatives are described in Chapter 2 of the Corps' DEIS. Alternative hydropower sites were not considered in the DEIS analysis because the purpose and need of the water supply project is specific to meeting Denver Water's water supply needs and because there is an existing hydropower project at the Gross Reservoir. An enlargement of Gross Reservoir, at various sizes, is a component of all five alternatives analyzed in the Corps' DEIS.

(2) A description of any alternative facility designs, processes, and operations that were considered.

Denver Water recently installed hydropower at Gross Dam pursuant to the 2001 FERC license and the 2004 amendment to that license. Denver Water considered options available to modifying the existing hydropower project under this license amendment application and determined that significant changes to the hydropower equipment are not cost-effective at this time. Therefore, changes in hydropower equipment analyzed in this license amendment application are limited to modifications to existing equipment that could be made to optimize power generation.

Denver Water analyzed whether an increase in capacity above the existing nameplate rating would be feasible. Increasing capacity would entail major modifications and/or complete replacement of the powerhouse equipment and the switchyard equipment. Having recently purchased and installed the current hydropower project, an increase in capacity is not economically feasible at this time. After final design, Denver Water will determine whether modifications to increase the operating range of the existing turbines would be economical.

(3) A statement as to whether operation of the power plant will be manual or automatic, an estimate of the annual plant factor, and a statement of how the project will be operated during adverse, mean, and high water years.

The power plant will normally be operated in automatic mode but has manual control capability, if needed.

Since the primary purpose of the project is for municipal water supply, the project is operated in response to the water demands of Denver Water's customers. Power generation is a secondary benefit derived from the release of this water through the project turbines,

Similar to the current license, the annual plant factor is expected to vary depending on the weather, demands on the water supply system, and other operational variables. It is estimated that the plant factor may suffer during adverse water years due to the need to store all excess water, other than minimum flow releases, in Gross Reservoir. It is estimated that the plant factor would be high during high water years due to additional water being released from Gross Reservoir for downstream demands.

(4) An estimate of the dependable capacity and average annual energy production in kilowatt-hours (or mechanical equivalent), supported by the following data:

(i) The minimum, mean, and maximum recorded flows in cubic feet per second of the stream or other body of water at the power plant intake or point of diversion, with a specification of any adjustments made for evaporation, leakage, minimum flow releases (including duration of releases), or other reductions in available flow; monthly flow duration curves indicating the period of record and the gauging stations used in deriving the curves; and a specification of the critical streamflow used to determine the dependable capacity

Because Gross Reservoir is operated to supply water according to downstream water consumption demands and power is only produced as a secondary benefit as that water is released, Denver Water is not claiming dependable capacity with respect to Gross Reservoir's hydroelectric production. Therefore, the subject of dependable capacity is not applicable to this license amendment application.

Energy generated under either the Proposed Project or the Alternative Proposed Project is expected to vary depending on the weather, demands of the water supply system, and other operational variables. For the existing project, the minimum, mean, and maximum recorded flows through the turbines are 50 cubic feet per second (cfs), approximately 125 cfs, and 315 cfs, respectively, and these flows would be the same under either the Proposed Project or the Alternative Proposed Project.

Monthly flow duration curves for the Proposed Project and the Alternative Proposed Project, indicating the period of record and gauging stations used in deriving the curves, are shown in Attachment B-1 *Proposed Project Average Monthly Total Outflow from Gross Reservoir* and Attachment B-2 *Alternative Proposed Project Average Monthly Total Outflow from Gross Reservoir*, respectively. Attachments B-1 and B-2 show the total amount of water released from Gross Reservoir. When the total amount of water released is between 50 cfs and 315 cfs, all of the water is released through the hydroelectric facility. When the amount of water released is less than 50 cfs, it bypasses the turbines and is released through valve house. Additionally, any water in excess of 315 cfs is also released through the valve house.

(ii) An area capacity curve showing the gross storage capacity and usable storage capacity of the impoundment, with a rule curve showing the proposed operation of the impoundment and how the usable storage capacity is to be utilized

Since the primary purpose of the project is for municipal water supply, reservoir levels fluctuate in response to the water demands of Denver Water's customers. Power generation is a secondary benefit derived from the release of this water through the project turbines. Because the project is not operated to respond to power demand, either by maximizing power production or by peaking, there is no rule curve related to hydroelectric production.

Gross Reservoir typically reaches its lowest point in March or April prior to spring runoff. As runoff begins, the reservoir begins to fill and is typically full by mid-July. Gross Reservoir is then kept as full as possible until customer demand exceeds available water supply. Typically, Denver Water begins lowering Gross Reservoir to meet customer water demand in August. The reservoir is then drawn down throughout the fall and winter until runoff begins again the following spring.

Proposed Project: The area capacity curve for the Proposed Project is provided in Attachment B-3 *Proposed Project Area Capacity Curve*, and the monthly operating elevation of Gross Reservoir under the Proposed Project is illustrated in Attachment B-4 *Proposed Project Average End of Month Elevation.* The Proposed Project would have an operating range from water surface elevation 7,178 feet mean sea level (msl) at minimum pool to 7,406 feet msl at full pool. On average, Gross Reservoir would fluctuate between 7,364 feet msl and 7,406 feet msl under the Proposed Project.

Alternative Proposed Project: The area capacity curve for the Alternative Proposed Project is provided in Attachment B-5 *Alternative Proposed Project Area Capacity Curve*, and the monthly operating elevation of Gross Reservoir under the Alternative Proposed Project is illustrated in Attachment B-6 *Alternative Proposed Project Average End of Month Elevation*. The Alternative Proposed Project would have an operating range from water surface elevation 7,178 feet msl to 7,400 feet msl. On average, Gross Reservoir would fluctuate between 7,358 feet msl and 7,400 feet msl under the Alternative Proposed Project.

(iii) The estimated minimum and maximum hydraulic capacity of the power plant in terms of flow and efficiency (cubic feet per second at one-half, full, and best gate) and the corresponding generator output in kilowatts

The estimated flow and efficiency at minimum gate, best gate, and maximum gate and the corresponding generator output are presented in Table B-1 *Power Plant Hydraulic Capacity and Generator Output.*

Table B-1
Power Plant Hydraulic Capacity and Generator Output

Gate	Flow (cfs*)	Turbine Efficiency (%)	Generator Output (kW**)
Minimum Gate	50	74.0	1,141
Best Gate	275	94.0	8,055
Maximum Gate	315	92.5	8,100

* cfs – cubic feet per second.
** kW – kilowatts.

(iv) A tailwater rating curve

A tailwater rating curve is not applicable since the water elevation over the tailrace weir is always higher than the stream elevation under either the Proposed Project or the Alternative Proposed Project.

(v) A curve showing power plant capability versus head and specifying maximum, normal, and minimum heads.

Annual energy generated under either the Proposed Project or the Alternative Proposed Project is expected to vary depending on the weather, demands of the water supply system, and other operational variables. A series of spreadsheets showing power plant capability versus head and specifying maximum, normal, and minimum heads is included as Attachment B-7 *Existing and Expected Turbine Generator Performance*. The spreadsheets represent three different scenarios of expected annual energy generation based on hydrology and on the hydroelectric equipment manufacturer's stated output and efficiency for various flows and heads. Each scenario includes an estimate of the energy (in kilowatt-hours [kWh]) that would be generated in an average hydrologic year.

The three scenarios are:

- Existing Turbine Generator Performance – Existing Conditions
- Expected Turbine Generator Performance – Proposed Project or Alternative Proposed Project with reservoir enlargement but no change to hydropower facilities
- Expected Turbine Generator Performance – Proposed Project or Alternative Proposed Project with a pressure reducing valve (PRV).

Table B-2 *Summary of Annual Energy Production* provides a summary of the annual energy produced under each scenario.

Table B-2
Summary of Annual Energy Production

Scenario	Annual Energy Produced (kWh*)	Comments
Existing Turbine Generator Performance – Existing Conditions	26,656,781	Existing base case.
Expected Turbine Generator Performance – Proposed Project or Alternative Proposed Project (reservoir enlargement but no changes to hydropower facilities)	5,031,330	Annual energy produced declines dramatically because the turbines can only operate at heads less than 380 feet.
Expected Turbine Generator Performance – Proposed Project or Alternative Proposed Project (with PRV**)	31,061,378	PRV allows turbines to operate at the higher heads resulting from increased reservoir depth, and annual energy production increases.

* kWh – kilowatt hours.
** PRV – pressure reducing valve.

Based on the modeling and as indicated in Table B-2, with the PRV in operation, either the Proposed Project or the Alternative Proposed Project would produce approximately 31,061,378 kWh per year, an increase in annual energy production of 16.5 percent over the existing project. This is because the PRV allows the turbines to operate at the higher heads (up to 451 feet) resulting from increased reservoir depths with the dam raise. (Note that, with the PRV in operation, the existing generator capacity of 8,100 kW is only exceeded when flows through both units total 300 cfs or more, which occurs less than 20 percent of the time.) Without the PRV, annual energy production would decline dramatically from the existing project because the turbines could only operate at heads less than 380 feet, which would occur less frequently with the increased reservoir depths under the Proposed Project or the Alternative Proposed Project.

The Turbine Performance Envelopes for the Proposed Project and the Alternative Proposed Project are indicated on Sheet 2 of Exhibit F.

(5) A statement of system and regional power needs and the manner in which the power generated at the project is to be utilized, including the amount of power to be used on-site, if any, supported by the following data:

(i) Load curves and tabular data, if appropriate

Refer to response to item (iii), below.

(ii) Details of conservation and rate design programs and their historic and projected impacts on system loads

Refer to response to item (iii), below.

(iii) The amount of power to be sold and the identity of proposed purchasers.

Denver Water currently sells the power generated at Gross Reservoir to Xcel Energy under a power purchase agreement that expires in 2027. The maximum capacity of Gross Dam generation is limited to 8,100 kW in the power purchase agreement. All generated power will be sold except that needed to supply the powerhouse, existing valve house, and caretakers' residences and facilities, an estimated average load of 146 kW. The estimated annual amount of energy to be sold under the Proposed Project or the Alternative Proposed Project is approximately 31 million kWh. These energy estimates are based on installation of a PRV in the penstock and on using the existing turbine equipment without any modifications.

(6) A statement of the applicant's plans for future development of the project or of any other existing or proposed water power project on the affected stream or other body of water, indicating the approximate location and estimated installed capacity of the proposed developments.

There are currently no plans for water power projects on South Boulder Creek or any other affected body of water.

Draft FERC Hydropower License Amendment Application Gross Reservoir Hydroelectric Project FERC Project No. 2035

EXHIBIT C

CONSTRUCTION SCHEDULE

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EXHIBIT C

CONSTRUCTION SCHEDULE

(1) The proposed commencement and completion dates of any new construction, modification, or repair of major project works.

The construction schedule is the same for either the Proposed Project or the Alternative Proposed Project, with design and construction proposed from 2010 through 2016. The construction schedule is provided in Chapter 2, Section 2.8.1 *Schedule and Sequencing* and Table 2-16 *Estimated Construction Schedules by Alternative* of the Corps' DEIS.

(2) The proposed commencement date of first commercial operation of each new major facility and generating unit.

The proposed commencement date for commercial operation of either the Proposed Project or the Alternative Proposed Project is projected to be in 2017, when the reservoir reaches full storage capacity, with an in-service date, when the hydropower facility is operated for the first time, of 2018. The actual date in which the reservoir fills for the first time will depend on two factors: 1) the completion date of the project and 2) hydrologic conditions. It is Denver Water's intent to fill Gross Reservoir to its new proposed capacity as soon as possible. Denver Water does not intend to operate the hydropower facilities during construction.

(3) If any portion of the proposed project consists of previously constructed, unlicensed water power structures or facilities, a chronology of original completion dates of those structures or facilities . . . .

Not applicable.

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Draft FERC Hydropower License Amendment Application Gross Reservoir Hydroelectric Project FERC Project No. 2035

EXHIBIT D

PROJECT COSTS AND FINANCING

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EXHIBIT D

PROJECT COSTS AND FINANCING

(1) A statement of estimated costs of any new construction, modification, or repair, including:

(i) The cost of any land or water rights necessary to the new development

The Proposed Project and Alternative Proposed Project would require the same amount of land to be purchased. Depending upon the final design of the spillway and dam, Denver Water may need to acquire approximately 15 acres of private property for either the Proposed Project or the Alternative Proposed Project. Denver Water estimates the cost of land to be between $10,000 and $20,000 per acre.

The Proposed Project would require that the City of Boulder and/or the City of Lafayette acquire a new water right to store water for the Environmental Pool. The Alternative Proposed Project would not require any new water rights.

(ii) The total cost of all major project works

Feasibility-level cost estimating was used for the Corps' DEIS to develop a capital construction cost estimate of $148 million and $140 million for the Proposed Project and the Alternative Proposed Project, respectively. These estimates were used by Denver Water as a starting point to develop more in-depth cost estimates of $233 million for the Proposed Project and $225 million for the Alternative Proposed Project.

(iii) Indirect construction costs such as costs of construction equipment, camps, and commissaries

All construction cost have been included in the cost estimates of $233 million and $225 million for the Proposed Project and the Alternative Proposed Project, respectively. It is assumed that the workforce will commute daily to Gross Reservoir and that no camp or commissaries will be needed.

(iv) Interest during construction

The total interest during construction included in the cost estimates is $37.2 million for the Proposed Project and $37.0 million the Alternative Proposed Project.

(v) Overhead, construction, legal expenses, and contingencies.

The total overhead costs included in the cost estimates are $16.6 million for the Proposed Project and $16.4 million for the Alternative Proposed Project.

(2) If any portion of the proposed project consists of previously constructed, unlicensed water power structures or facilities, a statement of the original cost of these structures or facilities . . . .

Not applicable. Neither the Proposed Project nor the Alternative Proposed Project includes any previously constructed, unlicensed water power structures or facilities.

(3) If the applicant is a licensee applying for a new license, and is not a municipality or a state, an estimate of the amount which would be payable if the project were to be taken over pursuant to section 14 of the Federal Power Act, 16 U.S.C. 807 . . . .

Not applicable. The applicant is a municipality.

(4) A statement of the estimated average annual cost of the total project as proposed, specifying any projected changes in the costs (life-cycle costs) over the estimated financing or licensing period if the applicant takes such charges into account, including:

(i) Cost of capital (equity and debt)

(ii) Local, state, and federal taxes

(iii) Depreciation or amortization

(iv) Operation and maintenance expenses, including interim replacements, insurance, administrative and general expenses, and contingencies

(v) The estimated capital cost and estimated annual operation and maintenance expense of each proposed environmental measure.

The estimated annual cost of the total project is approximately $11.0 million for the Proposed Project and $10.6 million for the Alternative Proposed Project, respectively. This amount was calculated by forecasting the estimated project cash flows (costs and revenues) over a 30-year financing period. A discount rate was then applied to each incremental cash flow to calculate the net present value of the project. The net present value was then divided by a factor of 30 to derive the estimated annual project cost over the 30-year financing period.

Key costs and revenues included in the cash flow calculations include construction costs, capitalized interest during construction, operations and maintenance expenditures, a sinking fund

contribution for depreciation, hydropower revenues from electricity generated by the project, and cash receipts from participation fees forecast to be paid by the City of Arvada pursuant to an existing contractual agreement. Because Denver Water is a non-taxable municipal government entity, no provision for income taxes was made in the cash flow forecasts.

Cash flows for the Proposed Project and the Alternative Proposed Project are forecast in 2009 dollars, and no inflation factors have been applied. Because inflation factors are not applied, the discount rate used to calculate the net present value is 2.5 percent for both the Proposed Project and the Alternative Proposed Project. This rate is assumed to represent the natural or "real" rate of interest in the underlying economy without additions for inflation or other factors. Key data assumptions and analytical methods used in calculating the annual cost of the Proposed Project and the Alternative Proposed Project include the following.

- The 30-year forecasting period is 2010 – 2039. The period of project design and construction is assumed to be 2010 – 2016. Capitalized project costs incurred prior to 2009 are also included in the cash flow calculation as a time-zero cash outflow. The project is assumed to reach full storage capacity in 2017, with an in-service date of 2018. In order to simplify the calculation, it assumed that the 30-year financing period for the project would be 2010 – 2039.

- During the period 2009 – 2017 (the 8 years prior to the 2018 in-service date), the cash flow calculation includes cash outflows associated with the design and construction of the project. The cash flow calculation also includes cash inflows from third-party participation payments forecast to be made by the City of Arvada equal to 16.67 percent of total estimated construction cost. The exact timing of these payments, which sum to an estimated $59.0 million, is uncertain, but, for purposes of the forecast, they are assumed to be received during the period 2012 – 2016. Hydropower revenues of approximately $1 million are included for 2009 based on the sale of approximately 26 million kilowatt-hours (kWh) of electricity, but no other costs or revenues, including revenues from the sale of electricity, are otherwise included in cash flows for the period 2009 – 2017. The total undiscounted project cost is estimated at $364.1 million for the Proposed Project and $353.5 million for the Alternative Proposed Project. These amounts include construction costs expressed in 2009 dollars, estimated inflation, overhead allocations, and interest during construction.

- Beginning in 2018, after the in-service date of the project, the cash flow calculation includes cash outflows for on-going operations and maintenance and for depreciation sinking fund contributions (80-year useful life). Also beginning in 2018, cash inflows from the sale of electricity generated by the project are included in the cash flow forecast. The amount of energy to be sold under the Proposed Project or the Alternative Proposed Project is estimated at approximately 31 million kWh per year after installation of a pressure reducing valve (PRV), an increase of approximately 5 million kWh over current levels of approximately 26 million kWh per year.

Table D-1 *Summary of Average Annual Estimated Cost* summarizes the key components of the average annual total cost calculation.

Table D-1
Summary of Average Annual Estimated Cost

Item	Proposed Project Cost ($ in thousands)	Alternative Proposed Project Cost ($ in thousands)
Construction Cost Through 2008	$10,625	$10,625
Budgeted Construction Cost 2009	$1,235	$1,235
Incremental Construction Cost 2010 – 2016	$233,415	$225,415
Total Construction Cost Before Inflation	$245,275	$237,275
Construction Cost Inflation 2010 – 2016	$65,066	$62,836
Indirect Overhead Allocations	$16,570	$16,443
Interest During Construction	$37,233	$36,977
Total Estimated Construction Cost	$364,144	$353,531
Less: Third-Party Participation	($60,703)	($58,934)
Estimated Construction Costs Net of Third-Party Participation	$303,441	$294,598
Incremental Capital Costs Related to Hydropower and Capitalized Maintenance	$4,641	$4,535
Estimated O&M Costs	$23,016	$23,016
Less: Estimated Hydropower Revenue	($28,598)	($28,598)
Depreciation Sinking Fund	$100,139	$97,221
Net Cash Flows	$397,474	$385,606
Discount Rate	2.5%	2.5%
Net Present Value	$328,980	$319,244
Levelized Cost Over 30-Year Financing Term	$10,966	$10,641

(5) A statement of the estimated annual value of project power based on a showing of the contract price for sale of power or the estimated average annual cost of obtaining an equivalent amount of power (capacity and energy) from the lowest cost alternative source of power, specifying any projected changes in the costs (life-cycle costs) of power from that source over the estimated financing or licensing period if the applicant takes such changes into account.

The estimated annual value of project power is based on the Primary General electric purchase rate in affect for 2009, as posted by Xcel Energy under Contract 10426A:

- 2009 Capacity Payment Rates: $7.33 per kilowatt (kW) (for 8,100-kW capacity) for the 8 months October through May
  $9.01 per kW (for 8,100-kW capacity) for the 4 months June through September
- 2009 Energy Payment Rate: $0.02360 per kWh

Based on these 2009 rates, the future annual value of project power for either the Proposed Project or the Alternative Proposed Project without escalation is estimated to be $766,908 for capacity (8,100 kW) and $731,600 for energy (31million kWh), for a total value of $1,498,508.

(6) A statement describing other electric energy alternatives, such as gas, oil, coal, and nuclear-fueled power plants and other conventional and pumped storage hydroelectric plants.

No change to license.

(7) A statement and evaluation of the consequences of denial of the license application and a brief perspective of what future use would be made of the proposed site if the proposed project were not constructed.

The No Action Alternative in the Corps' DEIS describes the consequences of denial of the Corps' Section 404 Permit. Since enlargement of the reservoir requires both Corps and FERC approval, the denial of this license amendment would have the same consequences. The No Action Alternative is described in Chapter 2 of the DEIS, and its impacts are analyzed in Chapter 4 of the DEIS. Without approval from both federal agencies, the hydropower project would continue to operate under the current license.

(8) A statement specifying the sources and extent of financing and annual revenues available to the applicant to meet the costs identified in [sections] (1) and (4), of this [exhibit].

The total estimated construction cost for the Proposed Project, prior to any payments from third-party participation, is estimated at approximately $364.1 million. The estimated payments from third-party participation are estimated to be $60.7 million. The total estimated construction cost

for the Alternative Proposed Project is estimated to be $353.5 million, with payments of $58.9 million from third-party participation.

Denver Water has adequate sources of financing and annual revenues to construct and operate either the Proposed Project or the Alternative Proposed Project. Key Denver Water financial metrics supporting this assertion are given in Table D-2 *Key Denver Water Financial Metrics*.

Table D-2
Key Denver Water Financial Metrics

Revenue Metrics	**2008 Actual ($ in millions)**
Water Sales Revenue	$205.9
Hydropower Revenue	$10.3
Operating Revenues	$216.3
Operating Income	$44.9
System Development Charges	$21.5
Contributions in Aid of Construction	$18.5
Total Capital Contributions	$40.0
Increase in Net Assets	$71.9
Cash Flow Metrics	**2008 Actual ($ in millions)**
Cash Flow from Operating Activities	$76.0
Cash Flow from Financing Activities	($116.1)
Cash Flow from Investing Activities	$61.5
Change Increase (Decrease) in Cash	$21.5
Ending Cash Balance at December 31, 2008	$186.5
Forecast Ending Cash Balance at December 31, 2009	$198.3

Debt Financing Metrics	**2008 Actual ($ in millions)**
Outstanding Long-term Debt	$377.8
Net Fixed Assets	$1,506.5
Debt to Fixed Assets Ratio	25.06%
Debt Service	$49.6
Debt Service Coverage Ratio	2.48
Debt Rating as of May 28, 2009	
Moody's	Aa2

Standard & Poors	AAA
Fitch	AA+

(9) An estimate of the cost to develop the license application.

Denver Water estimates the cost to develop the license amendment application to be approximately $300,000. This does not include any cost associated with developing the Corps' DEIS or any additional studies. The current cost of the Corps' DEIS is estimated to be approximately $12 million.

(10) The on-peak and off-peak values of project power and the basis for estimating the values, for projects which are proposed to operate in a mode other than run-of-river.

Gross Reservoir will not be operated as a "run-of-river" reservoir because its primary purpose is for water supply. Hydropower is produced as a secondary benefit as the water is released for water supply purposes. Consequently, neither the Proposed Project nor the Alternative Proposed Project would operate as a peaking facility, and the values of on-peak and off-peak project power are not germane to this analysis.

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EXHIBIT E

ENVIRONMENTAL REPORT

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EXHIBIT E

ENVIRONMENTAL REPORT

As described in the Introduction to this license amendment application, the Proposed Project is the Proposed Action described in the Corps' DEIS plus additional storage capacity for an Environmental Pool, a mitigation measure proposed by Denver Water. The Alternative Proposed Project is the Proposed Action of the DEIS without an Environmental Pool. The primary differences between the Proposed Project and the Alternative Proposed Project are the proposed dam heights and the resulting differences in the physical dimensions of an enlarged Gross Reservoir, namely total storage volume, normal water surface elevation, surface area, maximum and mean depth, and shoreline length (see Table E-1 *Comparison of Gross Dam and Reservoir Features by Alternative*, below for details). In general, these parameters would be slightly greater (5 percent or less) under the Proposed Project than under the Alternative Proposed Project. Therefore, Denver Water believes that the impact analyses for the Proposed Action of the DEIS (the Alternative Proposed Project of this license amendment application) reasonably represent impacts for both the Proposed Project and the Alternative Proposed Project. Unless otherwise noted, the information provided in this Exhibit E relates to both the Proposed Project and Alternative Proposed Project, which are referred to here as the (lowercase) proposed project.

(1) General Description of the locale. The applicant must provide a general description of the environment of the proposed project area and its immediate vicinity. The description must include location and general information helpful to an understanding of the environmental setting.

The general location and description of the environment of the Gross Reservoir hydroelectric project and its immediate vicinity are the same as provided in the current FERC license. Additionally, Chapter 3 of the Corps' DEIS describes the existing environment of Gross Reservoir and is organized by resources at and surrounding Gross Reservoir. The information can be found in Chapter 3, Section 3.5.1.1 [*Vegetation*] *Gross Reservoir*, Section 3.6.1.1 [*Riparian and Wetland Areas*] *Gross Reservoir*, Section 3.6.5.5 [*Riparian and Wetland Areas*] *South Boulder Creek*, Section 3.14.1.1 [*Land Use*] *Gross Reservoir*, and Section 3.17.1.1 [*Socioeconomics*] *Gross Reservoir*.

(2) Report on water use and quality. The report must discuss water quality and flows and contain baseline data sufficient to determine the normal and seasonal variability, the impacts expected during construction and operation, and any mitigative, enhancement, and protective measures proposed by the applicant. The report must include the items listed below.

Existing water use and water quality associated with Gross Reservoir and South Boulder Creek are described in Chapter 3, Section 3.1.1.1 [*Surface Water*] *Gross Reservoir* and Section 3.1.5.5

[*Surface Water*] *South Boulder Creek* of the Corps' DEIS, respectively. Potential impacts of the project and the seasonal variability expected from construction and operation of the proposed project as compared to baseline conditions are discussed in Chapter 4, Section 4.1.1.1 [*Surface Water*] *Gross Reservoir* and Section 4.1.1.2 [*Surface Water*] *River Segments* of the DEIS. Denver Water's proposed mitigation measures and enhancements are provided in the *Draft Mitigation Plan for the Moffat Collection System Project*, which is attached as Appendix M to the DEIS. Mitigation, protection, and enhancement measures proposed by Denver Water are also discussed in this Exhibit E. The Proposed Project, which includes storage capacity for an Environmental Pool, encompasses one of the mitigation measures proposed by Denver Water.

(i) A description of existing instream flow uses of streams in the project area that would be affected by construction and operation; estimated quantities of water discharged from the proposed project for power production; and any existing and proposed uses of project waters for irrigation, domestic water supply, industrial, and other purposes.

Existing Instream Flow Uses: Instream flow uses in South Boulder Creek are described in Chapter 3, Section 3.1.5.5 [*Surface Water*] *South Boulder Creek* of the Corps' DEIS. The effects of project construction and operation on South Boulder Creek flows are discussed in Chapter 4, Section 4.1.1.2 [*Surface Water*] *River Segments* of the DEIS.

Estimated Quantities of Flows for Power Production: The minimum, mean, and maximum recorded flows through the turbines for the existing project are 50 cubic feet per second (cfs), approximately 125 cfs, and 315 cfs, respectively, and these flows would be the same under either the Proposed Project or the Alternative Proposed Project.

Existing and Proposed Uses of Project Waters: The use of Gross Reservoir for municipal drinking water supply remains the same as under the current FERC license. Denver Water's operation of an enlarged Gross Reservoir would continue under Colorado water rights laws and would use Denver Water's decreed water rights. Because Denver Water operates the hydroelectric project ancillary to water supply releases, the effects of operating Gross Reservoir for water supply encompass the effects of operating the hydroelectric project. Denver Water would also operate the hydroelectric project ancillary to environmental releases made from the Environmental Pool.

Due to the various components of Denver Water's raw water collection system (see Chapter 1, Section 1.3 *Denver Water's Existing System* of the Corps' DEIS), the amount of water delivered from Gross Reservoir would vary depending upon hydrologic conditions, scheduled and unscheduled maintenance, and other factors. In general, Denver Water anticipates that approximately 22 percent of the water needed to meet demand would flow through Gross Reservoir and then to Ralston Reservoir via the South Boulder Diversion Canal. By the year 2030, Denver Water is projecting total system demand to be 379,000 acre-feet per year, and Gross Reservoir would help meet approximately 82,500 acre-feet of this demand.

Denver Water's raw water collection system is described in Chapter 1, Section 1.3 *Denver Water's Existing System* of the DEIS, and the treated water system is explained in Section 1.3.2 [*Denver Water's Existing System*] *Treated Water System*.

(ii) A description of the seasonal variation of existing water quality for any stream, lake, or reservoir that would be affected by the proposed project, including (as appropriate) measurements of: significant ions, chlorophyll *a*, nutrients, specific conductance, pH, total dissolved solids, total alkalinity, total hardness, dissolved oxygen, bacteria, temperature, suspended sediments, turbidity, and vertical illumination.

Existing water quality associated with Gross Reservoir and South Boulder Creek is described in Chapter 3, Section 3.1.1.1 [*Surface Water*] *Gross Reservoir* and Section 3.1.5.5 [*Surface Water*] *South Boulder Creek* of the Corps' DEIS, respectively.

(iii) A description of any existing lake or reservoir and any of the proposed project reservoirs including surface area, volume, maximum depth, mean depth, flushing rate, shoreline length, substrate classification, and gradient for streams directly affected by the proposed project.

Gross Reservoir is described in Chapter 2, Section 2.3.2.1 [*Project Components*] *Gross Reservoir* and Chapter 3, Section 3.1.1.1 [*Surface Water*] *Gross Reservoir* of the Corps' DEIS. Table E-1 *Comparison of Gross Dam and Reservoir Features by Alternative* provides a summary of Gross Reservoir features under the Proposed Project and the Alternative Proposed Project.

Table E-1
Comparison of Gross Dam and Reservoir Features by Alternative

Gross Dam and Reservoir Features	Existing	Proposed Project (with an Environmental Pool)	Alternative Proposed Project
Additional Storage Volume (acre-feet)	--	77,000 (72,000 + 5,000)	72,000
Approximate Storage Volume (acre-feet)	42,000	119,000	114,000
Normal Water Surface Elevation at Spillway Crest (feet msl*)	7,282 **	7,406	7,400
Surface Area (acres)	418	842	818
Maximum Depth (feet)***	297	421	415
Mean Depth (feet)***	261	379	373
Flushing Rate (times per year)	2.58	1.00	1.04
Shoreline Length (miles)	11	13.6	13.5

* msl – above mean sea level.
** Existing spillway crest includes 2 feet of flashboards.
*** The approximate dam height and dam crest length in the proposals are based on preliminary design work and may change once the final design is approved by the FERC.

Under existing conditions, Gross Reservoir has a maximum depth of 297 feet (7,282 feet msl [normal water surface elevation at spillway crest] less 6,985 feet msl [bottom elevation]) and, in an average year, decreases by 36 feet to an average water surface elevation of 7,246 feet msl and a mean depth of 261 feet. Under the Proposed Project, the reservoir would have a maximum depth of 421 feet (7,406 feet msl less 6,985 feet msl) and, on average, would decrease by 42 feet to an average water surface elevation of 7,364 feet msl and a mean depth of 379 feet. Under the Alternative Proposed Project, the reservoir would have a maximum depth of 415 feet (7,400 feet msl less 6,985 feet msl) and, on average, would decrease by 42 feet to an average water surface elevation of 7,358 feet msl and a mean depth of 373 feet.

The existing flushing rate of Gross Reservoir is approximately 2.58 times per year (108,597 acre-feet of inflow per year / 42,000 acre-feet of storage); thus, the average length of time water resides in the reservoir (residence time) is approximately 0.39 year. The Proposed Project would decrease the flushing rate to approximately 1.00 (118,732 acre-feet of inflow per year / 119,000 acre-feet of storage), with a residence time of approximately 1 year. The Alternative Proposed Project would decrease the flushing rate to approximately 1.04 (118,732 acre-feet of inflow per year / 114,000 acre-feet of storage), a residence time of approximately 0.96 year.

The length of the existing shoreline at Gross Reservoir is approximately 11 miles at the maximum water surface elevation of 7,282 feet (spillway crest elevation including 2 feet of flashboards). The shoreline length would increase to approximately 13.6 miles under the Proposed Project or approximately 13.5 miles under the Alternative Proposed Project.

The geology at Gross Reservoir is described in Chapter 3, Section 3.3.1.1 [*Geology*] *Gross Reservoir* of the DEIS. The hydrology of South Boulder Creek is described in Chapter 3, Section 3.1.5.5 [*Surface Water*] *South Boulder Creek*. Channel dynamics, including stream gradient and classification, for South Boulder Creek above and below Gross Reservoir are described in Chapter 3, Section 3.1.6.5 [*Channel Dynamics*] *South Boulder Creek*.

(iv) A quantification of the anticipated impacts of the proposed construction and operation of the project facilities on water quality and downstream flows, such as temperature, turbidity, and nutrients.

Chapter 4 of the Corps' DEIS discusses the impacts of the proposed project. Potential changes in reservoir evaporation, fluctuation, and water quality of Gross Reservoir are discussed in Section 4.1.1.1 [*Surface Water*] *Reservoir Evaporation, Fluctuation, and Quality*. Potential changes in stream flows and water quality in South Boulder Creek are discussed in Section 4.1.1.2 [*Surface Water*] *River Segments*.

Gross Reservoir: The expansion of Gross Reservoir is likely to temporarily affect water quality during the early years of filling the reservoir by increasing organic matter and total organic carbon and possibly decreasing dissolved oxygen. The increased volume and seasonal operations of Gross Reservoir could also result in long-term changes in reservoir turnover and thermal stratification due to the increased size. Increasing the proportion of water in Gross Reservoir derived from Moffat Tunnel deliveries may also affect the reservoir's general water

quality. See Chapter 4, Section 4.1.1.1 [*Surface Water*] *Reservoir Evaporation, Fluctuation, and Quality* of the DEIS.

South Boulder Creek: Predicted changes in South Boulder Creek stream flows resulting from the Moffat Collection System Project are discussed in detail in Chapter 4, Section 4.1.1.2 [*Surface Water*] *River Segments* of the DEIS. No water quality impacts are anticipated in South Boulder Creek upstream of Gross Reservoir. Downstream from the reservoir, water quality may be temporarily affected during the early years of reservoir filling due to potential changes in reservoir water quality. See Chapter 4, Section 4.1.1.2 [*Surface Water*] *River Segments* of the DEIS.

(v) A description of measures recommended by federal and state agencies and the applicant for the purpose of protecting or improving water quality and stream flows during project construction and operation; an explanation of why the applicant has rejected any measures recommended by an agency; and a description of the applicant's alternative measures to protect or improve water quality stream flow.

Water Quality at Gross Reservoir: At this time, no agencies have recommended measures for protecting or improving water quality at Gross Reservoir. Potential water quality impacts should be substantially prevented or mitigated by compliance with existing project license articles. These articles include Article 401: *Erosion Control Plan*, Article 405: *Rehabilitation and Restoration Plan*, Article 406: *Weed Management Plan*, and Article 407: *Forest Management Plan*. Potential water quality impacts should be further prevented or mitigated by the requirement for an erosion and sediment control plan approved by the FERC prior to the start of construction.

Chapter 2, Section 2.8.2 *Temporary Sediment and Erosion Control* of the Corps' DEIS discusses Denver Water's intention to obtain a Stormwater Discharge Permit for Construction Activities from the Colorado Department of Public Health and Environment (CDPHE). Denver Water will also obtain a Section 401 Water Quality Certification from the CDPHE.

South Boulder Creek below Gross Reservoir: At this time, no agencies have recommended measures for improving water quality in South Boulder Creek below Gross Reservoir. The City of Boulder has requested that storage capacity be included in Gross Reservoir for an Environmental Pool to enhance flows in South Boulder Creek below Denver Water's diversion structure (the South Boulder Diversion Canal). Denver Water proposes to include this enhancement in its Proposed Project.

During consultation, stakeholders raised concerns about low flows in South Boulder Creek below Gross Reservoir. These low flows occur downstream from Denver Water's diversion structure as a result of other water uses. During the relicensing of Gross Reservoir in 2001, Denver Water committed to not divert native South Boulder Creek water in the winter (November through March) if diversions would cause flows downstream from the diversion structure to fall below 7 cfs (Project No. 2035-006 FERC License, page 9, item 1 "The Denver-Boulder Agreement"). Denver Water will maintain this commitment in a new intergovernmental

agreement (IGA) with the cities of Boulder and Lafayette, which would replace the Denver-Boulder Agreement.

Additionally, under its current FERC license, Denver Water releases a minimum flow of 5 cfs into the 200-foot-long reach of South Boulder Creek from the valve house and outlet works downstream to the powerhouse during hydropower project operation. Denver Water will maintain this requirement.

Under Article 402: *Dissolved Oxygen and Water Temperature Monitoring of South Boulder Creek below Hydroelectric Facility* of the current FERC license, Denver Water is required to monitor dissolved oxygen (DO) levels and water temperatures of South Boulder Creek immediately downstream from the project tailrace. Denver Water commits to continuing this monitoring for 3 years after project construction.

(vi) A description of groundwater in the vicinity of the proposed project, including water table and artesian conditions, the hydraulic gradient, the degree to which groundwater and surface water are hydraulically connected, aquifers and their use as water supply, and the location of springs, wells, artesian flows, and disappearing streams; a description of the anticipated impacts on groundwater and measures proposed by the applicant and others for the mitigation of impacts on groundwater.

Groundwater in the project area is described in Chapter 3, Section 3.2.1.1 [*Groundwater*] *Gross Reservoir* and Section 3.2.5.5 [*Groundwater*] *South Boulder Creek* of the Corps' DEIS. Potential impacts to groundwater are discussed in Chapter 4, Section 4.2.1.1 [*Groundwater*] *Gross Reservoir* and Section 4.2.1.2 [*Groundwater*] *River Segments* of the DEIS.

(3) Report on fish and wildlife, and botanical resources. The applicant must provide a report that describes the fish, wildlife, and botanical resources within the vicinity of the proposed project; expected impacts of the project on those resources; and mitigation, enhancement, or protection measures proposed by the applicant. The report must contain:

(i) A description of existing fish, wildlife, and plant communities of the proposed project area and its vicinity, including any downstream areas that may be affected by the proposed project and the area within the transmission line corridor or right-of-way. A map of vegetation types should be included in the description. For species considered important because of commercial or recreational value, the information provided should include temporal and spatial distributions and densities of such species. Any fish, wildlife, or plant species proposed or listed as threatened or endangered by the U.S. Fish and Wildlife Service or National Marine Fisheries Service must be identified.

Existing conditions at Gross Reservoir for fish, wildlife, and botanical resources are described in the following sections of Chapter 3 of the Corps' DEIS.

Section 3.5.1.1 – [*Vegetation*] *Gross Reservoir* and Figure 3.5-1 *Vegetation – Gross Reservoir*
Section 3.6.1.1 – [*Riparian and Wetland Areas*] *Gross Reservoir* and Figure 3.6-1 *Wetlands – Gross Reservoir*
Section 3.6.5.5 – [*Riparian and Wetland Areas*] *South Boulder Creek* and Figure 3.6-1 Wetlands – *Gross Reservoir*
Section 3.7.1.1 – [*Wildlife*] *Gross Reservoir*
Section 3.7.5.5 – [*Wildlife*] *South Boulder Creek*
Section 3.8.1.1 – [*Special Status Species*] *Gross Reservoir* and Appendix G *Biological Resources*
Section 3.8.5.5 – [*Special Status Species*] *South Boulder Creek* and Appendix G *Biological Resources*
Section 3.9.1.1 – [*Aquatic Biological Resources*] *Gross Reservoir*
Section 3.9.5.5 – [*Aquatic Biological Resources*] *South Boulder Creek*

Fish Entrainment: Fish entrainment at Gross Reservoir is non-existent or negligible under existing conditions because of the depth of the inlet works and the nature of habitat for resident fish species at that depth. The inlet works at Gross Reservoir are very deep. The centerline of the intake trashrack screen is approximately 289 feet below the full pool water surface elevation as represented by the elevation of the spillway crest. Fluctuations in water surface elevation throughout the year reduce this depth somewhat, but, regardless of the time of year, the inlet works are very deep.

Temperature data are not available at the inlet depth of 289 feet, but temperature profiles from summer and fall 2009 indicate temperatures from less than 6° C (43 ° F) to less than 9° C (48 ° F) at a depth of approximately 180 feet. The trends in these profiles suggest that temperatures would likely be consistently quite low at the intake, probably very near 4° C (39° F) year round. Such temperatures which would provide unattractive habitat for resident fish species. Given these cold temperatures and the great depth (and pressure) at the intake, resident fish species in Gross Reservoir are unlikely to be distributed as deep in the reservoir water column as the location of the inlet works. Furthermore, evidence of fish entrainment and mortality has not historically been observed at the powerhouse outlet. For these reasons, entrainment was not considered an issue of concern when the project was relicensed in 2001.

(ii) A description of the anticipated impacts on fish, wildlife, and botanical resources of the proposed construction and operation of project facilities, including possible changes in size, distribution, and reproduction of essential populations of these resources and any impacts on human utilization of these resources.

Potential impacts to fish, wildlife, and botanical resources at Gross Reservoir and South Boulder Creek are discussed in the following sections of Chapter 4 of the Corps' DEIS.

Section 4.5.1.1 – [*Vegetation*] *Gross Reservoir*
Section 4.6.1.1 – [*Riparian and Wetland Areas*] *Gross Reservoir*
Section 4.6.1.2 – [*Riparian and Wetland Areas*] *River Segments*

Section 4.7.1.1 – [*Wildlife*] *Gross Reservoir*
Section 4.7.1.2 – [*Wildlife*] *River Segments*
Section 4.8.1.1 – [*Special Status Species*] *Gross Reservoir*
Section 4.8.1.2 – [*Special Status Species*] *River Segments*
Section 4.9.1.1 – [*Aquatic Biological Resources*] *Gross Reservoir*
Section 4.9.1.2 – [*Aquatic Biological Resources*] *River Segments*

Fish Entrainment: Fish entrainment at Gross Reservoir is non-existent or negligible under existing conditions because of the depth of the inlet works and the nature of habitat for resident fish species at that depth. See item (3)(i), above.

The Proposed Project would increase the height of the spillway by almost 124 feet, which would increase the depth of the intake structure at full pool to approximately 413 feet. The Alternative Proposed Project would increase the height of the spillway by 118 feet, which would increase the depth of the intake structure at full pool to approximately 407 feet. These increases in intake depth would further reduce any potential for entrainment from existing conditions. The depth, pressures, and temperatures near the intake, as well as empirical evidence from the operation of the existing project, clearly indicate that fish entrainment is highly unlikely and is not a resource issue of concern under either the Proposed Project or the Alternative Proposed Project.

Impacts on human utilization of fish, wildlife, and botanical resources are discussed in the following sections of Chapter 4 of the DEIS.

Section 4.13.1.1 – [*Recreation*] *Gross Reservoir*
Section 4.13.1.2 – [*Recreation*] *River Segments*
Section 4.15.1.1 – [*Visual Resources*] *Gross Reservoir*
Section 4.15.1.2 – [*Visual Resources*] *River Segments*

(iii) A description of any measures or facilities recommended by state or federal agencies for the mitigation of impacts on fish, wildlife, and botanical resources or for the protection or enhancement of these resources, the impact on threatened or endangered species, and an explanation of why the applicant has determined any measure or facilities recommended by an agency are inappropriate, as well as a description of alternative measures proposed by the applicant to protect fish, wildlife, and botanical resources.

Threatened and Endangered Species: The Corps met with the U.S. Fish and Wildlife Service (USFWS) to initiate Section 7 consultation on the likely occurrence of and potential impacts to threatened and endangered species in the project area (see Appendix G *Biological Resources* of the Corps' DEIS). Two documents were submitted to the USFWS in February 2009: *Biological Assessment for Moffat Project* and *Biological Assessment of Moffat Project Depletions and Request for Formal Section 7 Consultation for Federally-Listed Species in Nebraska*. The USFWS issued a final Biological Opinion, dated July 31, 2009 (see Appendix G *Biological Resources* of the Corps' DEIS).

Wildlife: Denver Water consulted with stakeholders and agencies during the FERC consultation process. Comments regarding potential impacts to elk and other wildlife at Gross Reservoir during project construction are addressed in Chapter 4, Section 4.7.1.1 [*Wildlife*] *Gross Reservoir* of the DEIS.

Botanical Resources/Tree Removal: During the consultation process, many stakeholders commented about tree removal that must occur around the shoreline in order to enlarge Gross Reservoir. Denver Water hired a consultant and the Colorado State Forest Service to assess the best methods for removing and disposing of trees removed for project construction. This study has been supplemented to include more information about the location of temporary roads and helicopter landing sites.

The U.S. Forest Service (USFS) has requested that Denver Water conduct a cruise design, approved by a qualified USFS cruiser, to determine the number of trees on USFS lands that would be removed for project construction. Denver Water will conduct this study prior to removal of the trees and will work closely with the USFS during this process. Denver Water's proposed method for removing trees is included as Attachment E-1 *Gross Reservoir Tree Removal Plan for Pool Enlargement February 2008 and Supplement* to *Gross Reservoir Tree Removal Plan for Pool Enlargement October 2008* to this license amendment application and is generally described in Chapter 2, Section 2.3.2.1 [*Project Components*] *Gross Reservoir* of the DEIS. Impacts of tree removal at Gross Reservoir are analyzed in Chapter 4, Section 4.5.1.1 [*Vegetation*] *Gross Reservoir* of the DEIS.

Stakeholders also expressed a concern about erosion following the removal of trees. Following reservoir filling, the area where trees are to be removed would be inundated except for the shoreline buffer area. Under Articles 401: *Erosion Control Plan* and Article 405: *Rehabilitation and Restoration Plan* of the current FERC license, Denver Water developed an Erosion Control and Rehabilitation and Restoration Plan. The existing plan will be amended to incorporate Best Management Practices (BMPs) for the tree removal areas during and after logging operations. In addition, under Article 406: *Weed Management Plan* of the current FERC license, Denver Water will conduct a weed survey within the logged area around the reservoir and will control any new weed infestation, as needed.

Tree Thinning and Wildfire Management: Many stakeholders expressed interest in Denver Water's conducting tree thinning and other wildfire management activities at Gross Reservoir. Under Article 407: *Forest Management Plan* of the current FERC license, Denver Water developed a Forest Management Plan to reduce insect infestation and the danger of wildfire. This plan includes prescribed fires within the current FERC Project Boundary and fuel break thinning. The existing plan will be reviewed and revised, as needed, to reflect any new BMPs to be implemented within the proposed FERC Project Boundary. In addition, Denver Water is conducting a watershed assessment within the Gross Reservoir watershed to identify other areas that require forest treatment to protect Denver Water's water supply and infrastructure. The watershed assessment process and follow-up development of forest treatments will be developed in cooperation with the USFS and other stakeholders in an on-going effort separate from this FERC process.

Environmental Pool within Gross Reservoir: Local governments and stakeholders have requested that additional storage capacity be provided at Gross Reservoir for environmental releases. Denver Water is currently exploring an agreement with the City of Boulder and the City Lafayette to provide this enhancement. The dam height increase under the Proposed Project would provide 5,000 acre-feet of additional storage capacity to Gross Reservoir (Environmental Pool [aka additional environmental storage]) to allow the City of Boulder and/or Lafayette to store water for the purpose of maintaining instream flows in South Boulder Creek. Releases from the Environmental Pool would occur during times when the natural flow of South Boulder Creek does not meet minimum flow recommendations. This release of water during low flow periods would increase the amount of aquatic habitat in South Boulder Creek below Gross Reservoir. None of Denver Water's existing or future water supply would be stored in the Environmental Pool.

Acreage Compensation: Boulder County has requested that Denver Water compensate for the loss of "approximately 400 acres of shoreline, tributary and bank habitat" that would result from expansion of Gross Reservoir. Denver Water anticipates that the lost riparian resources would reestablish over time along the shoreline of an expanded Gross Reservoir. Denver Water will determine those areas of an expanded Gross Reservoir that would likely support riparian vegetation and will plant native woody riparian vegetation in these areas to speed the establishment of riparian vegetation. To provide supportive hydrology for riparian vegetation, these plantings would occur once an expanded Gross Reservoir has filled. Denver Water will prepare a riparian vegetation establishment plan that will:

- Establish a schedule for the proposed plantings
- Identify the areas (location and size) for proposed riparian establishment
- Identify the quantity, size, and species of plant materials
- Establish success criteria and monitoring requirements.

Existing Measures to Continue to be Implemented and/or Amended under the Proposed Project or the Alternative Proposed Project:

Article 401: *Erosion Control Plan* and Article 405: *Rehabilitation and Restoration Plan*. Will continue to be implemented and will be revised to incorporate BMPs to control erosion related to tree removal, dam construction, and other ground-disturbing activities.

Article 402: *Dissolved Oxygen and Water Temperature Monitoring of South Boulder Creek below Hydroelectric Facility*. Will continue to be implemented for an additional 3 years after project construction.

Articles 403 and 404: *Ramping Rate Compliance*. Will continue to be implemented. Denver Water is proposing to add the following language to Article 403: "In maintaining the limits on the maximum rate of change, the licensee is allowed a tolerance of plus or minus 5 cubic feet per second (cfs) per hour." Denver Water is proposing this 5 cfs margin for reservoir outflow rate changes to allow for the imprecise and essentially

empirical nature of attempting to adjust relatively small amounts of water by means of very large valves.

Articles 406 and 408: *Weed Management Plan*. Will continue to be implemented and will be revised to address new lands to be incorporated into the proposed FERC Project Boundary. Denver Water will conduct a weed survey of the new lands, as well as a survey of newly disturbed areas resulting from dam enlargement and shoreline tree removal.

Article 407: *Forest Management Plan*. Will continue to be implemented and will be revised to address shoreline tree removal.

Articles 411 and 412: *Participation in the Recovery Programs for the Colorado River and Platte River Endangered Species*. Will continue to be implemented and will be revised to address additional depletions caused by the Moffat Collection System Project.

(iv)The following materials and information regarding any mitigation measures or facilities identified above [that are] proposed for implementation or construction: (A) functional design drawings; (B) a description of proposed operations and maintenance procedures for any proposed measures or facilities; (C) an implementation, construction, and operation schedule for any proposed measures or facilities; (D) an estimate of the costs of construction, operation, and maintenance of any proposed facilities or implementation of any measures; (E) a statement of the sources and amount of financing for mitigation measures or facilities; and (F) a map or drawing showing, by the use of shading, cross-hatching, or other symbols, the identity and location of any proposed measures or facilities.

Denver Water's *Draft Mitigation Plan for the Moffat Collection System Project* is provided in Appendix M of the Corps' DEIS. The Plan is conceptual and is intended to provide the agencies and public with information for review and comment as part of the EIS process. The *Draft Mitigation Plan* will be revised based on comments received, additional coordination with the resource agencies, and direction from the FERC, USFS, and the Corps. The revised plan will include details for implementation and construction of mitigation measures.

(4) Report on historical and archeological resources. The applicant must provide a report that discusses any historical and archaeological resources in the proposed project area, the impact of the proposed project on those resources, and the avoidance, mitigation, and protection measures proposed by the applicant. The report must contain:

(i) A description of any discovery measures, such as surveys, inventories, and limited subsurface testing work recommended by the specified state and federal agencies for the purpose of locating, identifying, and assessing the significance of historic and archaeological resources that would be affected by construction and

operation of the proposed project, together with a statement of the applicant's position regarding the acceptability of the recommendations.

An overview of federal and state agency and Native American consultation on cultural resources and the discovery measures used to identify cultural resources is provided in Chapter 3, Section 3.16.0 [*Cultural Resources/Paleontology*] *Overview* of the Corps' DEIS. Cultural resource inventories at Gross Reservoir are described in Chapter 3, Section 3.16.1.1 [*Cultural Resources/Paleontology*] *Gross Reservoir*.

(ii) The results of surveys, inventories, and subsurface testing work recommended by the state and federal agencies, together with an explanation by the applicant of any variations from the survey, inventory, or testing procedures recommended.

The Corps consulted with the State Historic Preservation Officer (SHPO), the Advisory Council on Historic Preservation (ACHP), the FERC, the USFS, various Native American tribes, and the Boulder County Historic Preservation Advisory Board (as a Certified Local Government). See response to item (4)(iii), below, for the results of the cultural resources inventories.

(iii) An identification (without providing specific site or property locations) of any historic or archaeological site in the proposed project area, with particular emphasis on sites or properties either listed in or recommended by the SHPO for inclusion in the National Register of Historic Places that would be affected by the construction of the proposed project.

Sites recorded at Gross Reservoir, along with their eligibility for listing on the National Register of Historic Places (NRHP), are identified in Chapter 3, Section 3.16.1.1 [*Cultural Resources/Paleontology*] *Gross Reservoir* and in Table 3.16-1 *Previously Recorded Sites in the Gross Reservoir APE* and Table 3.16-2 *Newly Recorded Sites in the Gross Reservoir APE* of the Corps' DEIS. Gross Dam and Reservoir, the Resumption Flume, and a Denver and Rio Grande Western Railroad tunnel are officially eligible for listing on the NRHP. Only Gross Dam and Reservoir and the Resumption Flume would be affected by either the Proposed Project or the Alternative Proposed Project.

(iv) A description of the likely direct and indirect impacts of proposed project construction or operation on sites or properties listed in or recommended as eligible for the National Register of Historic Places.

The likely direct and indirect impacts to cultural resources at Gross Reservoir are discussed in Chapter 4, Section 4.16 *Cultural Resources/Paleontology* of the Corps' DEIS.

(v) A management plan for the avoidance of or mitigation of impacts on historic or archaeological sites and resources based upon the recommendations of state and federal agencies and containing the applicant's explanation of variations from those recommendations.

The SHPO, ACHP, FERC, USFS, Native American tribes, and Denver Water reviewed and provided comments to the Corps on a Draft Programmatic Agreement to comply with Section 106 of the National Historic Preservation Act (NHPA). The Programmatic Agreement can be found in Appendix L *Draft Programmatic Agreement* of the DEIS.

Mitigation of potential adverse impacts to cultural resources will be determined by the SHPO and the Corps during Section 106 consultation. Treatment plans will be developed in accordance with the terms of the Programmatic Agreement. Possible treatment would be documentation of the historic resource per the Colorado SHPO's standards for site documentation, including historic resource documentation of Gross Dam and the Resumption Flume.

The Programmatic Agreement provides procedures to be followed should archaeological resources be discovered during construction.

(vi) The following materials and information regarding the mitigation measures described:

(A) A schedule for implementing the mitigation proposals

Historic resource documentation of Gross Dam and the Resumption Flume would occur prior to construction.

(B) An estimate of the cost of the measures

Based on similar levels of historic site documentation per Historic American Buildings Survey/Historic American Engineering Record (HABS/HAER) standards, the estimated cost of treatment for both Gross Dam and the Resumption Flume would be approximately $15,000 to $20,000.

(C) A statement of the sources and extent of financing

The sources and extent of funding for either the Proposed Project or Alternative Proposed Project are described in Exhibit D *Project Costs and Financing*.

(vii) The applicant must provide five copies of any survey, inventory, or subsurface testing reports containing specific site and property information and including maps and photographs showing the location and any required alteration of historic and archaeological resources in relation to proposed project facilities.

Copies of "Cultural Resources Survey of Gross Reservoir for the Moffat Collection System Project EIS, Boulder County, Colorado" (URS Corporation 2006) will be submitted to the FERC with the license amendment application. A description of affected cultural resources is provided in items 4(iii) and (iv), above.

(5) Report on socio-economic impacts. The applicant must provide a report which identifies and quantifies the impacts of constructing and operating the proposed project on employment, populations, housing, personal income, local governmental services, local tax revenues, and other factors within the towns and counties in the vicinity of the proposed project. The report must include:

(i) A description of the socio-economic impact area.

The socioeconomic impact area is described in Chapter 3, Section 3.17.1.1 [*Socioeconomics*] *Gross Reservoir* and Section 3.17.5.2 [*Socioeconomics*] *Boulder County* of the Corps' DEIS.

(ii) A description of employment, population, and personal income trends in the impact area.

Descriptions of the impacts to employment, population, and personal income trends in the socioeconomic impact area are provided in Chapter 4, Section 4.17.1.1 [*Socioeconomics*] *Economic Conditions* and Section 4.17.1.2 [*Socioeconomics*] *Demographic Conditions* of the Corps' DEIS.

(iii) An evaluation of the impact of any substantial in-migration of people on the impact area's governmental facilities and services, such as police, fire, health and educational facilities and programs.

An evaluation of the impact of any in-migration of people on governmental facilities and services within the socioeconomic impact area is provided in Chapter 4, Section 4.17.1.6 [*Socioeconomics*] *Public Facilities and Services* of the Corps' DEIS. Population changes are not expected as a result of the proposed project. In general, there would be no impacts on public facilities and services, including police departments, fire departments, health services, libraries, education, water providers, wastewater treatment, and solid waste disposal, although minor, temporary impacts on some services might occur during the construction phase.

(iv) On-site manpower requirements and payroll during and after project construction, including a projection of total on-site employment and construction payroll provided by month.

On-site manpower requirements and payroll during construction are discussed in Chapter 4, Section 4.17.1.1 [*Socioeconomics*] *Economic Conditions* of the Corps' DEIS. Construction manpower estimates are also addressed in Chapter 2, Section 2.8.6 [*Construction Activities for All Action Alternatives*] *Construction Manpower Estimate* and Table 2-19 *Construction Manpower Estimate* of the DEIS. Post-construction activities are described in Chapter 2, Section 2.8.7 [*Construction Activities for All Action Alternatives*] *Post-Construction Activities for All Action Alternatives* of the DEIS.

(v) Numbers of project construction personnel who: (A) reside within the area; (B) would commute daily to the construction site from places situated outside the impact area; and (C) would relocate on a temporary basis within the impact area.

The Gross Reservoir construction workforce would come mainly from the Denver Metro Area and Boulder County. Construction workers would generally travel to the construction site each day and would not relocate to the Primary Impact Area (PIA). Impacts from construction personnel commuting into the area on a temporary basis are discussed in Chapter 4, Section 4.17.1.1 [*Socioeconomics*] *Economic Conditions*, Section 4.17.1.2 [*Socioeconomics*] *Demographic Conditions*, and Section 4.17.1.5 [*Socioeconomics*] *Fiscal Conditions of Public Entities other than Denver Water* of the Corps' DEIS. A description of commuting worker vehicles is provided in Chapter 2, Section 2.8.5 [*Construction Activities for All Action Alternatives*] *Construction Traffic* and Table 2-18 *Estimated One Way Vehicle Trips* of the DEIS.

(vi) A determination of whether the existing supply of available housing within the impact area is sufficient to meet the needs of the additional population.

Existing housing availability is described in Chapter 3, Section 3.17.1.1 [*Socioeconomics*] *Gross Reservoir* of the Corps' DEIS, and impacts on housing are addressed in Chapter 4, Section 4.17.1.4 [*Socioeconomics*] *Housing Conditions*.

(vii) Numbers and types of residences and business establishments that would be displaced by the proposed project, procedures to be utilized to acquire these properties, and types and amounts of relocation assistance payments that would be paid to the affected property owners and businesses.

As discussed in Chapter 4, Section 4.17.1.2 [*Socioeconomics*] *Demographic Conditions* of the Corps' DEIS, no homes would be demolished, inundated, or relocated as a result of enlargement of Gross Reservoir. Therefore, no residents would be required to move out of the project area as a result of the proposed project. Additionally, no new residents would be expected to move into the project area, and no additional homes would be built in the project area as a result of construction activities or operation of the enlarged reservoir.

Likewise, it is not anticipated that any business establishments would be displaced as a result of the proposed project. Temporary, positive benefits to area businesses are discussed in Chapter 4, Sections 4.17.1.1 [*Socioeconomics*] *Economic Conditions* of the DEIS.

Denver Water would purchase or otherwise acquire the right to occupy private properties within the proposed FERC Project Boundary. Up to 15 acres of undeveloped private property may need to be acquired. The cost of land is estimated to be $10,000 to $20,000 per acre.

(viii) A fiscal impact analysis evaluating the incremental local government expenditures in relation to the incremental local government revenues that would result from the construction of the proposed project. Incremental expenditures may include, but are not limited to school operating costs, road maintenance and repair, public safety, and public utility costs.

The fiscal impact analysis evaluating incremental local governmental expenditures and local governmental revenues from project construction is provided in Chapter 4, Section 4.17.1.5 [*Socioeconomics*] *Fiscal Conditions of Public Entities other than Denver Water*, Section 4.17.1.6 [*Socioeconomics*] *Public Facilities and Services*, and Section 4.17.1.8 [*Socioeconomics*] *Summary of Socioeconomic Impacts of the Proposed Action* of the Corps' DEIS.

(6) Report on geological and soil resources. The applicant must provide a report on the geological and soil resources in the proposed project area and other lands that would be directly or indirectly affected by the proposed action and the impacts of the proposed project on those resources. The information required may be supplemented with maps showing the location and description of conditions. The report must contain:

(i) A detailed description of geological features, including bedrock lithology, stratigraphy, structural features, glacial features, unconsolidated deposits, and mineral resources.

Descriptions of the topography, lithology, geologic structures, geologic resources, and geologic hazards at Gross Reservoir are provided in Chapter 3, Section 3.3.1.1 [*Geology*] *Gross Reservoir* of the Corps' DEIS.

(ii) A detailed description of the soils, including the types, occurrence, physical and chemical characteristics, erodability, and potential for mass soil movement.

Descriptions of the soil types, physical characteristics, erodability, and potential for mass soil movement at Gross Reservoir are provided in Chapter 3, Section 3.4.1.1 [*Soils*] *Gross Reservoir* of the Corps' DEIS.

(iii) A description showing the location of existing and potential geological and soil hazards and problems, including earthquakes, faults, seepage, subsidence, solution cavities, active and abandoned mines, erosion, and mass soil movement, and an identification of any large landslides or potentially unstable soil masses which could be aggravated by reservoir fluctuation.

Geological and soil hazards and problems are described in Chapter 3, Section 3.3.1.1 [*Geology*] *Gross Reservoir* and Section 3.4.1.1 [*Soils*] *Gross Reservoir* of the Corps' DEIS.

(iv) A description of the anticipated erosion, mass soil movement, and other impacts on the geological and soil resources due to construction and operation of the proposed project.

The impacts of the proposed project on geology and soils are discussed in Chapter 4, Section 4.3.1.1 [*Geology*] *Gross Reservoir* and Section 4.4.1.1 [*Soils*] *Gross Reservoir* of the Corps' DEIS.

(v) A description of any proposed measures or facilities for the mitigation of impacts to soils.

Article 401: *Erosion Control* and Article 405: *Rehabilitation and Restoration Plan* of the current FERC license will continue to be implemented and will be revised to incorporate BMPs to control erosion related to tree thinning, dam construction, and other ground-disturbing activities.

Denver Water and its construction contractor will prepare and implement a stormwater management plan, including erosion and sediment control, for all construction activities per a Stormwater Discharge Permit for Construction Activities from the CDPHE.

(7) Report on recreational resources. The applicant must prepare a report containing a proposed recreation plan describing utilization, design and development of project recreational facilities, and public access to the project area. Development of the plan should include consideration of the needs of the physically handicapped. Public and private recreational facilities provided by others that would abut the project should be noted in the report. The report must contain:

(i) A description of any areas within or in the vicinity of the proposed project boundary that are included in or have been designated for study for inclusion in: (A) the National Wild and Scenic Rivers System; (B) the National Trails System; or (C) a wilderness area designated under the Wilderness Act.

No areas within or in the vicinity of the proposed FERC Project Boundary are included in or have been designated for study for inclusion in the National Wild and Scenic Rivers System or the National Trails System. Likewise, no area within or in the vicinity of the proposed FERC Project Boundary has been designated as a wilderness area, recommended for such designation, or designated as a wilderness study area.

(ii) A detailed description of existing recreational facilities within the project vicinity, the public recreational facilities which are to be provided by the applicant at its sole cost or in cooperation with others no later than 3 years from the date of first commercial operation of the proposed project, and those recreation facilities planned for future development based on anticipated demand. Copies of agreements with cooperating entities are to be appended to the plan.

Descriptions of existing recreation facilities in the project are provided in Chapter 3, Section 3.13.1.1 [*Recreation*] *Gross Reservoir* and Section 3.13.5.5 [*Recreation*] *South Boulder Creek* of the Corps' DEIS.

In 2002, Denver Water developed a Recreation Management Plan (RMP) for Gross Reservoir, which was approved by the FERC. The RMP followed the prescribed construction and maintenance of recreation facilities, pursuant to the conditions set in the current FERC license. Development of the RMP was a collaborative effort with stakeholder and agency input. Therefore, Denver Water is proposing to continue to adhere to the types of facilities and level of

management desired by the participants under that plan. The impacts to recreational opportunities at Gross Reservoir under the proposed project are discussed in Chapter 4, Section 4.13 *Recreation,* Section 4.13.1.1 [*Recreation*] *Gross Reservoir,* and Section 4.13.1.2 [*Recreation*] *River Segments* of the DEIS.

Denver Water has engaged consultant services to analyze the relocation of recreation facilities prescribed in the current FERC license. The consultants have developed a plan that demonstrates where facilities could be relocated to provide the same recreational opportunities that exist at Gross Reservoir under the current FERC license. The Recreation Relocation Plan is provided as Attachment E-2 *Gross Reservoir Recreation Relocation Plan*. Denver Water will revise the RMP in coordination with the USFS and other stakeholders to reflect relocation areas and construction schedules. Copies of agreements with cooperating entities for development of recreation facilities are included in Attachment E-3 *IGA and MOU for Management of Recreational Activities at Gross Reservoir May 2005*.

Denver Water intends to keep certain areas of Gross Reservoir open to limited recreation during construction. However, some areas would need to be closed temporarily during construction for public safety.

See also responses to items (7)(iv) and (7)(v), below.

(iii) A provision for a shoreline buffer zone that must be within the project boundary, above the normal maximum surface elevation of the project reservoir, and of sufficient width to allow public access to project lands and waters and to protect the scenic, public recreational, cultural, and other environmental values of the reservoir shoreline

Denver Water is proposing a shoreline buffer within the proposed FERC Project Boundary. The *Gross Reservoir Tree Removal Plan for Pool Enlargement February 2008 and Supplement* to *Gross Reservoir Tree Removal Plan for Pool Enlargement October 2008* (Attachment E-1) proposes removing trees along the perimeter of the reservoir to the 7,410-foot elevation. This would create a publically accessible buffer zone that would allow access to reservoir waters and adjacent lands within the proposed FERC Project Boundary. In certain areas, this buffer zone would be used in the development of shoreline trails to replicate those shoreline trails that currently exist but would be inundated. These trails would provide recreational access for fishing, wildlife observation, and hiking.

(iv) Estimates of existing and future recreational use at the project, in daytime and overnight visitation (recreation days), with a description of the methodology used in developing these data

Use of the day-use only recreation areas on the north, east, and south sides of Gross Reservoir are estimated at around 23,000 annual recreational visitor days (RVDs) based on 2006 (22,808 RVDs) and 2007 (23,465 RVDs) figures. Overnight camping at Gross Reservoir within the current FERC Project Boundary only takes place on Winiger Ridge on the west side of the

reservoir. Based on user surveys supported by use observations, there are approximately 3,000 overnight visitor days at Winiger Ridge annually.

Because it is Denver Water's intention to have no net gain in recreational use at Gross Reservoir, Denver Water anticipates that these use figures would remain stable under the proposed project.

(v) A development schedule and cost estimates of construction, operation, and maintenance of existing, initial, and future public recreational facilities, including a statement of the source and extent of financing for such facilities

Denver Water will be responsible for implementation, construction, management, and maintenance of existing, proposed, or relocated recreation facilities at Gross Reservoir. It is anticipated that relocation of recreation facilities would be completed during the final cleanup and restoration phases of construction. The proposed construction schedule is described in Chapter 4, Section 4.13.1.1 [*Recreation*] *Gross Reservoir* of the Corps' DEIS.

Depending on economic conditions and funding availability, all recreation facilities would be installed within 5 to 8 years of issuance of an amended FERC license. The estimated cost of construction of the proposed facilities, which is based on relocating existing facilities, is $2,160,000. This figure is based on the actual cost of constructing the existing facilities, with an added 10 percent per year increase over 6 years. If Denver Water determines that recreation facilities can be moved rather than reconstructed during the relocation process, the overall cost could be less. Because there would be no net increase in recreation facilities, there would be no increase in the cost of maintenance apart from normal cost-of-living increases. Denver Water will fund all recreation facility construction as part of the overall project.

(vi) A description of any measures or facilities recommended by the agencies consulted for the purpose of creating, preserving, or enhancing recreational opportunities at the proposed project and for the purpose of ensuring the safety of the public in its use of project lands and waters, including an explanation of why the applicant has rejected any measures or facilities recommended by an agency

As stated above, Denver Water does not intend to change the current recreational opportunities or management of Gross Reservoir under the proposed project. Similar or enhanced recreational opportunities for the handicapped public will be instituted at Gross Reservoir with the relocation of recreation facilities.

Comments received during the consultation process pertaining to recommended measures and facilities for recreational opportunities and Denver Water's responses to those comments are summarized below.

Trails: Boulder County would like to establish a trail corridor along the South Boulder Diversion Canal. This area is well outside the proposed FERC Project Boundary. Denver Water is willing to discuss this trail corridor with Boulder County outside the FERC license amendment

process. Denver Water is proposing to construct new trails within the proposed FERC Project Boundary to replace trails that would be inundated.

No Net Increase: Many entities expressed a preference that there be no net increase in dispersed or overall recreational opportunities at Gross Reservoir. Boulder County gave the following reasons: timely emergency response, law enforcement, patrolling of recreation/shoreline/closure areas, wildlife needs and habitat protection including possible seasonal or impact mitigation closures, and wildfire prevention. Other entities and stakeholders expressed a preference that there be no net increase in the types of recreation, recreation facility locations, parking, seasons and hours and that the same types of activities that are currently prohibited remain prohibited. Denver Water endorses the "no net increase" approach and supports the conclusions and recommendations that arose from the cooperative development of the current RMP.

Water Quality: The City of Louisville suggested that any recreation facilities should be designed and located to minimize their impacts upon water quality. Denver Water will follow all water quality regulations and BMPs for recreational development.

Picnic Areas: One stakeholder expressed concern about potential fire hazards from the grills in the picnic areas. Denver Water will take this suggestion under advisement. The current pedestal-mounted grills were selected as a safer alternative to ground-level grills because they have a lid that can be pivoted over coals or embers in windy or other conditions.

Patrol: It was suggested that Denver Water or Boulder County provide additional rangers and extend patrols of the recreation area at Gross Reservoir past 8:00 p.m.. Denver Water will take this suggestion under advisement. Denver Water has not noticed any major issues with the current ranger schedule. The rangers currently stay beyond normal working hours if there are immediate issues to address. The Boulder Sheriff's Department does provide patrols after hours and responds to public calls.

New Types of Recreation: A stakeholder expressed interest in Denver Water providing for ice skating at Gross Reservoir. Denver Water has considered this new recreational opportunity and has decided not to include ice skating at Gross Reservoir because of the unpredictability of ice conditions, safety concerns, and a possible need for additional facilities and patrol. Because of its locations in the eastern Colorado foothills, the ice at Gross Reservoir is very susceptible to warming, downslope westerly winds that can change ice conditions very quickly, and there are occasions when open water can occur even in winter months.

A stakeholder requested that Denver Water open its property at Gross Reservoir to hunting. Denver Water would be opposed to the introduction of hunting on Denver Water property at Gross Reservoir because the majority of this land is developed for public picnic uses and because, in some cases, it borders residential neighborhoods. Hunting is currently allowed within the FERC Project Boundary on USFS property on the west side of the reservoir. Denver Water would consider working with the Colorado Division of Wildlife (CDOW) to make Gross Reservoir a State Wildlife Area if the CDOW has funding and is interested in pursuing this designation. The CDOW has not raised this possibility with Denver Water at this time.

Regardless of any potential CDOW State Wildlife Area designation, Denver Water would remain opposed to hunting on Denver Water property because of the potential conflict with other public uses.

It was also suggested that non-motorized boating, such as kayaks, inner tubes, sailboats, and fishing float tubes be allowed at Gross Reservoir. Kayaks and multi-chambered fishing float tubes are currently allowed at Gross Reservoir, and Denver Water does not intend to change the current boat restrictions and regulations at Gross Reservoir.

In discussions with emergency services agencies during the development of the RMP, the following concerns were raised about hazardous conditions at Gross Reservoir that could impact boating. 1) Because the water that fills Gross Reservoir comes from high mountain snow runoff, the water temperature is dangerously cold. 2) One of the highest wind speeds in Colorado, over 120 mph, was recorded at a town near Gross Reservoir. The reservoir regularly receives extremely high sustained winds and higher wind gusts. 3) Because of the location of the mountains west of Gross Reservoir, severe thunderstorms, which typically come from the west, can approach the reservoir with almost no warning. These storms regularly produce very high wind gusts and downdraft winds, which have unpredictable and changing wind direction as they are influenced by the surrounding mountains. 4) Gross Reservoir has many fingers, and, at any location, portions of the reservoir would not be visible by patrol and emergency services.

Therefore, it was determined that sail boating at Gross Reservoir represented a high and prohibitive safety risk. Inner-tubes are not permitted because of the dangers noted above and the prohibitive risk associated with their deflation potential under adverse conditions. As noted above, multi-chambered fishing float tubes and multi-chambered inflatable kayaks are allowed at Gross Reservoir.

Signs: It was suggested that Denver Water provide fencing marked with private property signage below the residential area along the north shore of Gross Reservoir. Denver Water will take this suggestion under advisement.

Fees: It was suggested that Denver Water charge daily use fees. Daily use fees were examined as part of the development of the current RMP. It was determined that fee collection would not be practical because there are multiple access points and there would be a minimal net return from fees collected after accounting for collection costs. With an expansion of Gross Reservoir, Denver Water would take this suggestion under advisement, but it is unlikely that there would be a change from the original determination.

(vii) A drawing or drawings, one of which describes the entire project area, clearly showing: (A) the location of project lands and the types and number of existing recreation facilities and those proposed for initial development, including access roads and trails and facilities for camping, picnicking, swimming, boat docking and launching, fishing, and hunting, as well as provisions for sanitation and waste disposal; (B) the location of project lands and the type and number of recreation facilities planned for future development; (C) the location of all project

lands reserved for recreational uses other than those listed above, and (D) the project boundary of all areas designated for recreational development, sufficiently referenced to the appropriate Exhibit G drawings to show that all lands reserved for existing and future public recreational development and the shoreline buffer zone are included within the proposed project boundary.

Attachment E-2 *Gross Reservoir Recreation Relocation Plan* is a concept plan for relocating the recreation facilities. Maps showing the locations of existing recreation facilities and the proposed facility relocation sites are included in the Recreation Relocation Plan.

No plans have been developed for the Winiger Ridge area. Denver Water will generate plans for relocating facilities at Winiger Ridge in coordination with the USFS pursuant to a revised RMP. All recreation facilities contained in the current FERC license would be relocated per the distribution pattern developed by the USFS.

(8) Report on aesthetic resources. The applicant must provide a report that describes the aesthetic resources of the proposed project area, the expected impacts of the project on these resources, and the mitigation, enhancement, or protection measures proposed. The report must contain:

(i) A description of the aesthetic character of lands and waters directly and indirectly affected by the proposed project facilities.

The existing aesthetic character of lands and waters potentially affected by the proposed project is described in the following sections of Chapter 3 of the Corps' DEIS.

Section 3.10.1.1 – [*Transportation*] *Gross Reservoir*
Section 3.11.2 – [*Air Quality*] *Regional Haze/Visibility/Extinction*
Section 3.12.1.1 – [*Noise*] *Gross Reservoir*
Section 3.14.1.1 – [*Land Use*] *Gross Reservoir*
Section 3.15.1.1 – [*Visual Resources*] *Gross Reservoir*
Section 3.15.5 – [*Visual Resources*] *River Segments*

(ii) A description of the anticipated impacts on aesthetic resources from construction activity and related equipment and material and the subsequent presence of proposed project facilities in the landscape

Impacts to aesthetics related to the enlarged reservoir are discussed in the following sections of Chapter 4 of the Corps' DEIS.

Section 4.10 – [*Transportation*] and Section 4.10.1 [*Transportation*] *Gross Reservoir*
Section 4.11.1.1 – [*Air Quality*] *Gross Reservoir*
Section 4.12.1 – [*Noise*] *Proposed Action*
Section 4.14.1.1 – [*Land Use*] *Gross Reservoir*
Section 4.15.1.1 – [*Visual Resources*] *Gross Reservoir*

Section 4.15.1.2 – [*Visual Resources*] *River Segments*

(iii) A description of the mitigative measures proposed by the applicant, including architectural design, landscaping, and other reasonable treatment to be given project works to preserve and enhance aesthetic and related resources during construction and operation of project facilities.

In addition to the design criteria identified in Chapter 2, Section 2.3.2.1 [*Project Components*] *Gross Reservoir* of the Corps' DEIS, recommended mitigation measures to minimize effects to visual resources are discussed in Chapter 4, Section 4.15.7 [*Visual Resources*] *Mitigation and Monitoring*.

During Initial Consultation, Boulder County, the USFS, and residents around Gross Reservoir requested that Denver Water explore options for reducing construction-related traffic. Denver Water conducted a traffic study, which is included as Attachment E-4 *Borrow Haul Study January 2009* of this license amendment application. Denver Water is still exploring the most practical options for reducing construction-related traffic.

(iv) Maps, drawings and photographs sufficient to provide an understanding of the information required under this section. Maps or drawings may be consolidated with other maps or drawings required in this exhibit.

Maps showing the location and nature of measures proposed to ensure public use and aesthetic values are included in the Recreation Relocation Plan in Attachment E-2 *Gross Reservoir Recreation Relocation Plan*.

Report on land use. The applicant must provide a report that describes the existing uses of the proposed project lands and adjacent property and those land used that would occur if the project is constructed. The report must include:

(i) A description of existing land use in the proposed project area, including identification of wetlands, floodlands, prime or unique farmland as designated by the Natural Resources Conservation Service of the U.S. Department of Agriculture, and lands owned or subject to control by government agencies.

Existing and planned land uses in the project area are described in Chapter 3, Section 3.14.1.1 [*Land Use*] *Gross Reservoir* of the Corps' DEIS. Land use is also discussed in the context of various resources in many other sections of Chapter 3 of the DEIS.

Land ownership surrounding Gross Reservoir is described in Exhibit G *Project Boundary* of this license amendment application. The lands abutting the impoundment within the current FERC Project Boundary are owned by Denver Water and the USFS. Boulder County representatives encouraged Denver Water to contact the owners of lands adjoining the roads leading to the site, as well as contacting those landowners whose properties abut the FERC Project Boundary. Any

of these landowners not on Denver Water's stakeholder list were added to the list prior to releasing this license amendment application for public comment.

Wetlands near Gross Reservoir and South Boulder Creek are identified in Chapter 3, Section 3.6.1.1 [*Riparian and Wetland Areas*] *Gross Reservoir* and Section 3.6.5.5 [*Riparian and Wetland Areas*] *South Boulder Creek* of the Corps' DEIS, respectively. Floodplains along South Boulder Creek are identified in Chapter 3, Section 3.1.5.5 [*Surface Water*] *South Boulder Creek* of the DEIS.

The proposed project would not impact any prime or unique farmland. See Table F-1 in Appendix F *Soils within the Project Area* of the Corps' DEIS.

(ii) A description of the proposed land uses within and abutting the project boundary that would occur as a result of development and operation of the project.

Potential impacts to land use near Gross Reservoir are discussed in Chapter 4, Section 4.14.1.1 [*Land Use*] *Gross Reservoir* of the Corps' DEIS. Approximately 15 acres of undeveloped private property would need to be acquired along the southern FERC Project Boundary, and approximately 1.1 additional acres of USFS land (woodland) would need to be included within the proposed FERC Project Boundary. Most of these lands would be inundated under either the Proposed Project or the Alternative Proposed Project.

(iii) Aerial photographs, maps, drawings, or other graphics sufficient to show the location, extent, and nature of the land uses referred to in this section.

Current land ownership around Gross Reservoir is shown on the map provided in Exhibit G *Project Boundary* of this license amendment application.

(9) Alternative locations, designs, and energy sources. The applicant must provide an environmental assessment of the following:

(i) Alternative sites considered in arriving at the selection of the proposed project site.

Alternative sites considered in arriving at the Proposed Project are described in Chapter 2, Section 2.3.2.1 [*Proposed Action – Gross Reservoir Expansion (72,000 (AF)*] *Project Components Gross Reservoir* of the Corps' DEIS. Additionally, for purposes of the water supply project to be permitted by the Corps, Denver Water explored the four other alternatives described in Chapter 2, Section 2.4 *Alternative 1c – Gross Reservoir Expansion (40,700 AF) / New Leyden Gulch Reservoir (31,300 AF),* Section 2.5 *Alternative 8a – Gross Reservoir Expansion (52,000 AF) / Reusable Return Flows / Gravel Pit Storage (5,000 AF),* Section 2.6 *Alternative 10a – Gross Reservoir Expansion (52,000 AF) / Reusable Return Flows / Denver Basin Aquifer Storage (20,000 AF),* and Section 2.7 *Alternative 13a –Gross Reservoir Expansion (60,000 AF) / Transfer of Agricultural Water Rights / Gravel Pit Storage (3,625 AF)* of the DEIS. Each of these alternatives considered a different size for an enlarged Gross Reservoir.

(ii) Alternative facility designs, processes, and operations that were considered and the reasons for their rejection.

Denver Water considered options for modifying the existing hydropower project and determined that significant changes to the hydropower equipment are not cost-effective at this time. Denver Water analyzed increasing generating capacity above the existing nameplate rating, which would entail major modifications and/or complete replacement of the powerhouse equipment, and determined that an increase in capacity is not economically feasible at this time.

Changes in hydropower equipment analyzed for this license amendment application focused on modifications to existing equipment to optimize power generation. Denver Water evaluated increasing hydropower production by modifying the valve vault on the penstock to include a pressure reducing valve (PRV). The analysis determined that a PRV is economically feasible because it would increase energy production by allowing the existing hydropower equipment to operate at all reservoir surface water elevations. Without the PRV, energy production would decline dramatically from the existing project because the turbines could only operate at heads less than 380 feet, which would occur less frequently with the increased reservoir depths under either the Proposed Project or the Alternative Proposed Project.

(iii) Alternative electrical energy sources, such as gas, oil, coal, and nuclear-fueled power plants, purchased power or diversity exchange, and other conventional and pumped-storage hydroelectric plants.

Alternative energy sources are not explored because Gross Reservoir currently generates hydroelectric energy.

(iv) The overall consequences if the license application is denied.

The overall consequences of denial of the Corps' Section 404 Permit is described by the No Action Alternative in the Corps' DEIS; the No Action Alternative is described and its impacts analyzed in Chapter 2 and Chapter 4 of the DEIS, respectively. Since enlargement of the reservoir requires both Corps and FERC approval, denial of this FERC license amendment application would have the same consequences described for the No Action Alternative in the DEIS. Without approval from both federal agencies, Denver Water would continue to operate Gross Reservoir under its existing FERC license.

(10) List of literature. Exhibit E must include a list of all publications, reports, and other literature which were cited or otherwise utilized in the preparation of any part of the environmental report.

Chapter 7 *References* of the Corps' DEIS includes a list of all publications, reports, and other literature used in the preparation of the environmental report.

CONSULTATION

Attachment E-5 *Summary of Consultation* contains a summary of the FERC consultation process for this license amendment application.

Draft FERC Hydropower License Amendment Application Gross Reservoir Hydroelectric Project FERC Project No. 2035

EXHIBIT F

GENERAL DESIGN DRAWINGS OF PRINCIPAL PROJECT WORKS

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EXHIBIT F

GENERAL DESIGN DRAWINGS OF PRINCIPAL PROJECT WORKS

Exhibit F provides general design drawings of the principal project works described in Exhibit A of this license amendment application, as well as supporting information used as the basis of design. The Exhibit F drawings conform to the specifications of 18 CFR §4.39. This Exhibit F is preliminary in nature.

(1) The drawings must show all major project structures in sufficient detail to provide a full understanding of the project, including: (i) plans (overhead view), (ii) elevations (front view), (iii) profiles (side view), and (iv) sections.

General preliminary design drawings for the Proposed Project and the Alternative Proposed Project are included in Exhibit F, Sheets 1 through 6, as follows:

SHEET 1 – Location Map and Sheet Index

SHEET 2 – Dam Section, Site Plan, and Performance Envelope

SHEET 3 – Hydraulic Piping Plan and Profile

SHEET 4 – Hydraulic Piping Plan and Profile

SHEET 5 – Powerhouse Mechanical Equipment Plan

SHEET 6 – Powerhouse Mechanical Equipment Section.

No existing structures beyond the scope of the current license would be affected by the Proposed Project or the Alternative Proposed Project.

(2) The applicant may submit preliminary design drawings with the application. The final Exhibit F may be submitted during or after the license process and must show the precise plans and specifications for proposed structures. If the project is licensed on the basis of preliminary design, the applicant must submit a final Exhibit F for Commission approval prior to commencement of any construction of the project.

This Exhibit F contains preliminary design drawings. The final Exhibit F, showing precise plans and specifications for proposed structures, will be submitted during or after the licensing process for Commission approval prior to commencement of any project construction.

(3) Supporting design report. The applicant must furnish, at a minimum, the following supporting information to demonstrate that existing and proposed structures are safe and adequate to fulfill their stated functions and must submit such information in a separate report at the time the application is filed. The report must include:

(i) An assessment of the suitability of the site and the reservoir rim stability based on geological and subsurface investigations, including investigation of soils and rock boring and tests for the evaluation of all foundations and construction materials sufficient to determine the location and type of dam structure suitable for the site

(ii) Copies of boring logs, geology reports, and laboratory test reports

(iii) An identification of all borrow area and quarry sites and an estimate of required quantities of suitable construction material

(iv) Stability and stress analysis for all major structures and critical abutment slopes under all probable loading conditions, including seismic and hydrostatic forces induced by water loads up to the Probable Maximum Flood, as appropriate

(v) The bases for determination of seismic loading and the Spillway Design Flood in sufficient detail to permit independent staff evaluation.

A separate preliminary supporting design report providing the supporting information listed above will be submitted to the FERC with the final license amendment application. All final project design drawings and the final supporting design report will be submitted with the final design.

(4) The applicant must submit two copies of the supporting design report described in [item (3), above] at the time preliminary and final design drawings are submitted to the Commission for review. If the report contains preliminary drawings, it must be designated a "Preliminary Supporting Design Report."

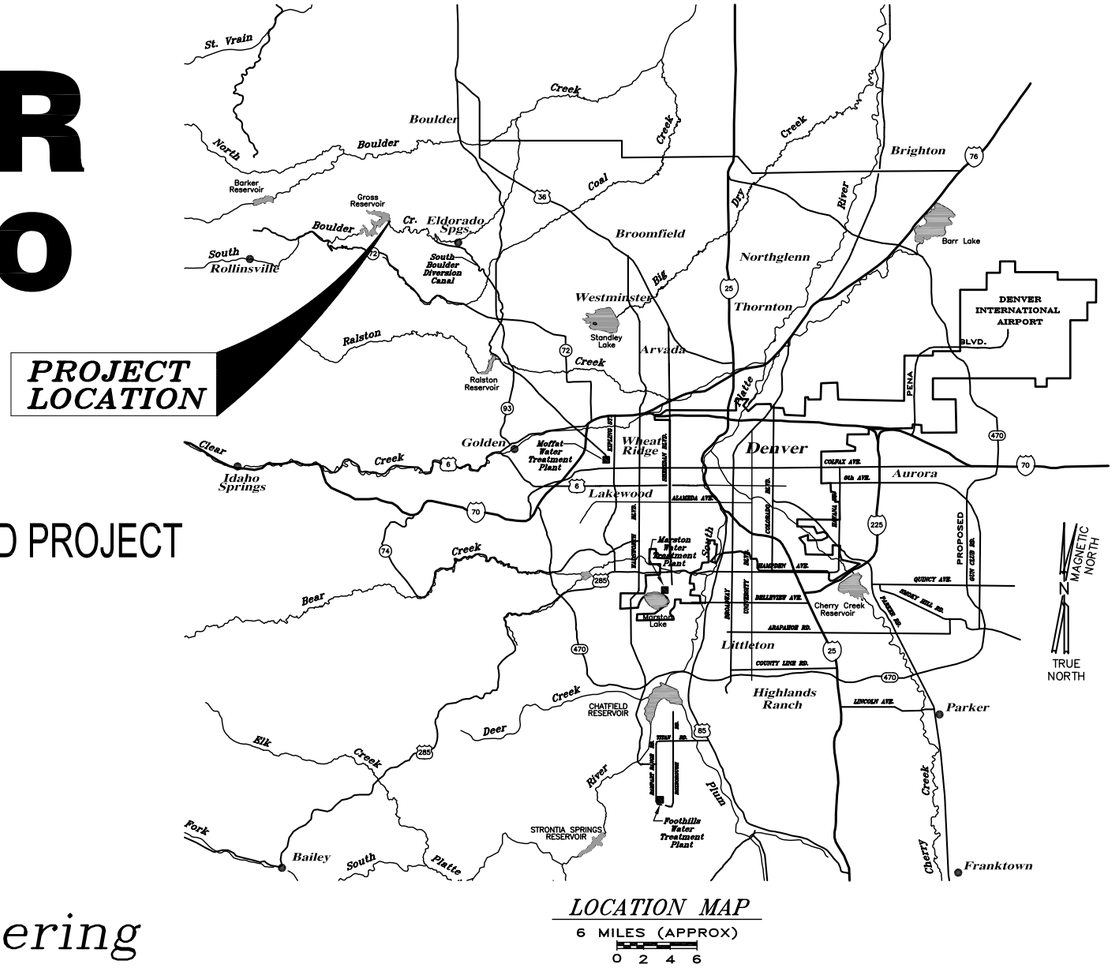
Two copies of the preliminary supporting design report labeled "Preliminary Supporting Design Report" will be submitted to the FERC with the final license amendment application. Two copies of the final supporting design report will be submitted with final design.

EXHIBIT F

DENVER WATER
DENVER, COLORADO

GROSS RESERVOIR
HYDROELECTRIC PROJECT
FERC NO 2035

PRELIMINARY DESIGN DRAWINGS - PROPOSED & ALTERNATIVE PROPOSED PROJECT

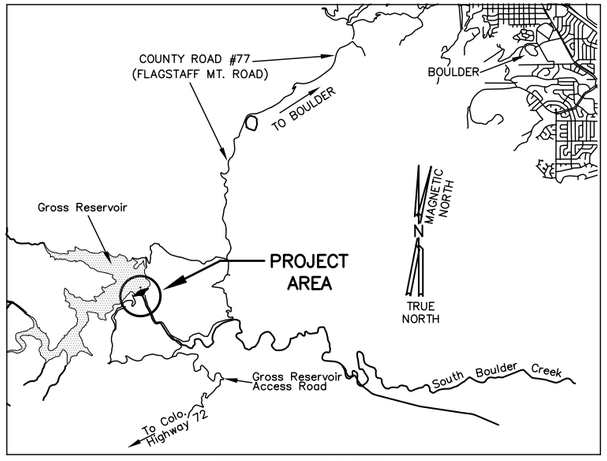


LOCATION MAP

6 MILES (APPROX)

0 2 4 6

BOARD OF WATER COMMISSIONERS
DENVER, COLORADO
Penfield W. Tate, III – President
H. J. Barry – Manager
Robert J. Mahoney – Director of Engineering



VICINITY MAP

2000 0 2000 4000

SCALE IN FEET

SHEET INDEX:

DENVER WATER
1600 West 12th Avenue·Denver, Colorado 80204
Phone(303)628-6000·Telecopier No.(303)628-8851

GROSS RESERVOIR
HYDROELECTRIC PROJECT – FERC NO 2035 – EXHIBIT F
PRELIMINARY DESIGN DRAWINGS – PROPOSED & ALTERNATIVE PROPOSED PROJECT
LOCATION MAP AND SHEET INDEX

Scale: AS SHOWN | Date: NOV 2008
Drawn: BALLIET | Checked: HEMPELMAN
Approved: | Dr. No.

0 1000 2000 (IN FEET) 1 inch = 2 ft.

0 3 6 (IN MILES) 1 inch = 6 mi.

SHEET 1

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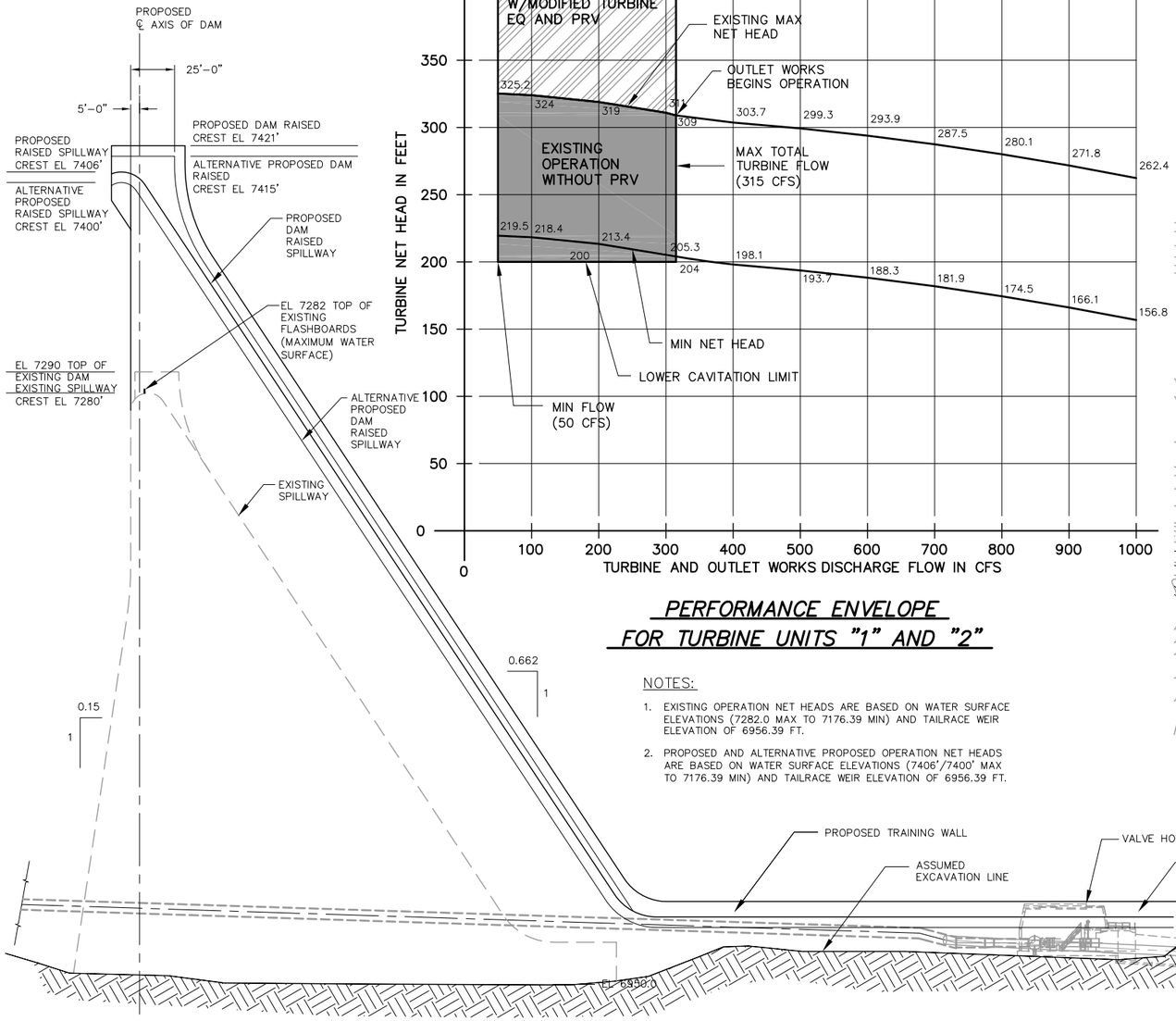
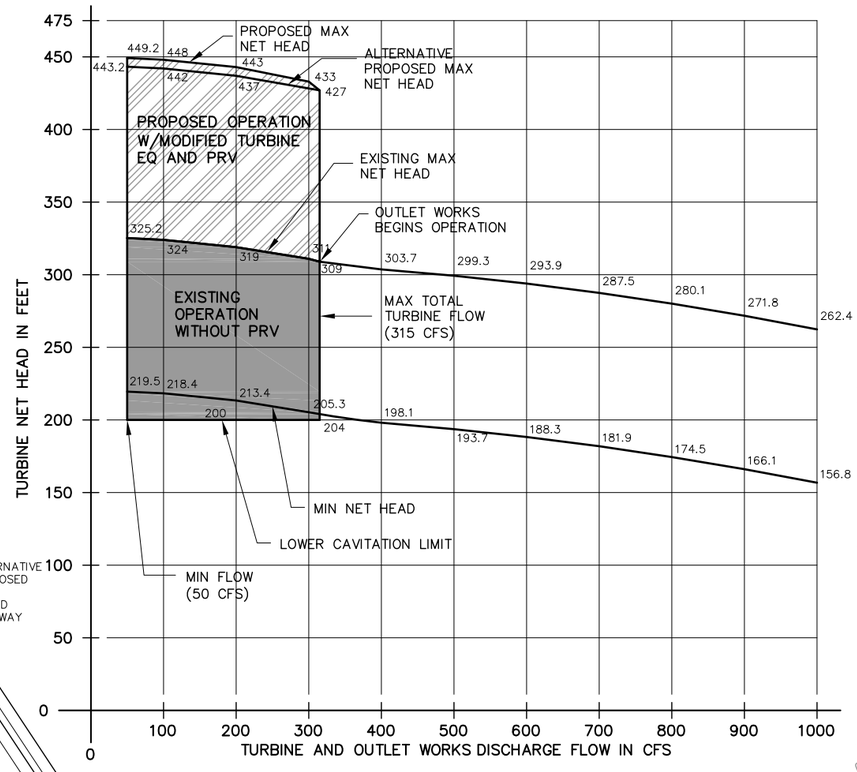


GROSS DAM – TYPICAL SECTION OF EXISTING, PROPOSED AND ALTERNATIVE PROPOSED DAM

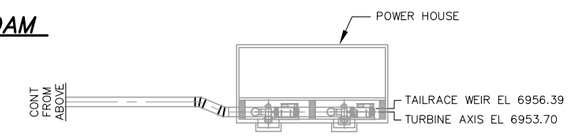
SCALE: 1"=40'

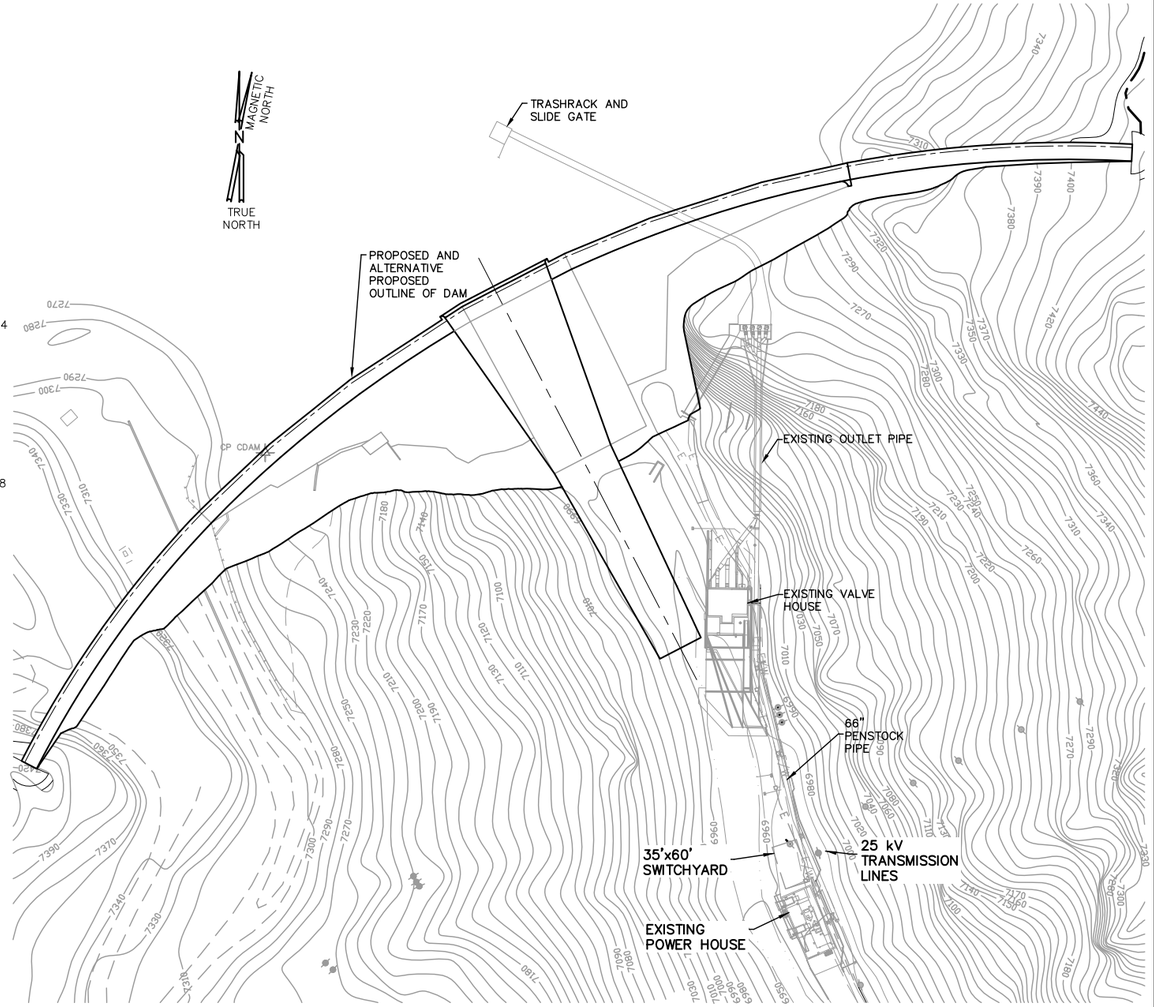


PERFORMANCE ENVELOPE FOR TURBINE UNITS "1" AND "2"

NOTES:

1. EXISTING OPERATION NET HEADS ARE BASED ON WATER SURFACE ELEVATIONS (7282.0 MAX TO 7176.39 MIN) AND TAILRACE WEIR ELEVATION OF 6956.39 FT.
2. PROPOSED AND ALTERNATIVE PROPOSED OPERATION NET HEADS ARE BASED ON WATER SURFACE ELEVATIONS (7406'/7400' MAX TO 7176.39 MIN) AND TAILRACE WEIR ELEVATION OF 6956.39 FT.





GROSS DAM – SITE PLAN

SCALE: 1"=100'
CONTOUR INTERVAL = 5'

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GROSS RESERVOIR

HYDROELECTRIC PROJECT – FERC NO 2035 – EXHIBIT F
PRELIMINARY DESIGN DRAWINGS – PROPOSED & ALTERNATIVE PROPOSED PROJECT
DAM SECTION, SITE PLAN & PERFORMANCE ENVELOPE

Scale: AS SHOWN	Date: NOV 2008
Drawn: BALLIET	Checked: HEMPELMAN/
Approved:	Dr. No.

0 20 40
(IN FEET)
1 inch = 40 ft.

0 50 100
(IN FEET)
1 inch = 100 ft.

SHEET
2

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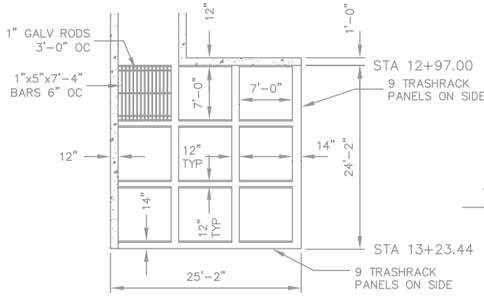
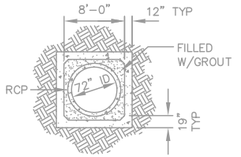


STA 12+97.00 TO STA 13+23.44
(1 OF 27 PANELS SHOWN IN PLACE)

TRASHRACK PLAN

SCALE: 1"=10'



STA 12+51.42 TO STA 12+97.00

TYPICAL BOX FLUME SECTION

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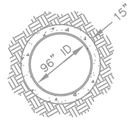

STA 8+73.08 TO STA 12+49.42

TYPICAL TUNNEL SECTION

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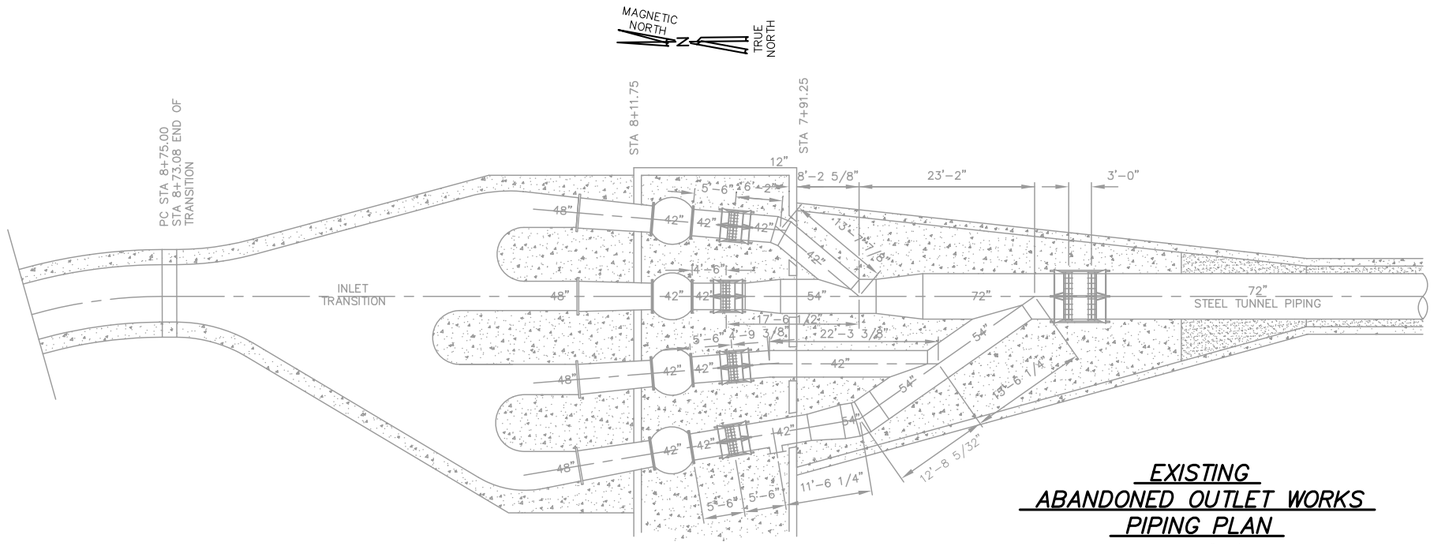
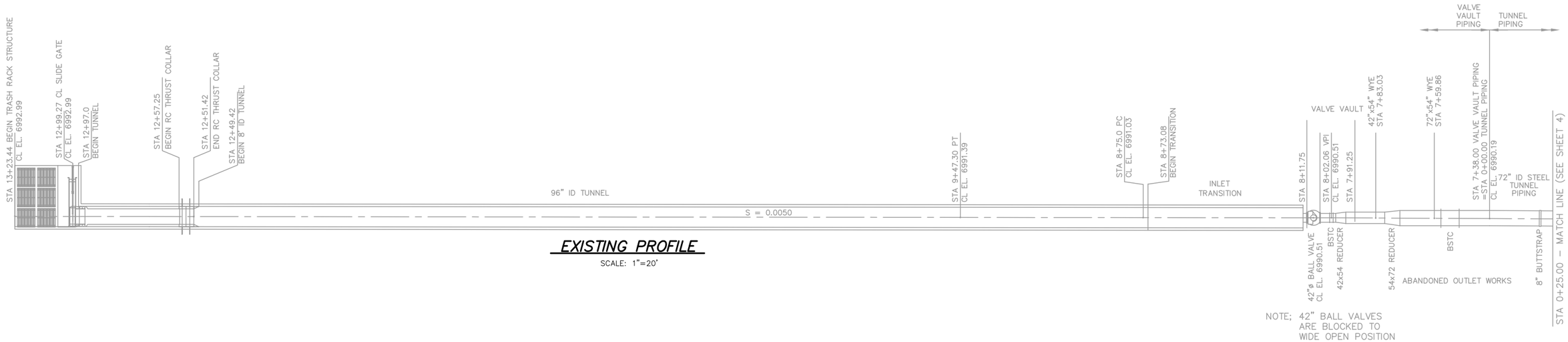


EXISTING ABANDONED OUTLET WORKS PIPING PLAN

SCALE: 1"=10'



EXISTING PROFILE

SCALE: 1"=20'

NOTE; 42" BALL VALVES
ARE BLOCKED TO
WIDE OPEN POSITION

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1600 West 12th Avenue·Denver, Colorado 80204
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GROSS RESERVOIR

HYDROELECTRIC PROJECT – FERC NO 2035 – EXHIBIT F
PRELIMINARY DESIGN DRAWINGS – PROPOSED & ALTERNATIVE PROPOSED PROJECT
HYDRAULIC PIPING PLAN AND PROFILE

Scale: AS SHOWN	Date: NOV 2008
Drawn: BALLIET	Checked: HEMPELMAN/
Approved:	Dr. No.

0 5 10
(IN FEET)
1 inch = 10 ft.

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(IN FEET)
1 inch = 20 ft.

SHEET
3

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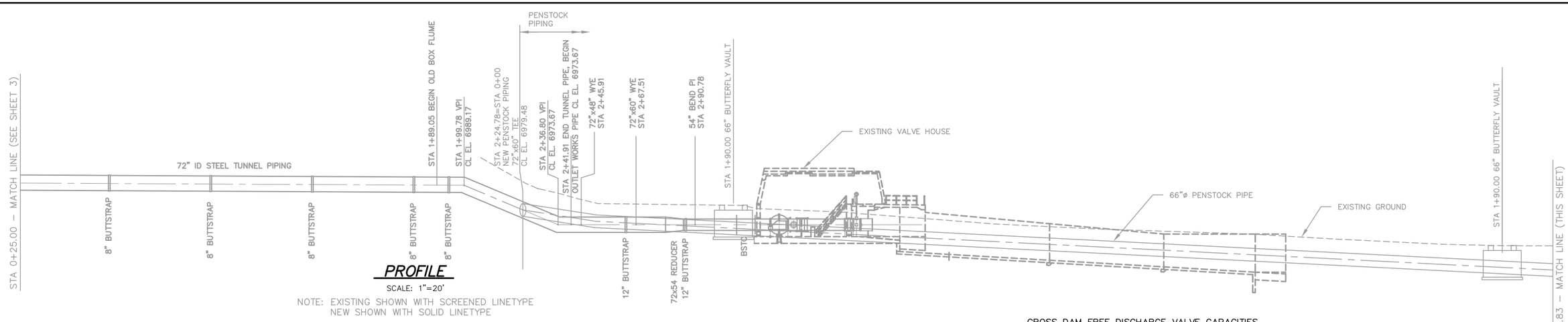
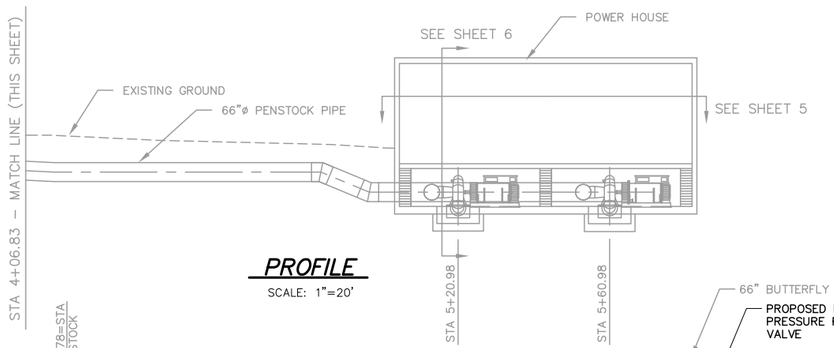


PROFILE

SCALE: 1"=20'

NOTE: EXISTING SHOWN WITH SCREENED LINETYPE
NEW SHOWN WITH SOLID LINETYPE



PROFILE

SCALE: 1"=20'

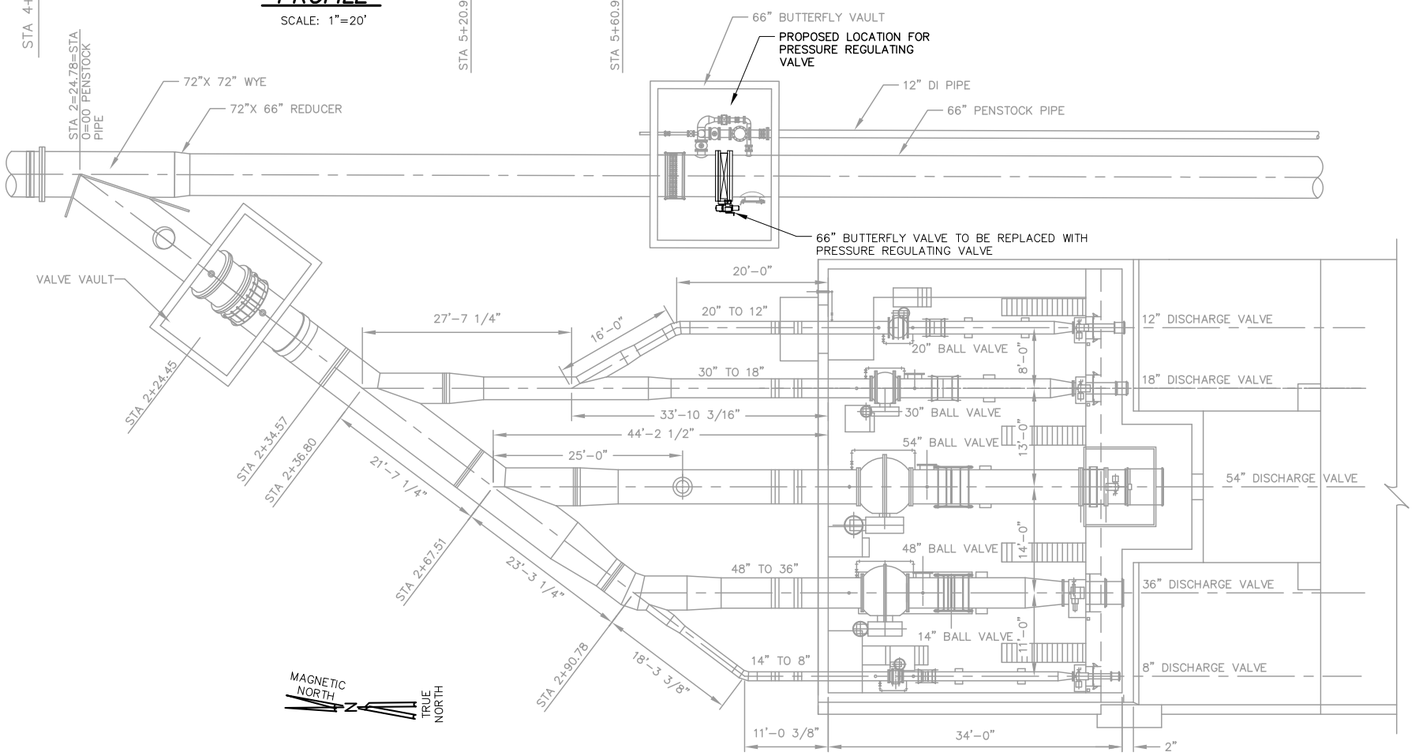
GROSS DAM FREE DISCHARGE VALVE CAPACITIES

DISCHARGE IN CFS

		RESERVOIR ELEVATION																
VALVE SIZE (IN)	OPERATION	7100	7120	7140	7160	7180	7200	7220	7240	7260	7280	7300	7320	7340	7360	7380	7400	7420
8	ALONE	24	25	27	29	30	31	33	34	36	37	38	39	40	41	42	43*	43*
12	ALONE	54	59	63	66	70	73	76	79	82	85	88	88*	88*	88*	88*	88*	88*
18	ALONE	120	129	138	146	153	161	168	174	180	187	193	199*	199*	199*	199*	199*	199*
36	ALONE	445	479	503*	503*	503*	503*	503*	503*	503*	503*	503*	503*	503*	503*	503*	503*	503*
54	ALONE	636*	636*	636*	636*	636*	636*	636*	636*	636*	636*	636*	636*	636*	636*	636*	636*	636*
8,12,18,36,54	ALL TOGETHER	1139*	1188*	1234*	1277*	1318*	1357*	1368*	1381*	1392*	1403*	1414*	1424*	1434*	1444*	1453*	1461*	1467*

NOTES:

1. TABLE IS FOR EXISTING OUTLET WORKS RUNNING INDEPENDENTLY OF FLOW THROUGH PROPOSED NEW POWER HOUSE
2. *VELOCITY THROUGH GUARD BALL VALVES IS LIMITED TO 40 FPS
3. DISCHARGE CAPACITY FOR RESERVOIR ELEVATIONS GREATER THAN 7400' IS CONSTANT.
4. SINCE TESTING IS IMPRACTICAL, ALL VALUES SHOWN ARE CALCULATED



EXISTING VALVE HOUSE OUTLET WORKS PIPING PLAN

SCALE: 1"=10'

DENVER WATER
1600 West 12th Avenue·Denver, Colorado 80204
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GROSS RESERVOIR

HYDROELECTRIC PROJECT – FERC NO 2035 – EXHIBIT F
PRELIMINARY DESIGN DRAWINGS – PROPOSED & ALTERNATIVE PROPOSED PROJECT

HYDRAULIC PIPING PLAN AND PROFILE

Scale: AS SHOWN | Date: NOV 2008
Drawn: BALLIET | Checked: HEMPELMAN
Approved: | Dr. | No.

0 5 10 (IN FEET) 1 inch = 10 ft.
0 10 20 (IN FEET) 1 inch = 20 ft.

SHEET 4

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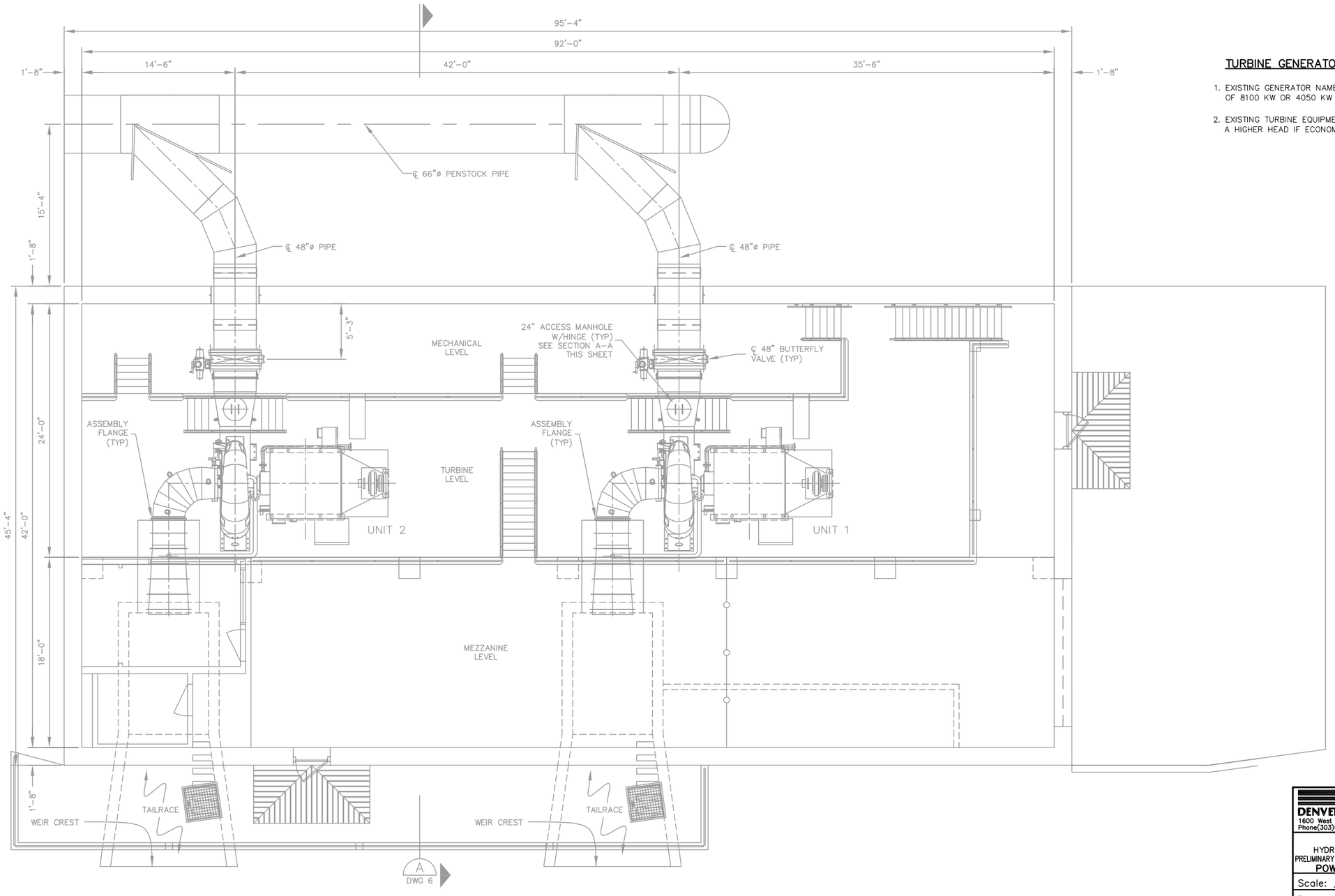

EXISTING POWERHOUSE MECHANICAL EQUIPMENT PLAN

SCALE: 1"=5'-0"

TURBINE GENERATOR EQUIPMENT MODIFICATION NOTES:

1. EXISTING GENERATOR NAMEPLATE CAPACITY WILL REMAIN THE SAME AT A TOTAL OF 8100 KW OR 4050 KW EACH.
2. EXISTING TURBINE EQUIPMENT WILL BE ANALYZED AND MODIFIED TO OPERATE AT A HIGHER HEAD IF ECONOMICAL.

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GROSS RESERVOIR
HYDROELECTRIC PROJECT – FERC NO 2035 EXHIBIT F
PRELIMINARY DESIGN DRAWINGS – PROPOSED & ALTERNATIVE PROPOSED PROJECT
POWERHOUSE MECHANICAL EQUIPMENT PLAN

Scale: _AS SHOWN_ _	Date: _NOV 2008_ _ _
Drawn: _BALLIET_	Checked: _HEMPELMAN/_
Approved: _ _ _ _ _ _ _	Dr._ _ _ _No._ _ _

0 2.5 5
(IN FEET)
1 inch = 5 ft.

SHEET 5

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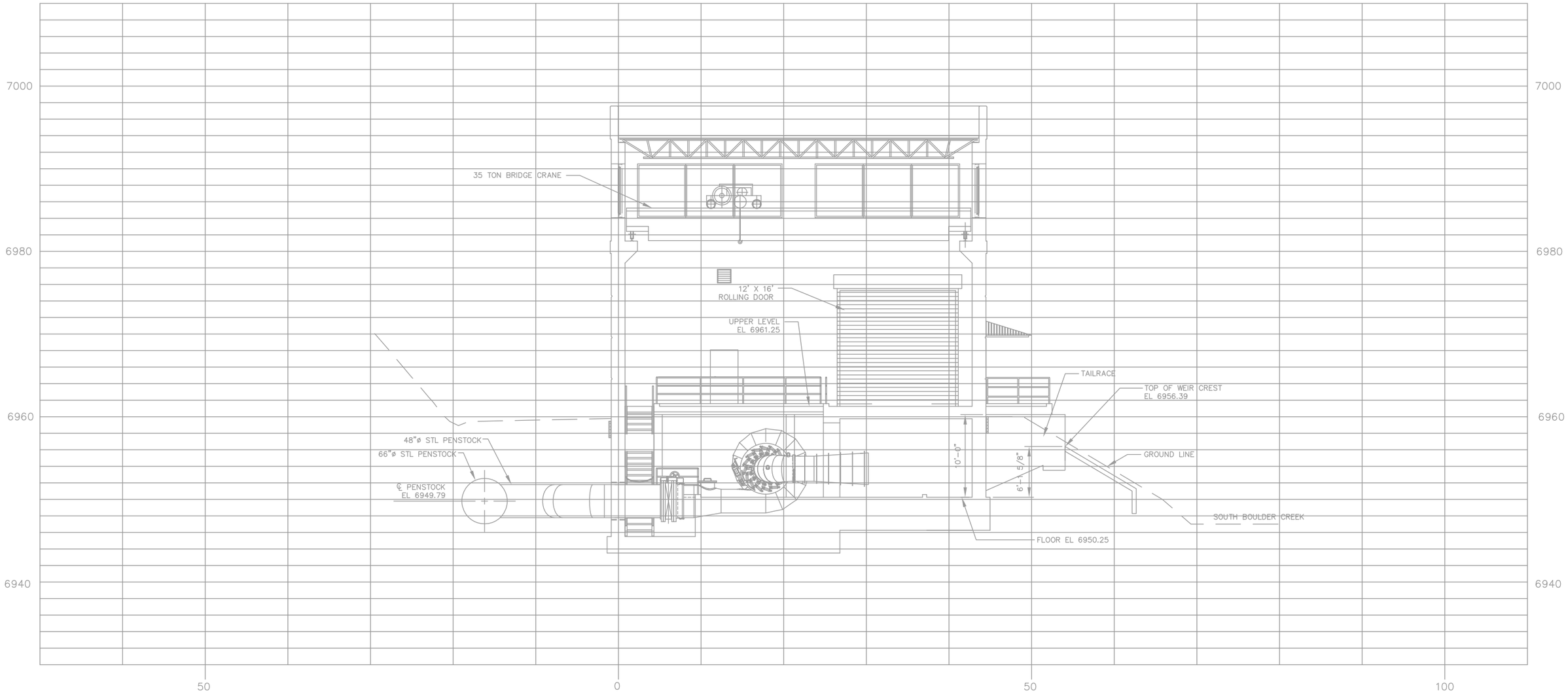

SECTION OF EXISTING POWERHOUSE (A)

SCALE: 1"=6'-0" DWG 5

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GROSS RESERVOIR
HYDROELECTRIC PROJECT – FERC NO 2035 – EXHIBIT F
PRELIMINARY DESIGN DRAWINGS – PROPOSED & ALTERNATIVE PROPOSED PROJECT
POWERHOUSE MECHANICAL EQUIPMENT SECTION

Scale: AS SHOWN	Date: NOV 2008
Drawn: BALLIET	Checked: HEMPELMAN/
Approved:	Dr. No.

0 2.5 5
(IN FEET)
1 inch = 5 ft.

SHEET
6

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Draft FERC Hydropower License Amendment Application Gross Reservoir Hydroelectric Project FERC Project No. 2035

EXHIBIT G

PROJECT BOUNDARY

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EXHIBIT G

PROJECT BOUNDARY

Exhibit G provides a map of the project that conforms to the specifications of 18 CFR §4.39 and to other requirements for paper maps at 18 CFR §4.41(h). The project boundary data will also be provided in a geo-referenced electronic format, as specified under 18 CFR §4.41(h). If there is any change in the project boundary at any time after the application is filed, a final Exhibit G showing the extent of such changes will be submitted within 90 days following completion of project construction.

The Exhibit G provides the:

(1) Location of the project and principal features

The Exhibit G map shows the location of the project as a whole with reference to the affected stream (South Boulder Creek), a nearby town (Boulder, Colorado), and other permanent features such as local roads. The map also shows the locations and physical interrelationships of the principal project works and other features described in Exhibit A of this FERC license amendment application. The use of a large scale for Exhibit G is utilized to portray important project and site features.

(2) Project boundary

The Exhibit G map shows a proposed FERC Project Boundary enclosing all project works and other features described under Exhibit A that are to be licensed. The applicant is submitting a preliminary FERC Project Boundary because accurate survey information is not yet available. The proposed FERC Project Boundary encloses only those lands necessary for operation and maintenance of the project and for other project purposes, such as recreation, shoreline control, or protection of environmental resources. Existing residential, commercial, or other structures are included within the proposed FERC Project Boundary only to the extent that underlying lands are needed for project purposes such as flowage, public recreation, shoreline control, or protection of environmental resources.

The proposed FERC Project Boundary around the project impoundment, continuous project features, and noncontiguous project work is described on the Exhibit G map according to the methods required under 18 CFR §4.41(h)(2).

(3) Federal lands

The Exhibit G map identifies public lands of the United States, including lands administered by the U.S. Forest Service, that are within the proposed FERC Project Boundary and shows the boundaries of those federal lands. Public lands are identified on the Exhibit G map according to the requirements of 18 CFR §4.41(h)(3). The proposed FERC Project Boundary would

encompass approximately 1.1 acres of additional federal lands not included in the current FERC Project Boundary.

(4) Non-federal lands

The proposed FERC Project Boundary would encompass additional non-federal lands not included in the current FERC Project Boundary. Approximately 15 acres of undeveloped private property would need to be acquired along the southern FERC Project Boundary. Denver Water plans to purchase or otherwise acquire the rights to occupy these non-federal lands. The Exhibit G map identifies non-federal lands 1) owned in fee by the applicant and lands that the applicant plans to acquire in fee and 2) lands over which the applicant has acquired or plans to acquire rights to occupancy and use other than fee title, including rights acquired or to be acquired by easements or lease.

EXHIBIT G

6th PRINCIPAL MERIDIAN, COLORADO

T 1S R 72W

T 1S R 71W

SECTION 18

SECTION 19

SECTION 24

SECTION 25

SECTION 30

PROJECT BOUNDARY

Gross Reservoir

PROPOSED PROJECT SPILLWAY ELEVATION 7406 FEET MSL
ALTERNATIVE PROPOSED PROJECT SPILLWAY ELEVATION 7400 FEET MSL

DAM

SOUTHWEST CORNER
SECTION 19 NAD 83
LAT 39°56' 31.76372" N
LONG 105°23' 22.21236" W

NORTHEAST CORNER
TRACT 47 NAD 83
LAT 39°57' 25.27009" N
LONG 105°21' 04.63487" W

SOUTHEAST CORNER
TRACT 64 NAD 83
LAT 39°56' 04.16625" N
LONG 105°21' 41.32274" W

CONNECTION TO ELECTRIC UTILITY (XCEL ENERGY)

COUNTY ROAD NO. 77 (FLAGSTAFF MTN. ROAD) TO BOULDER

TRANSMISSION LINES

EXISTING VALVE HOUSE

EXISTING POWER HOUSE

DENVER WATER RIGHT-OF-WAY

ELLIS CODE SURVEY NO. 19788

RESUMPTION PLACER (DW)

SURVEY NO. 480 Am (DW)

WINIGER RIDGE

ACCESS ROAD

GROSS RESERVOIR

AVENT GULCH

NINETEEN GULCH

SOUTH BOULDER CREEK

BOULDER

TRACT 44 (DW)
TRACT 45 (DW)
TRACT 46 (COUNTY OF BOULDER)
TRACT 47 (DW)
TRACT 48 (DW)
TRACT 49 (DW)
TRACT 50 (CITY OF BOULDER)
TRACT 51 (CITY OF BOULDER)
TRACT 52 (PR)
TRACT 53 (BLM)
TRACT 54 (DW)
TRACT 55 (PR)
TRACT 56 (BLM)
TRACT 57 (BLM)
TRACT 58 (DW)
TRACT 59 (PR)
TRACT 60 (DW)
TRACT 61 (DW)
TRACT 62 (FS)
TRACT 63 (FS)
TRACT 64 (FS)
TRACT 65 (DW)
TRACT 83A (BLM)
TRACT 83B (BLM)
TRACT 83C (BLM)
TRACT 103 (DW)
TRACT 104 (DW)
TRACT 107 (DW)
TRACT 107 (PR)
TRACT 108 (DW)
TRACT 108 (PR)
TRACT 109 (DW)

LEGEND

- PROJECT BOUNDARY
- DENVER WATER PROPERTY BOUNDARY
- DENVER WATER PROPERTY
- DENVER WATER RIGHT OF WAY
- U.S. FOREST SERVICE BOUNDARY
- (BLM) BUREAU OF LAND MANAGEMENT LAND
- (DW) DENVER WATER PROPERTY
- (FS) U.S. FOREST SERVICE LAND
- (PR) PRIVATE
- HIGH WATER LINE
  PROPOSED PROJECT SPILLWAY ELEVATION 7406 FEET MSL
  ALTERNATIVE PROPOSED PROJECT SPILLWAY ELEVATION 7400 FEET MSL
  DAM DATUM (NGVD29/PREVIOUS TO 1961 ADJUSTMENT)

① AUXILIARY SPILLWAY IN THE TOPOGRAPHIC SADDLE.

② AUXILIARY SPILLWAY ON THE ABUTMENT OF GROSS DAM.

③ EXISTING SPILLWAY.

MAGNETIC NORTH

TRUE NORTH

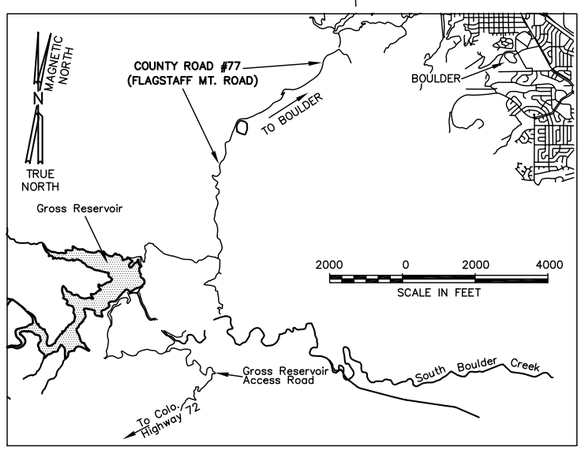
PROJECT BOUNDARY

ROOSEVELT NATIONAL FOREST BOUNDARY

GRAPHIC SCALE

600 0 300 600 1200 2400

SCALE IN FEET



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GROSS RESERVOIR
HYDROELECTRIC PROJECT-FERC PROJECT No 2035-EXHIBIT G
PRELIMINARY PROJECT BOUNDARY MAP
PROPOSED PROJECT AND ALTERNATIVE PROPOSED PROJECT

Scale: _AS SHOWN_ | Date: _NOV 2008_
Drawn: _WEB/DIR_ | Checked: _HEMPELMAN/_
Approved: _____ | Dr._____No._____

0 300 600
(IN FEET)
1 inch = 600 ft.

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Draft FERC Hydropower License Amendment Application Gross Reservoir Hydroelectric Project FERC Project No. 2035

ATTACHMENTS

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Draft FERC Hydropower License Amendment Application Gross Reservoir Hydroelectric Project FERC Project No. 2035

LIST OF ATTACHMENTS

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Draft FERC Hydropower
License Amendment Application
Gross Reservoir Hydroelectric Project
FERC Project No. 2035

ATTACHMENT B-1

PROPOSED PROJECT
AVERAGE MONTHLY TOTAL OUTFLOW
FROM GROSS RESERVOIR

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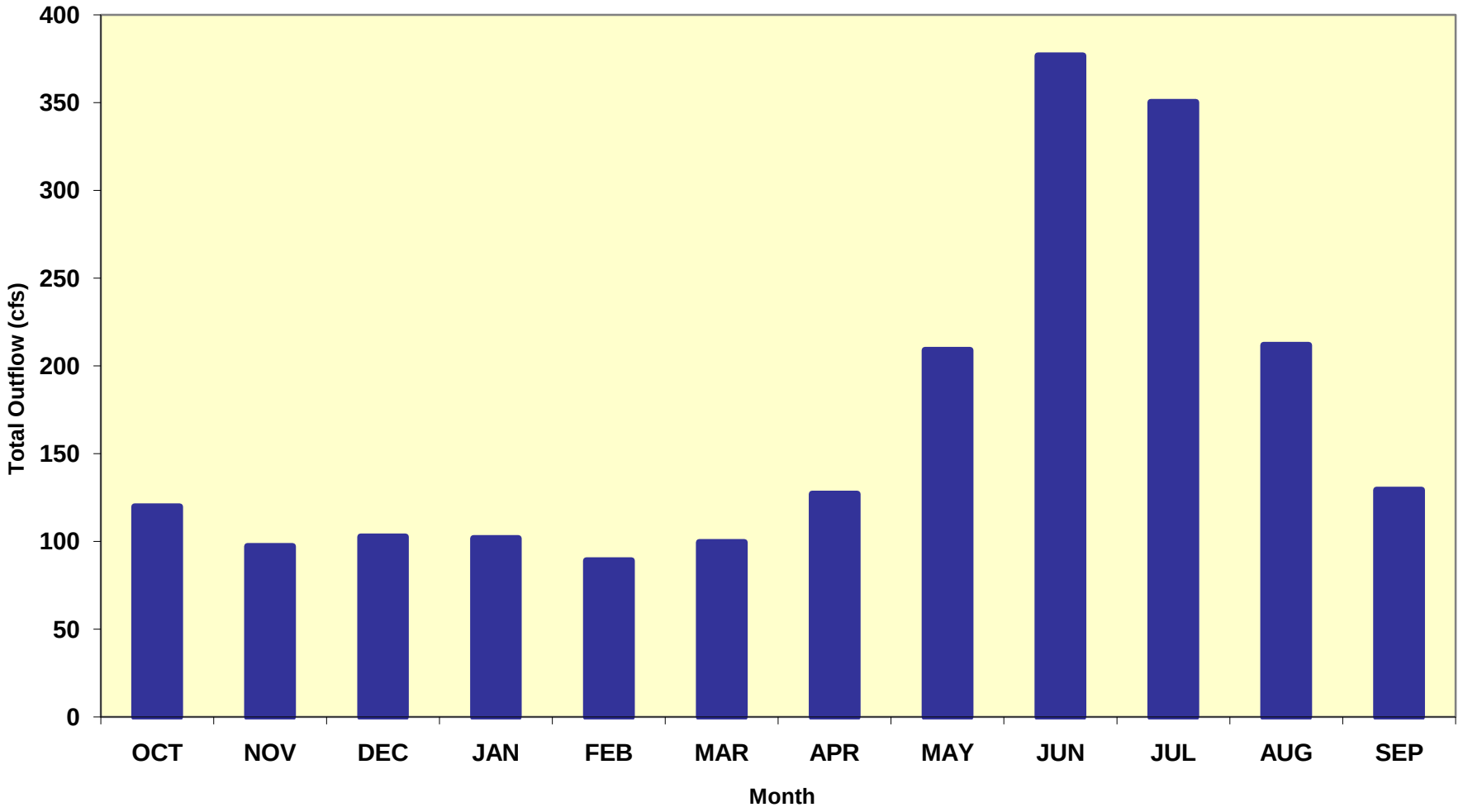
Attachment B-1

Proposed Project

Gross Reservoir 77,000 acre-foot Enlargement (with environmental pool)

Average Monthly Total Outflow from Gross Reservoir

Hydrologic Study Period 1947-1991



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Draft FERC Hydropower
License Amendment Application
Gross Reservoir Hydroelectric Project
FERC Project No. 2035

ATTACHMENT B-2

ALTERNATIVE PROPOSED PROJECT AVERAGE MONTHLY TOTAL OUTFLOW FROM GROSS RESERVOIR

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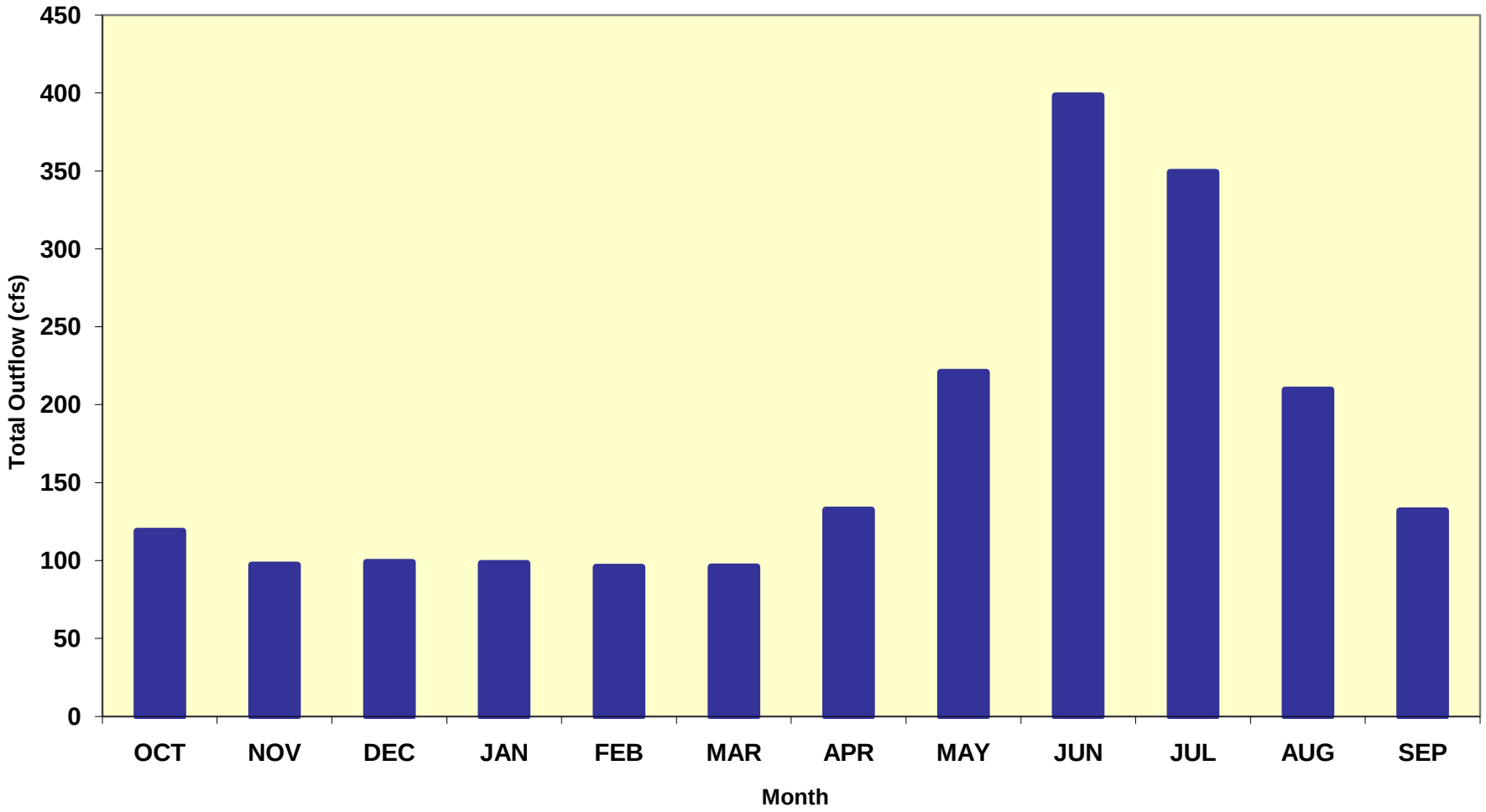
Attachment B-2

Alternative Proposed Project

Gross Reservoir 72,000 acre-foot Enlargement

Average MonthlyTotal Outflow from Gross Reservoir

Hydrologic Study Period 1947-1991



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Draft FERC Hydropower
License Amendment Application
Gross Reservoir Hydroelectric Project
FERC Project No. 2035

ATTACHMENT B-3

PROPOSED PROJECT
AREA CAPACITY CURVE

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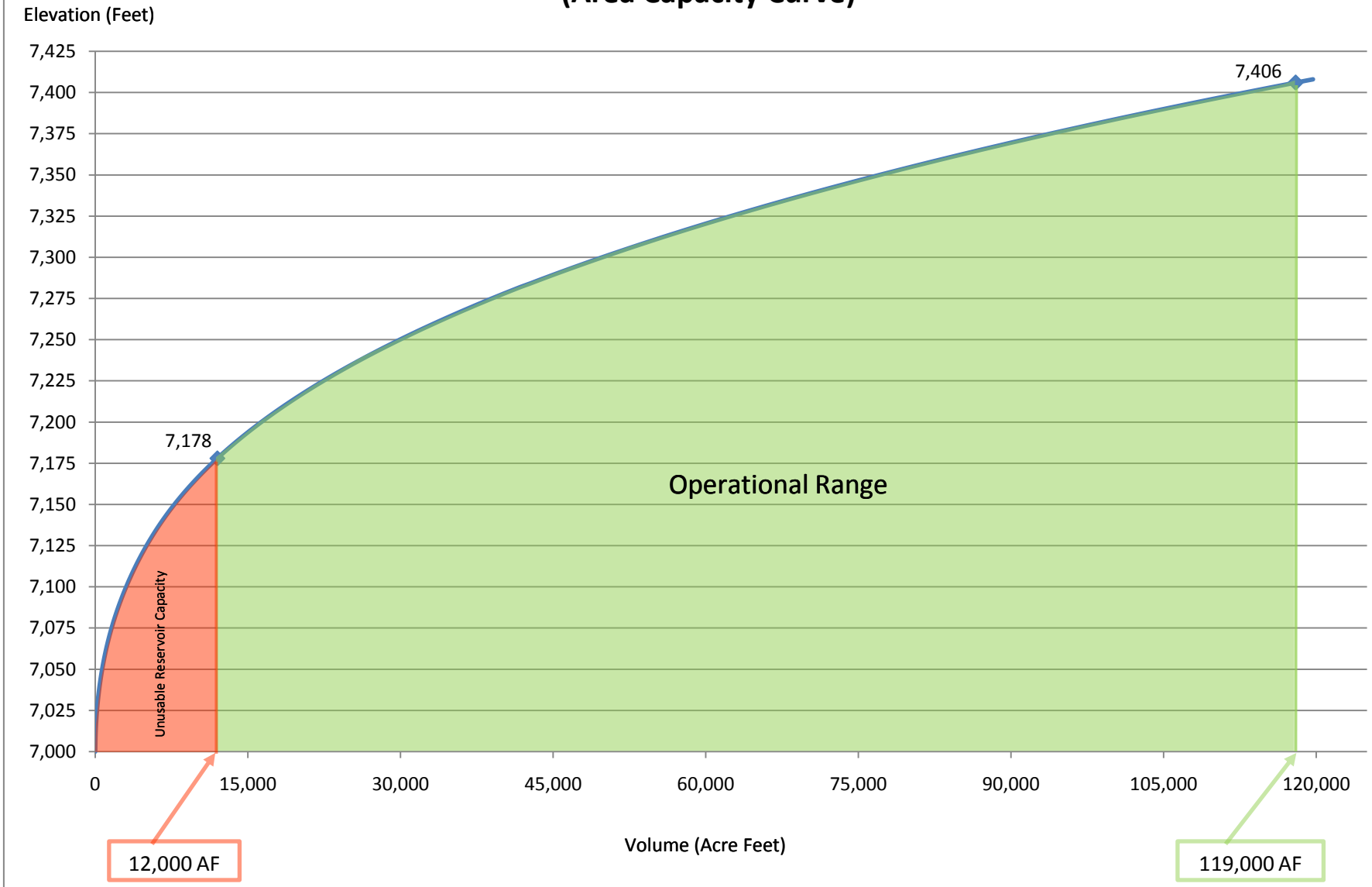
Attachment B-3 - Proposed Project
(Area Capacity Curve)



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Draft FERC Hydropower License Amendment Application Gross Reservoir Hydroelectric Project FERC Project No. 2035

ATTACHMENT B-4

PROPOSED PROJECT AVERAGE END OF MONTH ELEVATION

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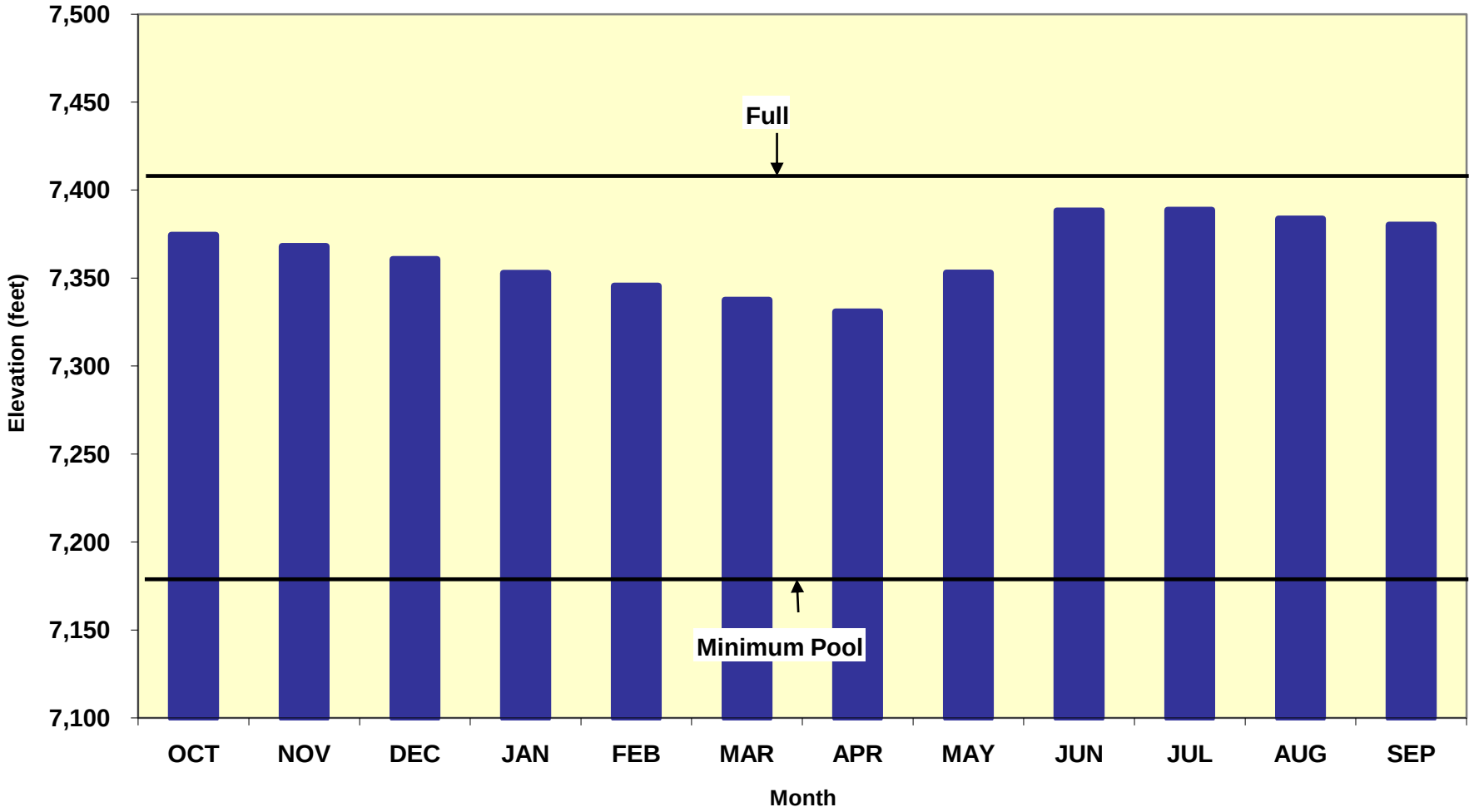
Attachment B-4

Proposed Project

Gross Reservoir 77,000 acre-foot Enlargement (with environmental pool)

Average End of Month Elevation

Hydrologic Study Period 1947-1991



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Draft FERC Hydropower License Amendment Application Gross Reservoir Hydroelectric Project FERC Project No. 2035

ATTACHMENT B-5

ALTERNATIVE PROPOSED PROJECT AREA CAPACITY CURVE

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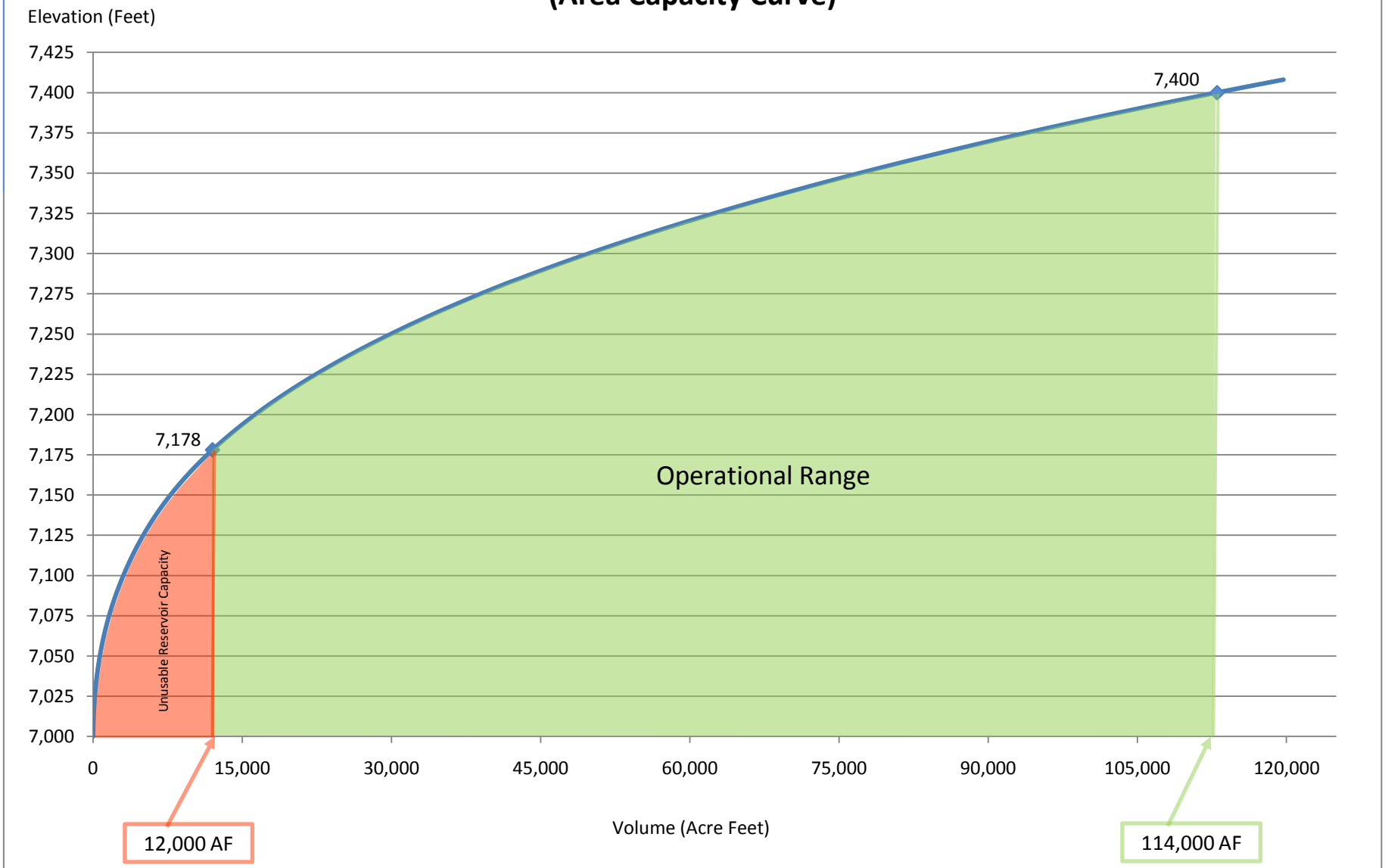
Attachment B-5 - Alternative Proposed Project (Area Capacity Curve)



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Draft FERC Hydropower
License Amendment Application
Gross Reservoir Hydroelectric Project
FERC Project No. 2035

ATTACHMENT B-6

ALTERNATIVE PROPOSED PROJECT AVERAGE END OF MONTH ELEVATION

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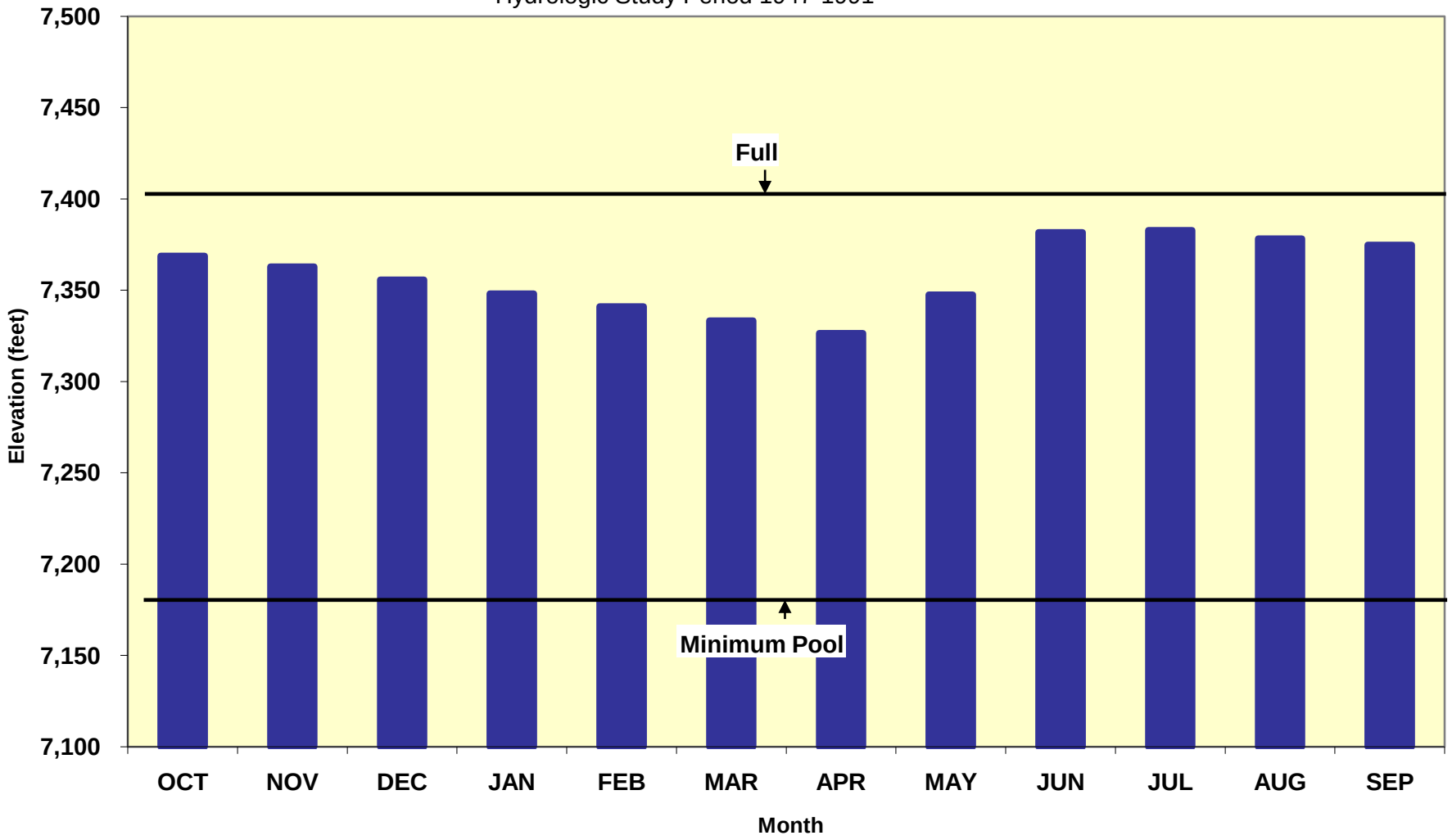
Attachment B-6

Alternative Proposed Project

Gross Reservoir 72,000 acre-foot Enlargement

Average End of Month Elevation

Hydrologic Study Period 1947-1991



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Draft FERC Hydropower License Amendment Application Gross Reservoir Hydroelectric Project FERC Project No. 2035

ATTACHMENT B-7

EXISTING AND EXPECTED TURBINE GENERATOR PERFORMANCE

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EXISTING TURBINE GENERATOR PERFORMANCE - EXISTING CONDITIONS

Average Annual Revenue = $ 1,287,523

Total Present Worth Revenue = $ 13,364,484 (15 years @ 5% Discount Rate)

Indicates Turbine Operation is out of design range

Energy Rate = ***0.0483*** $ / kWh

Average Annual Energy = 26,656,781 kWh/year

Rate		5					25						50						75						100						125					
Net Head	Duration %	Duration Hours	Turbine Effc.	Gen Effc.	Gen.Out kW	Revenue	Duration %	Duration Hours	Turbine Effc.	Gen Effc.	Gen.Out kW	Revenue	Duration %	Duration Hours	Turbine Effc.	Gen Effc.	Gen.Out kW	Revenue	Duration %	Duration Hours	Turbine Effc.	Gen Effc.	Gen.Out kW	Revenue	Duration %	Duration Hours	Turbine Effc.	Gen Effc.	Gen.Out kW	Revenue	Duration %	Duration Hours	Turbine Effc.	Gen Effc.	Gen.Out kW	Revenue
330	2.10%	184	0.00%	0.00%	0	$0	2.33%	204	50.00%	95.00%	331	$3,263	2.01%	176	76.00%	96.00%	1018	$8,661	0.41%	36	86.00%	96.00%	1727	$2,999	2.50%	219	90.80%	97.00%	2457	$26,007	1.91%	167	94.00%	97.00%	3180	$25,712
320	4.56%	400	0.00%	0.00%	0	$0	4.56%	400	47.00%	95.00%	302	$5,833	0.05%	4	76.00%	96.00%	987	$209	0.05%	4	86.50%	96.00%	1685	$357	2.01%	176	89.80%	97.00%	2356	$20,053	1.55%	136	94.00%	97.00%	3083	$20,234
310	0.46%	40	0.00%	0.00%	0	$0	1.32%	116	47.00%	95.00%	293	$1,639	0.98%	86	76.00%	96.00%	956	$3,967	0.72%	63	86.00%	96.00%	1623	$4,947	2.28%	200	91.20%	97.00%	2318	$22,379	2.09%	183	94.00%	97.00%	2987	$26,430
300	0.00%	0	0.00%	0.00%	0	$0	0.46%	40	45.00%	95.00%	271	$524	0.05%	4	75.00%	96.00%	913	$193	0.09%	8	86.00%	96.00%	1570	$598	1.28%	112	91.25%	97.00%	2245	$12,165	0.73%	64	94.00%	97.00%	2890	$8,934
290	3.97%	348	0.00%	0.00%	0	$0	1.41%	124	45.00%	95.00%	262	$1,569	0.82%	72	75.50%	96.00%	888	$3,085	0.14%	12	86.00%	96.00%	1518	$900	2.19%	192	91.20%	97.00%	2169	$20,109	1.05%	92	94.00%	97.00%	2794	$12,422
280	1.09%	96	0.00%	0.00%	0	$0	1.60%	140	45.00%	95.00%	253	$1,710	0.83%	73	76.50%	96.00%	869	$3,054	0.82%	72	86.00%	96.00%	1466	$5,088	0.32%	28	91.00%	97.00%	2089	$2,831	1.28%	112	93.60%	97.00%	2686	$14,558
265	2.60%	228	0.00%	0.00%	0	$0	1.05%	92	40.00%	95.00%	213	$945	0.05%	4	75.50%	96.00%	812	$172	0.09%	8	86.00%	96.00%	1387	$529	0.69%	60	90.50%	97.00%	1967	$5,745	0.32%	28	92.50%	97.00%	2513	$3,404
250	0.00%	0	0.00%	0.00%	0	$0	0.36%	32	40.00%	95.00%	201	$310	0.27%	24	75.00%	96.00%	761	$870	0.00%	0	85.00%	96.00%	1293	$0	0.91%	80	89.50%	97.00%	1835	$7,069	0.55%	48	91.00%	97.00%	2332	$5,430
235	0.00%	0	0.00%	0.00%	0	$0	0.09%	8	35.00%	95.00%	165	$64	0.73%	64	75.00%	96.00%	715	$2,210	0.05%	4	84.00%	96.00%	1201	$254	0.50%	44	88.00%	97.00%	1696	$3,590	0.41%	36	88.50%	97.00%	2132	$3,701
220	0.00%	0	0.00%	0.00%	0	$0	0.00%	0	30.00%	95.00%	133	$0	0.00%	0	68.50%	96.00%	611	$0	0.00%	0	81.50%	96.00%	1091	$0	0.14%	12	85.80%	97.00%	1548	$917	0.14%	12	85.00%	97.00%	1917	$1,136
TOTALS:	14.78%					$0	13.18%					$15,857	5.79%					$22,421	2.37%					$15,671	12.82%					$120,867	10.03%					$121,962
				% of Total $ =		0.00%				% of Total $ =		1.23%				% of Total $ =		1.74%				% of Total $ =		1.22%				% of Total $ =		9.39%				% of Total $ =		9.47%

	150						175						200						225						250					
Net Head	Duration %	Duration Hours	Turbine Effc.	Gen Effc.	Gen.Out kW	Revenue	Duration %	Duration Hours	Turbine Effc.	Gen Effc.	Gen.Out kW	Revenue	Duration %	Duration Hours	Turbine Effc.	Gen Effc.	Gen.Out kW	Revenue	Duration %	Duration Hours	Turbine Effc.	Gen Effc.	Gen.Out kW	Revenue	Duration %	Duration Hours	Turbine Effc.	Gen Effc.	Gen.Out kW	Revenue
330	0.59%	52	92.75%	97.00%	3765	$9,404	0.99%	87	88.80%	97.00%	4205	$17,626	2.86%	251	90.80%	97.00%	4914	$59,505	1.32%	116	92.75%	97.00%	5647	$31,560	0.95%	83	94.00%	97.00%	6359	$25,578
320	1.14%	100	92.40%	97.00%	3637	$17,554	0.09%	8	89.00%	97.00%	4087	$1,557	0.96%	84	89.80%	97.00%	4713	$19,155	0.63%	55	92.75%	97.00%	5476	$14,606	0.59%	52	94.00%	97.00%	6166	$15,404
310	1.41%	124	92.00%	97.00%	3508	$20,942	0.37%	32	88.80%	97.00%	3950	$6,188	0.41%	36	91.20%	97.00%	4637	$8,049	0.41%	36	92.75%	97.00%	5305	$9,209	0.09%	8	94.00%	97.00%	5974	$2,276
300	1.54%	135	91.50%	97.00%	3376	$22,015	0.64%	56	89.00%	97.00%	3831	$10,382	0.10%	9	91.25%	97.00%	4489	$1,901	0.32%	28	92.75%	97.00%	5134	$6,955	0.05%	4	94.00%	97.00%	5781	$1,224
290	1.28%	112	90.50%	97.00%	3228	$17,495	0.14%	12	89.00%	97.00%	3704	$2,195	0.00%	0	91.20%	97.00%	4337	$0	0.19%	17	92.75%	97.00%	4963	$3,992	0.14%	12	94.00%	97.00%	5588	$3,312
280	1.46%	128	89.50%	97.00%	3082	$19,054	0.09%	8	88.50%	97.00%	3556	$1,355	0.00%	0	91.00%	97.00%	4179	$0	0.05%	4	92.25%	97.00%	4766	$1,009	0.05%	4	93.60%	97.00%	5373	$1,137
265	0.64%	56	87.50%	97.00%	2852	$7,728	0.32%	28	89.00%	97.00%	3384	$4,585	0.00%	0	90.50%	97.00%	3933	$0	0.00%	0	91.75%	97.00%	4486	$0	0.00%	0	92.50%	97.00%	5025	$0
250	0.05%	4	85.00%	97.00%	2614	$553	0.00%	0	87.50%	97.00%	3139	$0	0.00%	0	89.50%	97.00%	3669	$0	0.00%	0	91.00%	97.00%	4197	$0	0.00%	0	91.00%	97.00%	4664	$0
235	0.14%	12	80.00%	97.00%	2312	$1,371	0.23%	20	86.30%	97.00%	2910	$2,834	0.18%	16	88.00%	97.00%	3391	$2,585	0.32%	28	89.20%	97.00%	3867	$5,240	0.09%	8	88.50%	97.00%	4263	$1,625
220	0.05%	4	78.00%	97.00%	2111	$447	0.32%	28	83.80%	97.00%	2646	$3,584	0.05%	4	85.80%	97.00%	3096	$655	0.00%	0	86.70%	97.00%	3519	$0	0.05%	4	85.00%	97.00%	3833	$812
TOTALS:	8.30%					$116,563	3.19%					$50,308	4.56%					$91,850	3.24%					$72,572	2.01%					$51,368
					% of Total $ =	9.05%					% of Total $ =	3.91%					% of Total $ =	7.13%				% of Total $ =	5.64%					% of Total $ =	3.99%

	275						300						315					
Net Head	Duration %	Duration Hours	Turbine Effc.	Gen Effc.	Gen.Out kW	Revenue	Duration %	Duration Hours	Turbine Effc.	Gen Effc.	Gen.Out kW	Revenue	Duration %	Duration Hours	Turbine Effc.	Gen Effc.	Gen.Out kW	Revenue
330	1.08%	95	94.00%	97.00%	6995	$31,986	3.04%	266	92.75%	97.00%	7529	$96,913	8.60%	753	91.80%	97.00%	7825	$284,590
320	0.27%	24	94.00%	97.00%	6783	$7,754	0.19%	17	92.40%	97.00%	7274	$5,851	0.95%	83	91.75%	97.00%	7584	$30,402
310	0.05%	4	93.75%	97.00%	6554	$1,387	0.55%	48	92.00%	97.00%	7016	$16,338	0.50%	44	90.80%	97.00%	7271	$15,451
300	0.10%	9	93.70%	97.00%	6339	$2,684	0.09%	8	91.50%	97.00%	6753	$2,573	0.55%	48	90.20%	97.00%	6990	$16,205
290	0.18%	16	93.25%	97.00%	6098	$4,647	0.23%	20	90.50%	97.00%	6456	$6,287	1.02%	89	88.50%	97.00%	6629	$28,497
280	0.05%	4	92.75%	97.00%	5856	$1,240	0.05%	4	89.50%	97.00%	6165	$1,305	0.54%	47	87.50%	97.00%	6328	$14,366
265	0.09%	8	90.00%	97.00%	5378	$2,049	0.14%	12	87.50%	97.00%	5704	$3,381	0.76%	67	85.00%	97.00%	5818	$18,828
250	0.00%	0	87.50%	97.00%	4933	$0	0.05%	4	85.00%	97.00%	5227	$1,107	0.37%	32	80.00%	97.00%	5166	$7,984
235	0.00%	0	84.90%	97.00%	4499	$0	0.14%	12	80.00%	97.00%	4625	$2,741	0.18%	16	75.00%	97.00%	4552	$3,518
220	0.00%	0	78.00%	97.00%	3870	$0	0.00%	0	78.00%	97.00%	4221	$0	0.00%	0	70.00%	97.00%	3978	$0
TOTALS:	1.82%					$51,748	4.48%					$136,496	13.46%					$419,841
				% of Total $ =		4.02%				% of Total $ =		10.60%				% of Total $ =		32.61%

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EXPECTED TURBINE GENERATOR PERFORMANCE - PROPOSED PROJECTS AND ALTERNATIVE PROPOSED PROJECT WITHOUT A PRESSURE REDUCTION VALVE (PRV)

No Modifications to Turbines or Penstock PRV

Average Annual Revenue = $ 243,013

Total Present Worth Revenue = $ 2,522,477 (15 years @ 5% Discount Rate)

Indicates Turbine Operation i is out of design range

Energy Rate = ***0.0483*** $ / kWh

Average Annual Energy = 5,031,330 kWh/year

Average Turbine Flow Rate		**5**					**25**						**50**						**75**						**100**						**125**					
Net Head	Duration %	Duration Hours	Turbine Effc.	Gen Effc.	Gen.Out kW	Revenue	Duration %	Duration Hours	Turbine Effc.	Gen Effc.	Gen.Out kW	Revenue	Duration %	Duration Hours	Turbine Effc.	Gen Effc.	Gen.Out kW	Revenue	Duration %	Duration Hours	Turbine Effc.	Gen Effc.	Gen.Out kW	Revenue	Duration %	Duration Hours	Turbine Effc.	Gen Effc.	Gen.Out kW	Revenue	Duration %	Duration Hours	Turbine Effc.	Gen Effc.	Gen.Out kW	Revenue
430	2.10%	184	0.00%	0.00%	0	$0	2.33%	204	0.00%	0.00%	0	$0	2.01%	176	0.00%	0.00%	0	$0	0.41%	36	0.00%	0.00%	0	$0	2.50%	219	0.00%	0.00%	0	$0	1.91%	167	0.00%	0.00%	0	$0
420	4.56%	400	0.00%	0.00%	0	$0	4.56%	400	0.00%	0.00%	0	$0	0.05%	4	0.00%	0.00%	0	$0	0.05%	4	0.00%	0.00%	0	$0	2.01%	176	0.00%	0.00%	0	$0	1.55%	136	0.00%	0.00%	0	$0
410	0.46%	40	0.00%	0.00%	0	$0	1.32%	116	0.00%	0.00%	0	$0	0.98%	86	0.00%	0.00%	0	$0	0.72%	63	0.00%	0.00%	0	$0	2.28%	200	0.00%	0.00%	0	$0	2.09%	183	0.00%	0.00%	0	$0
400	0.00%	0	0.00%	0.00%	0	$0	0.46%	40	0.00%	0.00%	0	$0	0.05%	4	0.00%	0.00%	0	$0	0.09%	8	0.00%	0.00%	0	$0	1.28%	112	0.00%	0.00%	0	$0	0.73%	64	0.00%	0.00%	0	$0
390	3.97%	348	0.00%	0.00%	0	$0	1.41%	124	0.00%	0.00%	0	$0	0.82%	72	0.00%	0.00%	0	$0	0.14%	12	0.00%	0.00%	0	$0	2.19%	192	0.00%	0.00%	0	$0	1.05%	92	0.00%	0.00%	0	$0
380	1.09%	96	0.00%	0.00%	0	$0	1.60%	140	0.00%	0.00%	0	$0	0.83%	73	74.00%	96.00%	1141	$4,010	0.82%	72	85.00%	96.00%	1966	$6,826	0.32%	28	90.20%	97.00%	2811	$3,808	1.28%	112	93.50%	97.00%	3642	$19,737
365	2.60%	228	0.00%	0.00%	0	$0	1.05%	92	0.00%	0.00%	0	$0	0.05%	4	75.00%	96.00%	1111	$235	0.09%	8	85.50%	96.00%	1899	$724	0.69%	60	90.50%	97.00%	2709	$7,913	0.32%	28	94.00%	97.00%	3517	$4,765
350	0.00%	0	0.00%	0.00%	0	$0	0.36%	32	0.00%	0.00%	0	$0	0.27%	24	76.00%	96.00%	1079	$1,234	0.00%	0	86.00%	96.00%	1832	$0	0.91%	80	90.80%	97.00%	2606	$10,040	0.55%	48	94.00%	97.00%	3372	$7,853
335	0.00%	0	0.00%	0.00%	0	$0	0.09%	8	0.00%	0.00%	0	$0	0.73%	64	77.00%	96.00%	1047	$3,235	0.05%	4	86.00%	96.00%	1754	$371	0.50%	44	91.00%	97.00%	2500	$5,292	0.41%	36	94.00%	97.00%	3228	$5,603
320	0.00%	0	0.00%	0.00%	0	$0	0.00%	0	45.00%	96.00%	292	$0	0.00%	0	77.50%	96.00%	1006	$0	0.00%	0	86.00%	96.00%	1675	$0	0.14%	12	91.00%	97.00%	2388	$1,415	0.14%	12	94.00%	97.00%	3083	$1,828
TOTALS:	14.78%					$0	13.18%					$0	5.79%					$8,714	2.37%					$7,921	12.82%					$28,469	10.03%					$39,785
				% of Total $ =		0.00%				% of Total $ =		0.00%				% of Total $ =		3.59%				% of Total $ =		3.26%				% of Total $ =		11.71%				% of Total $ =		16.37%

	150						**175**						**200**						**225**						**250**					
Net Head	Duration %	Duration Hours	Turbine Effc.	Gen Effc.	Gen.Out kW	Revenue	Duration %	Duration Hours	Turbine Effc.	Gen Effc.	Gen.Out kW	Revenue	Duration %	Duration Hours	Turbine Effc.	Gen Effc.	Gen.Out kW	Revenue	Duration %	Duration Hours	Turbine Effc.	Gen Effc.	Gen.Out kW	Revenue	Duration %	Duration Hours	Turbine Effc.	Gen Effc.	Gen.Out kW	Revenue
430	0.59%	52	0.00%	0.00%	0	$0	0.99%	87	0.00%	0.00%	0	$0	2.86%	251	0.00%	0.00%	0	$0	1.32%	116	0.00%	0.00%	0	$0	0.95%	83	0.00%	0.00%	0	$0
420	1.14%	100	0.00%	0.00%	0	$0	0.09%	8	0.00%	0.00%	0	$0	0.96%	84	0.00%	0.00%	0	$0	0.63%	55	0.00%	0.00%	0	$0	0.59%	52	0.00%	0.00%	0	$0
410	1.41%	124	0.00%	0.00%	0	$0	0.37%	32	0.00%	0.00%	0	$0	0.41%	36	0.00%	0.00%	0	$0	0.41%	36	0.00%	0.00%	0	$0	0.09%	8	0.00%	0.00%	0	$0
400	1.54%	135	0.00%	0.00%	0	$0	0.64%	56	0.00%	0.00%	0	$0	0.10%	9	0.00%	0.00%	0	$0	0.32%	28	0.00%	0.00%	0	$0	0.05%	4	0.00%	0.00%	0	$0
390	1.28%	112	0.00%	0.00%	0	$0	0.14%	12	0.00%	0.00%	0	$0	0.00%	0	0.00%	0.00%	0	$0	0.19%	17	0.00%	0.00%	0	$0	0.14%	12	0.00%	0.00%	0	$0
380	1.46%	128	93.00%	97.00%	4347	$26,870	0.09%	8	0.00%	0.00%	0	$0	0.00%	0	90.20%	97.00%	5621	$0	0.05%	4	92.00%	97.00%	6450	$1,365	0.05%	4	93.50%	97.00%	7284	$1,542
365	0.64%	56	93.00%	97.00%	4175	$11,314	0.32%	28	90.50%	97.00%	4740	$6,422	0.00%	0	90.50%	97.00%	5417	$0	0.00%	0	92.50%	97.00%	6229	$0	0.00%	0	94.00%	97.00%	7033	$0
350	0.05%	4	92.75%	97.00%	3993	$845	0.00%	0	90.00%	97.00%	4520	$0	0.00%	0	90.80%	97.00%	5212	$0	0.00%	0	92.75%	97.00%	5989	$0	0.00%	0	94.00%	97.00%	6744	$0
335	0.14%	12	92.75%	97.00%	3822	$2,265	0.23%	20	89.50%	97.00%	4302	$4,190	0.18%	16	91.00%	97.00%	4999	$3,810	0.32%	28	92.80%	97.00%	5736	$7,771	0.09%	8	94.00%	97.00%	6455	$2,460
320	0.05%	4	92.50%	97.00%	3641	$771	0.32%	28	89.00%	97.00%	4087	$5,537	0.05%	4	91.00%	97.00%	4776	$1,011	0.00%	0	92.50%	97.00%	5461	$0	0.05%	4	94.00%	97.00%	6166	$1,305
TOTALS:	8.30%					$42,065	3.19%					$16,149	4.56%					$4,821	3.24%					$9,137	2.01%					$5,307
				% of Total $ =		17.31%				% of Total $ =		6.65%				% of Total $ =		1.98%				% of Total $ =		3.76%				% of Total $ =		2.18%

	275						**300**						**315**					
Net Head	Duration %	Duration Hours	Turbine Effc.	Gen Effc.	Gen.Out kW	Revenue	Duration %	Duration Hours	Turbine Effc.	Gen Effc.	Gen.Out kW	Revenue	Duration %	Duration Hours	Turbine Effc.	Gen Effc.	Gen.Out kW	Revenue
430	1.08%	95	0.00%	0.00%	0	$0	3.04%	266	0.00%	0.00%	0	$0	8.60%	753	0.00%	0.00%	0	$0
420	0.27%	24	0.00%	0.00%	0	$0	0.19%	17	0.00%	0.00%	0	$0	0.95%	83	0.00%	0.00%	0	$0
410	0.05%	4	0.00%	0.00%	0	$0	0.55%	48	0.00%	0.00%	0	$0	0.50%	44	0.00%	0.00%	0	$0
400	0.10%	9	0.00%	0.00%	0	$0	0.09%	8	0.00%	0.00%	0	$0	0.55%	48	0.00%	0.00%	0	$0
390	0.18%	16	0.00%	0.00%	0	$0	0.23%	20	0.00%	0.00%	0	$0	1.02%	89	0.00%	0.00%	0	$0
380	0.05%	4	94.00%	97.00%	8055	$1,705	0.05%	4	93.00%	97.00%	8100	$1,715	0.54%	47	92.50%	97.00%	8100	$18,388
365	0.09%	8	94.00%	97.00%	7737	$2,948	0.14%	12	92.75%	97.00%	8100	$4,801	0.76%	67	92.50%	97.00%	8100	$26,212
350	0.00%	0	94.00%	97.00%	7419	$0	0.05%	4	92.75%	97.00%	7986	$1,691	0.37%	32	92.00%	97.00%	8100	$12,519
335	0.00%	0	93.50%	97.00%	7063	$0	0.14%	12	92.75%	97.00%	7643	$4,531	0.18%	16	91.75%	97.00%	7939	$6,135
320	0.00%	0	94.00%	97.00%	6783	$0	0.00%	0	93.00%	97.00%	7321	$0	0.00%	0	91.50%	97.00%	7563	$0
TOTALS:	1.82%					$4,653	4.48%					$12,737	13.46%					$63,255
				% of Total $ =		1.91%				% of Total $ =		5.24%				% of Total $ =		26.03%

Generator limit = 8100 kW

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EXPECTED TURBINE GENERATOR PERFORMANCE - PROPOSED PROJECT AND ALTERNATIVE PROPOSED PROJECT WITH A PRESSURE REDUCTION VALVE (PRV)

PRV is installed in penstock

Indicates PRV is in use

Average Annual Revenue =	$ 1,500,265	Total Present Worth Revenue =	$ 15,572,746 (15 years @ 5% Discount Rate)

Energy Rate =	***0.0483*** $ / kWh	Average Annual Energy =	31,061,378	kWh/year

Flow Rate		**5**					**25**						**50**						**75**						**100**						**125**					
Net Head	Duration %	Duration Hours	Turbine Effc.	Gen Effc.	Gen.Out kW	Revenue	Duration %	Duration Hours	Turbine Effc.	Gen Effc.	Gen.Out kW	Revenue	Duration %	Duration Hours	Turbine Effc.	Gen Effc.	Gen.Out kW	Revenue	Duration %	Duration Hours	Turbine Effc.	Gen Effc.	Gen.Out kW	Revenue	Duration %	Duration Hours	Turbine Effc.	Gen Effc.	Gen.Out kW	Revenue	Duration %	Duration Hours	Turbine Effc.	Gen Effc.	Gen.Out kW	Revenue
380	2.10%	184	0.00%	0.00%	0	$0	2.33%	204	0.00%	0.00%	0	$0	2.01%	176	74.00%	96.00%	1141	$9,710	0.41%	36	85.00%	96.00%	1966	$3,413	2.50%	219	90.20%	97.00%	2811	$29,750	1.91%	167	93.50%	97.00%	3642	$29,451
380	4.56%	400	0.00%	0.00%	0	$0	4.56%	400	0.00%	0.00%	0	$0	0.05%	4	74.00%	96.00%	1141	$242	0.05%	4	85.00%	96.00%	1966	$416	2.01%	176	90.20%	97.00%	2811	$23,919	1.55%	136	93.50%	97.00%	3642	$23,900
380	0.46%	40	0.00%	0.00%	0	$0	1.32%	116	0.00%	0.00%	0	$0	0.98%	86	74.00%	96.00%	1141	$4,734	0.72%	63	85.00%	96.00%	1966	$5,993	2.28%	200	90.20%	97.00%	2811	$27,132	2.09%	183	93.50%	97.00%	3642	$32,226
380	0.00%	0	0.00%	0.00%	0	$0	0.46%	40	0.00%	0.00%	0	$0	0.05%	4	74.00%	96.00%	1141	$242	0.09%	8	85.00%	96.00%	1966	$749	1.28%	112	90.20%	97.00%	2811	$15,232	0.73%	64	93.50%	97.00%	3642	$11,256
380	3.97%	348	0.00%	0.00%	0	$0	1.41%	124	0.00%	0.00%	0	$0	0.82%	72	74.00%	96.00%	1141	$3,961	0.14%	12	85.00%	96.00%	1966	$1,165	2.19%	192	90.20%	97.00%	2811	$26,061	1.05%	92	93.50%	97.00%	3642	$16,190
380	1.09%	96	0.00%	0.00%	0	$0	1.60%	140	0.00%	0.00%	0	$0	0.83%	73	74.00%	96.00%	1141	$4,010	0.82%	72	85.00%	96.00%	1966	$6,826	0.32%	28	90.20%	97.00%	2811	$3,808	1.28%	112	93.50%	97.00%	3642	$19,737
365	2.60%	228	0.00%	0.00%	0	$0	1.05%	92	0.00%	0.00%	0	$0	0.05%	4	75.00%	96.00%	1111	$235	0.09%	8	85.50%	96.00%	1899	$724	0.69%	60	90.50%	97.00%	2709	$7,913	0.32%	28	94.00%	97.00%	3517	$4,765
350	0.00%	0	0.00%	0.00%	0	$0	0.36%	32	0.00%	0.00%	0	$0	0.27%	24	76.00%	96.00%	1079	$1,234	0.00%	0	86.00%	96.00%	1832	$0	0.91%	80	90.80%	97.00%	2606	$10,040	0.55%	48	94.00%	97.00%	3372	$7,853
335	0.00%	0	0.00%	0.00%	0	$0	0.09%	8	0.00%	0.00%	0	$0	0.73%	64	77.00%	96.00%	1047	$3,235	0.05%	4	86.00%	96.00%	1754	$371	0.50%	44	91.00%	97.00%	2500	$5,292	0.41%	36	94.00%	97.00%	3228	$5,603
320	0.00%	0	0.00%	0.00%	0	$0	0.00%	0	45.00%	96.00%	292	$0	0.00%	0	77.50%	96.00%	1006	$0	0.00%	0	86.00%	96.00%	1675	$0	0.14%	12	91.00%	97.00%	2388	$1,415	0.14%	12	94.00%	97.00%	3083	$1,828
TOTALS:	14.78%					$0	13.18%					$0	5.79%					$27,603	2.37%					$19,657	12.82%					$150,563	10.03%					$152,808
					% of Total $ =	0.00%					% of Total $ =	0.00%					% of Total $ =	1.84%					% of Total $ =	1.31%				% of Total $ =	10.04%				% of Total $ =	10.19%

	150						**175**						**200**						**225**						**250**					
Net Head	Duration %	Duration Hours	Turbine Effc.	Gen Effc.	Gen.Out kW	Revenue	Duration %	Duration Hours	Turbine Effc.	Gen Effc.	Gen.Out kW	Revenue	Duration %	Duration Hours	Turbine Effc.	Gen Effc.	Gen.Out kW	Revenue	Duration %	Duration Hours	Turbine Effc.	Gen Effc.	Gen.Out kW	Revenue	Duration %	Duration Hours	Turbine Effc.	Gen Effc.	Gen.Out kW	Revenue
380	0.59%	52	93.00%	97.00%	4347	$10,858	0.99%	87	90.50%	97.00%	4935	$20,685	2.86%	251	90.20%	97.00%	5621	$68,068	1.32%	116	92.00%	97.00%	6450	$36,048	0.95%	83	93.50%	97.00%	7284	$29,297
380	1.14%	100	93.00%	97.00%	4347	$20,981	0.09%	8	90.50%	97.00%	4935	$1,880	0.96%	84	90.20%	97.00%	5621	$22,848	0.63%	55	92.00%	97.00%	6450	$17,205	0.59%	52	93.50%	97.00%	7284	$18,195
380	1.41%	124	93.00%	97.00%	4347	$25,950	0.37%	32	90.50%	97.00%	4935	$7,731	0.41%	36	90.20%	97.00%	5621	$9,758	0.41%	36	92.00%	97.00%	6450	$11,197	0.09%	8	93.50%	97.00%	7284	$2,775
380	1.54%	135	93.00%	97.00%	4347	$28,342	0.64%	56	90.50%	97.00%	4935	$13,372	0.10%	9	90.20%	97.00%	5621	$2,380	0.32%	28	92.00%	97.00%	6450	$8,739	0.05%	4	93.50%	97.00%	7284	$1,542
380	1.28%	112	93.00%	97.00%	4347	$23,557	0.14%	12	90.50%	97.00%	4935	$2,925	0.00%	0	90.20%	97.00%	5621	$0	0.19%	17	92.00%	97.00%	6450	$5,189	0.14%	12	93.50%	97.00%	7284	$4,317
380	1.46%	128	93.00%	97.00%	4347	$26,870	0.09%	8	90.50%	97.00%	4935	$1,880	0.00%	0	90.20%	97.00%	5621	$0	0.05%	4	92.00%	97.00%	6450	$1,365	0.05%	4	93.50%	97.00%	7284	$1,542
365	0.64%	56	93.00%	97.00%	4175	$11,314	0.32%	28	90.50%	97.00%	4740	$6,422	0.00%	0	90.50%	97.00%	5417	$0	0.00%	0	92.50%	97.00%	6229	$0	0.00%	0	94.00%	97.00%	7033	$0
350	0.05%	4	92.75%	97.00%	3993	$845	0.00%	0	90.00%	97.00%	4520	$0	0.00%	0	90.80%	97.00%	5212	$0	0.00%	0	92.75%	97.00%	5989	$0	0.00%	0	94.00%	97.00%	6744	$0
335	0.14%	12	92.75%	97.00%	3822	$2,265	0.23%	20	89.50%	97.00%	4302	$4,190	0.18%	16	91.00%	97.00%	4999	$3,810	0.32%	28	92.80%	97.00%	5736	$7,771	0.09%	8	94.00%	97.00%	6455	$2,460
320	0.05%	4	92.50%	97.00%	3641	$771	0.32%	28	89.00%	97.00%	4087	$5,537	0.05%	4	91.00%	97.00%	4776	$1,011	0.00%	0	92.50%	97.00%	5461	$0	0.05%	4	94.00%	97.00%	6166	$1,305
TOTALS:	8.30%					$151,754	3.19%					$64,624	4.56%					$107,876	3.24%					$87,515	2.01%					$61,433
					% of Total $ =	10.12%					% of Total $ =	4.31%					% of Total $ =	7.19%					% of Total $ =	5.83%				% of Total $ =	4.09%

	275						**300**						**315**					
Net Head	Duration %	Duration Hours	Turbine Effc.	Gen Effc.	Gen.Out kW	Revenue	Duration %	Duration Hours	Turbine Effc.	Gen Effc.	Gen.Out kW	Revenue	Duration %	Duration Hours	Turbine Effc.	Gen Effc.	Gen.Out kW	Revenue
380	1.08%	95	94.00%	97.00%	8055	$36,832	3.04%	266	93.00%	97.00%	8100	$104,257	8.60%	753	92.50%	97.00%	8100	$294,596
380	0.27%	24	94.00%	97.00%	8055	$9,208	0.19%	17	93.00%	97.00%	8100	$6,516	0.95%	83	92.50%	97.00%	8100	$32,472
380	0.05%	4	94.00%	97.00%	8055	$1,705	0.55%	48	93.00%	97.00%	8100	$18,862	0.50%	44	92.50%	97.00%	8100	$17,214
380	0.10%	9	94.00%	97.00%	8055	$3,410	0.09%	8	93.00%	97.00%	8100	$3,087	0.55%	48	92.50%	97.00%	8100	$18,779
380	0.18%	16	94.00%	97.00%	8055	$6,139	0.23%	20	93.00%	97.00%	8100	$7,888	1.02%	89	92.50%	97.00%	8100	$34,819
380	0.05%	4	94.00%	97.00%	8055	$1,705	0.05%	4	93.00%	97.00%	8100	$1,715	0.54%	47	92.50%	97.00%	8100	$18,388
365	0.09%	8	94.00%	97.00%	7737	$2,948	0.14%	12	92.75%	97.00%	8100	$4,801	0.76%	67	92.50%	97.00%	8100	$26,212
350	0.00%	0	94.00%	97.00%	7419	$0	0.05%	4	92.75%	97.00%	7986	$1,691	0.37%	32	92.00%	97.00%	8100	$12,519
335	0.00%	0	93.50%	97.00%	7063	$0	0.14%	12	92.75%	97.00%	7643	$4,531	0.18%	16	91.75%	97.00%	7939	$6,135
320	0.00%	0	94.00%	97.00%	6783	$0	0.00%	0	93.00%	97.00%	7321	$0	0.00%	0	91.50%	97.00%	7563	$0
TOTALS:	1.82%					$61,948	4.48%					$153,348	13.46%					$461,136
					% of Total $ =	4.13%					% of Total $ =	10.22%					% of Total $ =	30.74%

Generator limit = 8100 kW

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Draft FERC Hydropower License Amendment Application Gross Reservoir Hydroelectric Project FERC Project No. 2035

ATTACHMENT E-1

GROSS RESERVOIR TREE REMOVAL PLAN FOR POOL ENLARGEMENT FEBRUARY 2008 AND SUPPLEMENT TO GROSS RESERVOIR TREE REMOVAL PLAN FOR POOL ENLARGEMENT OCTOBER 2008

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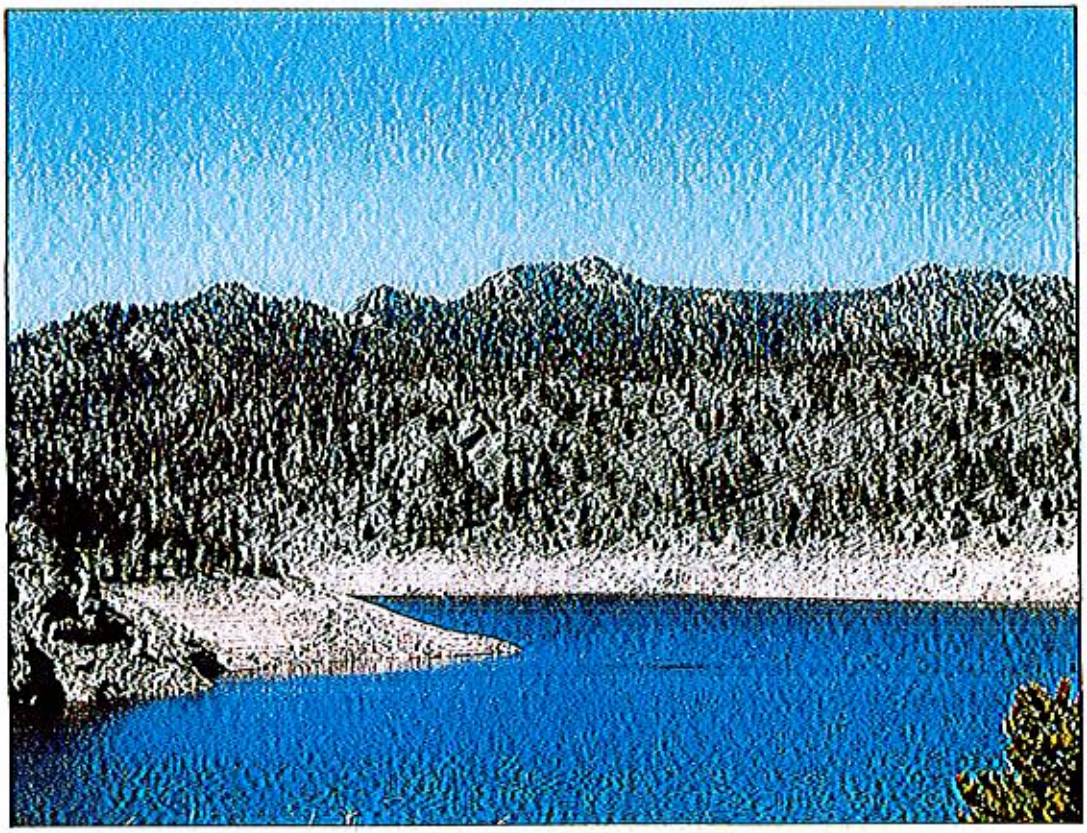
GROSS RESERVOIR

TREE REMOVAL PLAN FOR POOL ENLARGEMENT



February, 2008

Prepared by Land Stewardship Associates, LLC

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Table of Contents

Appendices

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INTRODUCTION

Denver Water Department owns and operates Gross Reservoir as part of its water supply system along the Front Range of Colorado. This reservoir is located southwest of Boulder, Colorado, in the upper reaches of the South Boulder Creek.

Current plans call for increasing the size of the dam at the Gross Reservoir, thereby raising the pool at the spillway elevation from 7,282' (USGS quad maps show the current spillway pool at 7,287') to 7,400'. **To minimize problems in the future with floating debris, etc., all trees and their associated debris, e.g. tops, slash, etc., on about 430 acres along 12.5 miles of shoreline will need to be removed between the current pool elevation of 7,282' and 7,410', which is ten feet above the new pool elevation.**

Because of the topography, e.g. very steep slopes, rock outcrops, etc., several, more complex tree removal (logging) systems will need to be used and some temporary roads will need to be constructed to remove the trees. Bruce Short, of Short Forestry, LLC, assisted Land Stewardship Associates, LLC in identifying and analyzing appropriate logging systems and access options. Also, because of air quality concerns, disposal of the "residue" resulting from tree removal, both merchantable forest products and slash, becomes complex and costly.

This "Tree Removal Plan" uses data and information from the recently completed "Gross Reservoir Forest Management Plan (May 22, 2005)" to characterize the condition of the vegetation along the shoreline. It also identifies recommended tree removal systems and alternative residue removal approaches and their associated costs.

There are a few recreation developments that will need to be removed or relocated if the reservoir is expanded: a boathouse, a few picnic sites, and a boat dock. New shoreline access roads may also be planned.

DESCRIPTION OF AREA

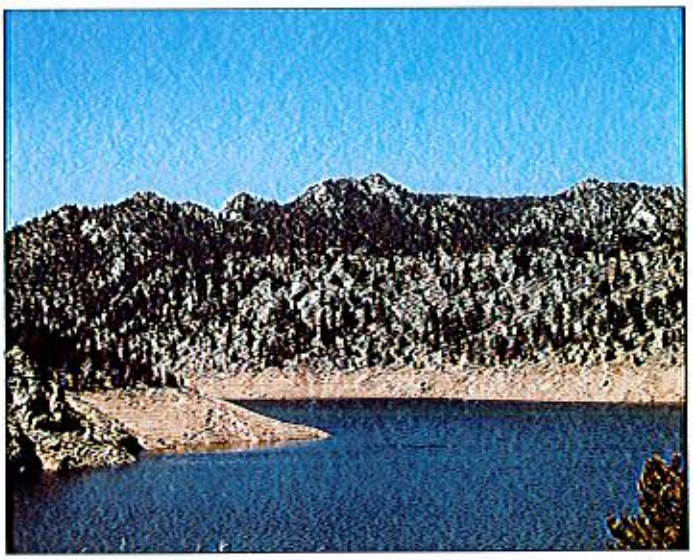
Vegetation, Topography and Surface Soil Conditions

<u>Vegetation</u> along the shoreline is primarily forest cover containing ponderosa pine, Douglas fir, and in spots, Rocky Mountain juniper, with inclusions of grass/shrub savannah. Most of the trees are 20 to 50 feet tall and vary in diameter at breast high (dbh) 4 to 14 inches. The density of the forest ranges from approximately 150 to 1800 trees/acre. See the "Gross Reservoir Forest Management Plan (May 22, 2005)" for a detailed description of the vegetation types.

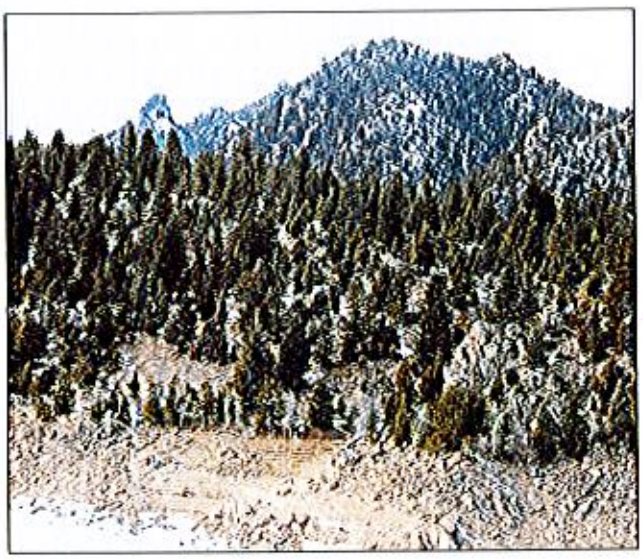
Thirty five (35) unique "stands" representing eleven (11) vegetation types (taken from the Gross Reservoir Forest Management Plan) were identified along the shoreline. **Maps A and B** in the **Appendix** identify the specific location of the stands. **Table 2** lists the stands and briefly identifies the vegetation, stems and merchantable volume for each stand. In addition, the table cross-references the vegetation types contained in the "Gross Reservoir Forest

Management Plan (May 22, 2005)" in a column labeled "Match" for a more detailed description of the vegetation.

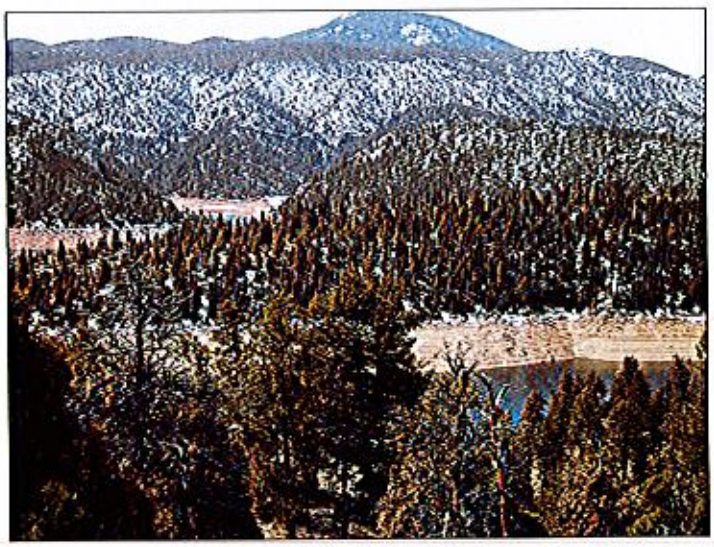
Following are several photos displaying vegetation, topography and tree removal method or other uses.



Stand 3 – Hand Fall, Grapple Skidder

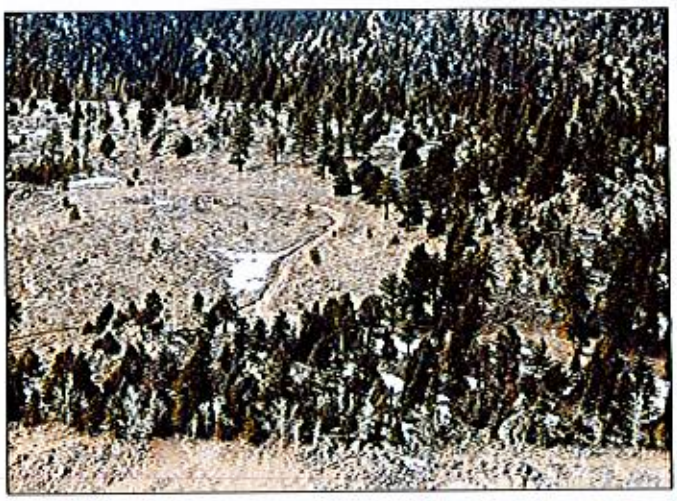


Stand 22 – Feller/buncher



Stand 24 - Cable

Stand 2 – Hand Fall, Grapple Skidder



Stand 20A – Main Helipad, ACDs

Stand 7 - Helicopter

Topography. Shoreline slopes range from 20% to well over 60%. **Map A** in the **Appendix** is a USGS contour map of the area. Because 40% slope is a usual guide to help determine whether ground-based logging systems are appropriate, **Map A** identifies slopes that are over 40 percent. **Table 2** lists the average slope of each stand, whether less than 40%, over 40% or a mix of under and over 40%. A **Gross Reservoir Map**, as listed in the **Appendices** and located in the report pocked, is a topographic map of the lake bottom. The **Gross Reservoir Map** is the only contour map of the lake bottom that the authors of this report found available. Because the cartographic controls are not known, the map is included for general reference purposes only.

Surface Soil Conditions. The shoreline soils are primarily comprised of a very porous decomposed granite. There is a very high density of small to large rock outcrops on all the slopes around the reservoir. These outcrops can have a substantial impact in selecting the appropriate type of tree removal system.

Access

Points to the lakeshore are the access road from Flagstaff Road east and north of the dam, Gross Dam Road to the south of the dam through Crescent to Highway 72, and from the west across Winiger Ridge using Forest Road 359 and the 68 Road. Portions of Forest Road 359 will need to be improved in order to haul the necessary equipment for logging, residue removal, etc.

Air Quality Considerations

Approximately fifty thousand tons of forest biomass are expected to be produced during the pool expansion clearing of Gross Reservoir. Most if not all of the material currently has little, if any, commercial value. Without a market the clearing residue becomes waste. Traditionally most of the slash would have been piled and burned in place. Any easily accessible firewood would have

been sold or given away. Today, burning large quantities of forest residue, in close proximity to residential areas, is problematic in the extreme.

Colorado Department of Health, Air Quality Division and the Bolder County Department of Health are responsible for stewardship of the air shed in the Gross Reservoir area. Two factors complicate the use of open burning on the large scale required for this project. Homes with year long residents are within a half mile to a mile of the most likely burn pile locations. Night time, down canyon air drainage, will concentrate smoke along Boulder Creek and well into the Boulder Area. This project will adversely impact air quality in the region for numerous days and nights.

None of the air quality regulations can be manipulated to allow the open burning of 50,000 tons of slash anticipated from the clearing. There is a full discussion of options for dealing with project residue in the Slash Disposal section of this report.

TREE REMOVAL SYSTEMS AND COSTS

Limited road access to the lakeshore, steep slopes and large rock outcrops complicate tree removal in most areas along the lake shoreline. Ground-based systems (hand-felling with rubber-tired grapple skidding and tracked feller/buncher) and cable yarding are used where existing roads are in place or where temporary road construction is possible along the shoreline. Helicopter yarding is employed where road access is not available or possible. Hydro-axing is recommended in the upper reaches of Forsythe Canyon (Stands 1 and 3) for tree removal due to steep slopes and heavy rock.

Table 2 identifies the recommended tree removal method and estimated costs for each stand. Production and costs were modeled using **'LOGCOST 8.0'** software developed by the USDA Forest Service Pacific Northwest Region. Total costs do not include improvements to Forest Road 395 across Winiger Ridge for hauling of equipment.

The use of specific equipment manufacturers names does not represent an endorsement by Land Stewardship Associates, LLC. Instead they are included only as representative equipment with certain production and operational capabilities and were used for modeling these capabilities in **'LOGCOST 8.0'**.

It should also be noted that the recommended tree removal methods for some of the units may leave pockets and stringers of trees due to steep pitches in slope and the presence of rock barriers. Throughout the removal area it may be necessary to use combinations of special spot removal techniques. This could include hand felling and the use of grapple skidders where feller/buncher is the prescribed method. In other units it may mean hand falling and short cable skidding where a grapple skidder was prescribed. For removal of trees on small rock bluffs prescribed for cable or some other technique, the use of helicopter may be necessary.

Piece size is the primary cost factor for all the logging systems used in the project. Many of the trees are small diameter and short in height. The project entails removal of as much of every tree

as possible to reduce floating debris once the reservoir reaches its new pool elevation. Accomplishing this objective means that smaller diameter trees and tops are skidded and removed from the harvest areas, further reducing average piece size. Most material is expected to be skidded whole-tree, i.e., with tops and limbs attached.

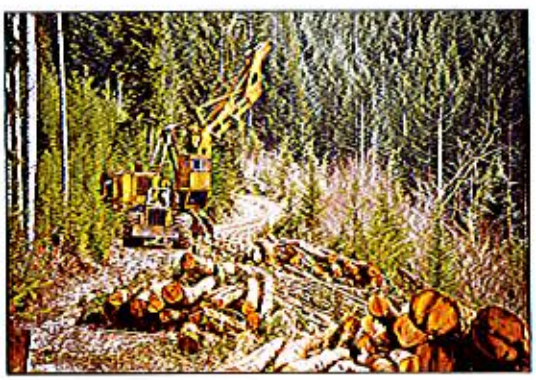
Ground-based Systems

The analysis was modeled in **'LOGCOST 8.0'** using a Cat 545B grapple skidder and hand felling with a medium-sized loader for conventional tractor operations; and a Timbco 425 EXL tilt tracked feller/buncher and JD 648 grapple skidder with medium loader for feller/buncher operations. Rubber-tired skidders were used for modeling due to their production rates, the amount of rock present in the project area and the general availability of that type of machine. Tracked skidders may be used in place of rubber-tired skidders if desired.

Example Grapple Skidder and Feller/Buncher

Cable System

The analysis uses a Linkbelt crane double drum yarder with an Eaglet Super carriage, a D6 landing cat and a medium loader.



Example High Lead Cable System

Helicopter System

The analysis was based on a light helicopter, e.g. Bell 210, with a payload of about 4800 pounds. Several of the harvest units (Stands 11A, 12, 13, 14A and 16A) use pre-bunching of the cut trees on centralized landings to increase helicopter efficiency and reduce costs. The helicopter landings are designated on **Map B** in the **Appendix** as H11, H13 and H16. The delivery point for all helicopter-yarded material is the main helipad located on the end of Winiger Ridge, accessed by Forest Road 359.

Example Bell 210 Helicopter

Example Hydro-ax

Hydro-ax

A Hydro-ax is recommended for tree removal in Stands 1 and 26 due to poor access, very low stocking levels, small trees, steep slopes and heavy rock. This machine can be worked around much of the rock and will reduce the trees and brush to small chunks which will readily decay.

Landings

Approximate landing locations for all yarding systems are shown on **Map B** in the **Appendix**. Helicopter landings are shown for Stands 11A, 12, 13, 14A and 16A. Helicopter landings H11 and H16 are located below the maximum existing pool elevation in order to utilize flatter terrain (see **Appendix** Gross Reservoir Contour map in report pocket). The remainder of the helicopter-yarded units are yarded directly from the stump to the main helipad.

Approximate landing locations for all other systems are shown on **Map B** in the **Appendix**. . Average yarding distance is generally less than 400 feet for ground-based and cable systems. Landings for Stands 2, 3, 3A, 8, 9, 10, 10A, 11, 16, and 17 are located below the existing maximum pool elevation to take advantage of flatter terrain features at the base of the tractor and feller/buncher units (see **Appendix** Gross Reservoir Contour map in report pocket). Pool elevations will need to be approximately 60 feet below maximum pool during logging operations to utilize these locations.

Temporary Roads

Temporary roads are needed to log Stands 2, 3, 3A, 8, 10, 10A, 11, 14, 15, 17, 24 and 24A and are shown on **Map B** in the **Appendix**, some of which are below existing maximum pool elevation as indicated on **Table 2.** Costs for the temporary roads are estimated at $1.00 per foot and are included in the logging system costs.

Costs

The costs between individual stands vary depending on slope, size of unit, number of stems per acre, move in/move out costs and the amount of temporary roads. Using the results of the **'LOGCOST 8.0'** analysis, the range and average costs per acre for each system are given in Table 1.

Table 1: Average Costs for Tree Removal Systems

System	Range in Costs ($/Acre)	Average Costs ($/Acre)
Cable	$4,400 - $4,700	$4,600
Feller/Buncher	$ 900 - $3,400	$1,500
Grapple Skidder	$1,000 - $6,200	$2,900
Hydro-ax	---	$750
Hellicopter	$2,000 - $13,500	$9,000

Access

From the west, across Winiger Ridge using Forest Road 359 and the 68 Road, a main helipad can be located in the open area designated as Unit 20A and adjacent open areas just north of Unit 20A. Unit 20A, and the area just north, are large enough and have favorable topography for safe helicopter operations and servicing plus enough area to locate decks of merchantable logs for resale. Chippers or Air Curtain Destructors can also be located in the Unit 20A area. As previously noted, the roads on Winiger Ridge (west side of the reservoir) will need some upgrading to bring them up to a standard needed for efficient access by helicopter refuel vehicles, timber utilization and transport of ACDs. The costs of improving the Winiger Ridge road are <u>not</u> included in this plan.

RECOMMENDED TREE REMOVAL METHODS

The following **Table 2** displays the tree removal/logging methods recommended for each of the stands identified on **Appendix I – Maps A and B**, and a number of other characteristics of the stands, including the costs of removal for each stand. Again, the costs include temporary road construction but <u>not</u> improvements to the Winiger Ridge road.

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Table 2: Recommended Tree Removal Methods for Stands

Stand ID	Slope (%)	Acres*	Dominant Vegetation**	Stems (#/AC)	Merch Vol (CCF)***	Tree Removal Method	Costs ($)	Match**** (Tract #)	Comments
1	Mix	6	J, PP, DF, Shrub	248	0	Hydro-ax	3,750	109	Not loggable
2	Mix	20	DF, PP	717	246	Hand fall, grapple skidder	68,550	103A	Lndngs/Temp Rds below 7282'
26	>40	5	J, PP, DF, Shrub	248	0	Hydro-ax	3,000	109	Not loggable
25	>40	3	J, PP, DF, Shrub	717	0	none	0	103A	Cliff, hand fell a few trees
3	>40	13	PP,DF,J	307	66	Hand fall, grapple skidder	21,250	65B	Lndngs/Temp Rds below 7282'
3A	Mix	20	PP,DF,J	307	105	Hand fall, grapple skidder	28,800	65B	
4	<40	6	DF, PP, J	125	31	Hand fall, grapple skidder	6,000	54A	
24	>40	27	DF, PP	1,170	76	Cable	120,900	58B	
24A	<40	8	DF, PP	1,170	18	Hand fall, grapple skidder	15,550	58B	
5	Mix	14	DF, PP	257	170	Hand fall, grapple skidder	37,350	47A	
22	<40	15	PP	307	75	Feller/buncher	19,750	65B	
18	<40	15	Shrub, Grass				0	Savanna	No treatment
23	<40	1	PP, DF	1,350	6	Hand fall, grapple skidder	4,300	65A	
21	<40	6	PP, DF	717	70	Feller/buncher	16,800	103A	
20	<40	8	PP	307	41	Feller/buncher	10,900	65B	
19	<40	4	PP	140	53	Feller/buncher	3,750	49A	
16	<40	28	PP, DF	717	352	Hand fall, grapple skidder	102,950	103A	Lndngs/Temp Rds below 7282'
16A	Mix	15	PP, DF	717	194	Helicopter	114,600	103A	
14	<40	5	PP, DF	1,350	25	Hand fall, grapple skidder	16,100	65A	
14A	>40	10	PP, DF	1,350	45	Helicopter	77,400	65A	Lndngs/Temp Rds below 7282'
15	>40	6	PP	307	30	Hand fall, grapple skidder	7,600	65B	
6	>40	20	PP, DF	386	126	Helicopter	85,800	108	
6A	>40	6	PP, DF	386	55	Cable	30,900	108	
13	Mix	35	PP, DF, J, Shrub	717	427	Helicopter	442,600	103A	
7	>40	4	DF, PP, J	125	21	Hand fall, grapple skidder	8,000	54A	
11	Mix	15	PP, DF	282	360	Hand fall, grapple skidder	72,450	60A	Lndngs/Temp Rds below 7282'
11A	>40	7	PP, DF	282	180	Helicopter	74,350	60A	Lndngs/Temp Rds below 7282'
12	>40	17	DF, PP	248	91	Helicopter	102,200	109	
8	<40	10	PP	307	47	Feller/buncher	12,550	65B	Lndngs/Temp Rds below 7282'
10	<40	6	PP	282	159	Hand fall, grapple skidder	32,500	60A	Lndngs/Temp Rds below 7282'
10A	Mix	31	DF, PP	248	161	Hand fall, grapple skidder	43,000	109	Lndngs/Temp Rds below 7282'

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Table 2: Recommended Tree Removal Methods for Stands (continued)

Stand ID	Slope (%)	Acres*	Dominant Vegetation**	Stems (#/AC)	Merch Vol (CCF)***	Tree Removal Method	Costs ($)	Match**** (Tract #)	Comments
9	<40	8	PP	218	84	Feller/buncher	8,550	107A	Lndngs/Temp Rds below 7282'
17	<40	12	PP	282	279	Hand fall, grapple skidder	68,400	60A	Lndngs/Temp Rds below 7282'
17A	>40	9	PP	282	231	Helicopter	121,500	60A	Lndngs/Temp Rds below 7282'
20A	<40	15	Grass, Rock, Shrub				0	Savanna	Helipad, ACDs, Log decks
Totals		**430**			**3,824**		**$1,782,100**		

* Includes removing trees to 7,410', or 10 feet above the new pool level of 7,400'.
** PP=ponderosa pine, DF=Douglas fir, J=Rocky Mountain juniper.
*** Merchantable Volume in Hundred Cubic Feet, assuming trees with 8" dbh and 20' height
**** Tracts from "Gross Reservoir Forest Management Plan Update", May 22, 2005.

Note: LSA considered the possibility of using a barge(s) in removing trees and moving residue. The use of barges could reduce the costs of temporary road construction, and a cable logging system could possibly be modified to pile trees and residue on a barge. However, it was concluded that the need for docking (loading/unloading) facilities, the need to maintain a full pool level, likely additional handling of the residues (loading and unloading) and the haul costs of barges to the reservoir would likely not make their use cost effective. If, however, barges will be needed during reconstruction of the dam, it may be prudent to evaluate their use at that time.

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RESIDUE (PRODUCTS AND SLASH) DISPOSAL

About fifty thousand tons of forest residues will be produced during the clearing phase of pool expansion for Gross Reservoir. Some of the residue can be turned into products (sawtimber, firewood, etc.) with the remaining material being slash (unmerchantable material).

Table 3: Residue Volumes for Stands (Tons)

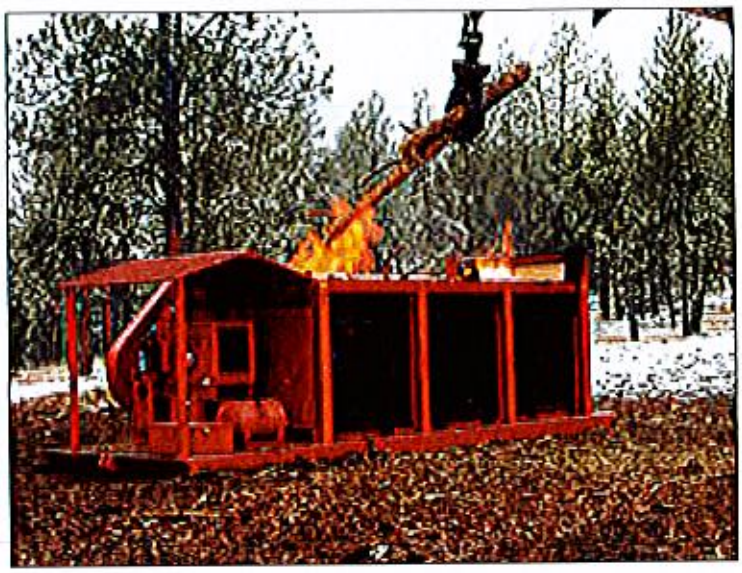
STANDS	ACRES	TONS/ACRE	TOTAL TONS
Stand 5	14	70.92	992.88
Stand 19	4	115.21	460.84
Stands 4 & 7	11	57.56	633.16
Stand 24 & 24A	35	206.63	7,232.05
Stands 10,10A,11,11A,17&17A	80	132.57	10,605.60
Stands 14 , 14A & 23	16	148.90	2,382.40
Stands 3,3A,8,15,20 & 22	72	106.24	7,649.28
Stands 2,13,16, 16A 21 & 25	107	159.59	17,076.13
Stand 9	8	93.94	751.52
Stand 6 & 6A	26	117.70	3,060.2
Stands 1,12 & 26	28	98.39	2,754.92
Totals	**401**		**53,598.98**

A traditional pile and burn approach to disposing of this material is no longer viable due to air quality concerns and regulations. To make the job less onerous, all opportunities to utilize some of the material need to be explored—see the discussion below in the **Potential Savings from Product Utilization** section of this report. Residue treatment options, with or without, utilization include: 1) burning in an air curtain destructor (ACD); 2) grinding whole trees and hauling to a landfill; 3) loading untreated residue into trucks and hauling to a landfill.

Each approach has its pros and cons. The following comparison of residue disposal methods is based on 2008 dollars and should be considered an approximation of the overall costs of each alternative. Perhaps the most important aspect of the analysis is the relative merits and costs of each approach.

Description of Residue Disposal Methods

Air Curtain Destructors are widely used in land clearing projects throughout the world. An ACD is a simple machine that is, in fact, a large mobile incinerator. Combustible material is loaded into the large bin and a fan blows a high pressure curtain of air across the top of the bin. The curtain recirculates combustible gases and smoke until only heat and a minimum of pollutants escape from the bin. ACDs have a 96 to 98 % reduction rate, so 2,000 pounds of slash turns into 40 to 80 pounds of ash. The ash is usually hauled to landfill.



Example Air Curtain Destructor

Operating an ACD is relatively simple. Brochures from Air Burners LLC describe the process. Slash is accumulated in large decks and a track hoe or loader with a thumb on the bucket is used to load the slash into the ACD. Each ACD will consume from 2 to 12 tons per hour depending upon the size of the unit. If one assumes a 12 ton/hour thru-put rate it will take 4,167 hours to burn all the slash anticipated from the clearing. A bank of several ACDs working simultaneously will speed the disposal process and efficiently utilize the track hoe or loader. Five ACDs working at peak efficiency can be expected to consume the slash in 833 hours. Equipment and personnel never run at peak efficiency 100% of the time. With 20% down time for maintenance and administrative gyrations the real burn time is closer to 1,000 hours for five ACDs working together. 1,000 to 2,000 tons of ash will be produced by the ACD operation and will need to be hauled to a landfill in a covered dump truck.

Grinding Whole Trees and Hauling to Landfill is another option for slash disposal. Large grinders are used to convert entire trees into rough chips. These chips can be used as fuel for steam generation, compost or simply dumped in a landfill. Currently there aren't any utilization opportunities in the steam generation or composting arena that will handle the amount of slash anticipated from this project. That leaves the landfill as the most likely contemporary solution.

Grinder operations are straight forward. Slash is decked in large piles and fed through the grinder with a track hoe or loader. The grinder blows chips into a pile or a truck and the chips are hauled to a landfill. If chips are not hauled off in a timely way, the chip pile can get large and take up a lot of space. Don Sanford from Spur Associates says they can grind 22.5 tons of dry logs in about twenty minutes. At this pace it will take 2,222 hours to grind the slash anticipated in this project. Realistically it will probably take 2,666 hours to grind the material when maintenance and administrative time is added. Obviously several grinders working at the same time will grind the material faster. Large chip vans, capable of holding

100 cubic yards of chips, will carry approximately 23 tons per load which equates to 2,174 truck loads. Grinding will produce 217,400 cubic yards of waste.

Loading and Hauling Whole Trees to a Landfill is the most primitive solution and perhaps the most expensive when haul costs and tipping fees are considered. Operationally it is the least complex approach. Trees are decked in several different locations. A track hoe with a grapple is used to load trucks. The loads are taken to a landfill. Stuffing entire trees in a truck is like trying to load cats in a bag. The loads will not be nearly as dense as chips, so many more truck loads will be required. The number of cubic yards resulting from this approach is 434,800.

Three landfills exist in the area: Denver Regional, Foothills and Front Range will accept the ash, chips or slash. Their tipping-fees range from $9.00 to $15.51 per cubic yard. Foothills Landfill is located at 8900 Hwy 93 near Golden and is closest to the project and also has the lowest tipping fee.

Table 4 summarizes the costs of disposing of residues using the above residue disposal methods.

Table 4: Residue Disposal Alternatives

ITEM	AIR CURTAIN DESTUCTOR	GRIND & LANDFILL DISPOSAL	WHOLE TREE HAUL & LANDFILL DISPOSAL
Tons of Residue	50,000	50,000	50,000
Cubic Yards to Landfill	3,613	217,400	434,800
Tipping Fees @ $9.00/yd	**$32,517**	**$1,956,600**	**$3,913,200**
Hours of operation	5,000	2,666	0
Operational costs/ton	$225	$525	0
Pre-haul costs	**$1,125,000**	**$1,399,650**	**0**
Load & haul to landfill $200/round trip	**$20,000**	**$434,800**	**$869,600**
Total Costs	**$1,177,517**	**$3,791,050**	**$4,782,800**
Cost/ton ($s)	**23.55**	**75.82**	**95.66**

Potential Savings by Product Utilization

If all of the residue generated from the shoreline clearing is disposed of by burning, it will take over four months with four Air Curtain Destructors (ACD) operating 12 hours a day, seven days a week with no breakdowns. Crews with equipment would need to be present at all times to feed the ACDs as they consume their loads. It includes over fifty thousand tons of forest residues (slash) a lot of which is tree stems over 6 inches in diameter and up to 50 feet long.

Removing merchantable material, such as logs and/or firewood, will reduce the volume of material to be treated. According to **'LOGCOST 8.0'**, generally 50% of a tree's above ground biomass is distributed in the crown (limbs, needles, and stem <4" diameter). As noted in **Table 2**, about 3,824 CCF (or about 1,800 MBF) of merchantable volume is included in the residue.

Removing and selling this material can reduce the residue volume by 25,000 tons, or 50 %, and can generate a substantial savings in residue disposal costs.

Table 5: Potential Savings by Removing Merchantable Products and/or Firewood from Residue

APPROACH TO RESIDUE DISPOSAL	AIR CURTAIN DESTRUCTOR	GRIND & LANDFILL DISPOSAL	WHOLE TREE HAUL & LANDFILL DISPOSAL
Dispose of 100% of the material removed from pool zone	$1,177,517	$3,791,050	$4,782,800
Remove merchantable sized/firewood material from residue disposal system	$588,758	1,895,525	2,391,400
Savings in Disposal from Utilization *	**$588,758**	**$1,895,525**	**$2,391,400**

* Does not include potential income from selling the merchantable material.

Market Situation for Merchantable Component of the Residue

Wood product prices vacillate according to market conditions. For example, the current market price for pine in this area in February 2008 is $5 to $10/ton. However, the prices are going down due to slowdowns in the housing market and because there is a surplus of pine. The surplus of pine on the market is caused by the mountain pine beetle epidemic in the Colorado and Wyoming lodgepole pine. Growing quantities of pine are being "dumped" on the market through service contracts and stewardship contracts where the logger is being paid to remove the dead or dying trees.

Aside from market conditions, most of the trees within the Gross Reservoir removal area are not highly desirable by the wood industry because of their relative short height and number of limbs (knots). Also, conventional logging truck access to most of the wood, even when decked, will be restrictive and expensive. However, there is a potential for conversion to a variety of small wood products. With the use of service contract(s) (subsidizing the logging or hauling cost depending on market conditions), disposal cost can be reduced if most of the logs (over 6 inches in diameter) were to be removed and utilized by the local wood product industry. Around the reservoir, Stands 4, 8, 9, 10, 16, 19, 20, 21, 22, and 23 are all on slopes that can be logged with conventional methods. With the use of service contracts, local loggers could clear cut and remove the timber on over 100 acres (the above listed Stands) and machine pile the slash for disposal later. One hundred acres is one fourth the total acreage and accounts for possibly 7,500 to 12,500 tons or 15 to 25 % of the total tonnage. **At current market prices of $5 to $10/ton, this could potentially generate $37,500 to $125,000 in income that could be applied to offset the project costs.** As previously discussed, the tonnage to be disposed could be reduced by 25,000 tons or 50% of the total if all the heavier pieces of wood throughout the removal area could be hauled away and utilized for firewood or some other wood product. Marketing the merchantable wood or paying a small fee to have it hauled to a local mill rather than burning it could generate substantial savings in disposal cost. Possibly the future tree removal contractor could consider salvaging the heavier (logs) when developing a proposal to remove all trees within 7410'.

Currently the most likely outlet for the small sized material coming from this project may be firewood sales or giveaway. There are approximately 3,800 cords of ponderosa pine and Douglas fir firewood within the area to be cleared. There will be a cost associated with disposing of the firewood. The least-cost approach will be to allow someone to salvage all the firewood for free. This approach will involve administering the salvage operation. The highest cost method to remove firewood from the slash is to buck and split all the wood and allow people to haul it off. The method selected depends on how much control Denver Water feels they need over the pace and quality of the firewood operation.

SUMMARY OF METHODS AND COSTS

Table 6 displays the costs for tree removal, options for residue removal and savings resulting from product utilization. The costs do not include improvement of the Winiger Ridge road (Forest Road #359). **In general, total costs range from $2.27 million for tree removal combined with product utilization and use of Air Curtain Destructors to as much as $6.51 million for tree removal and whole tree haul to a landfill without product utilization.**

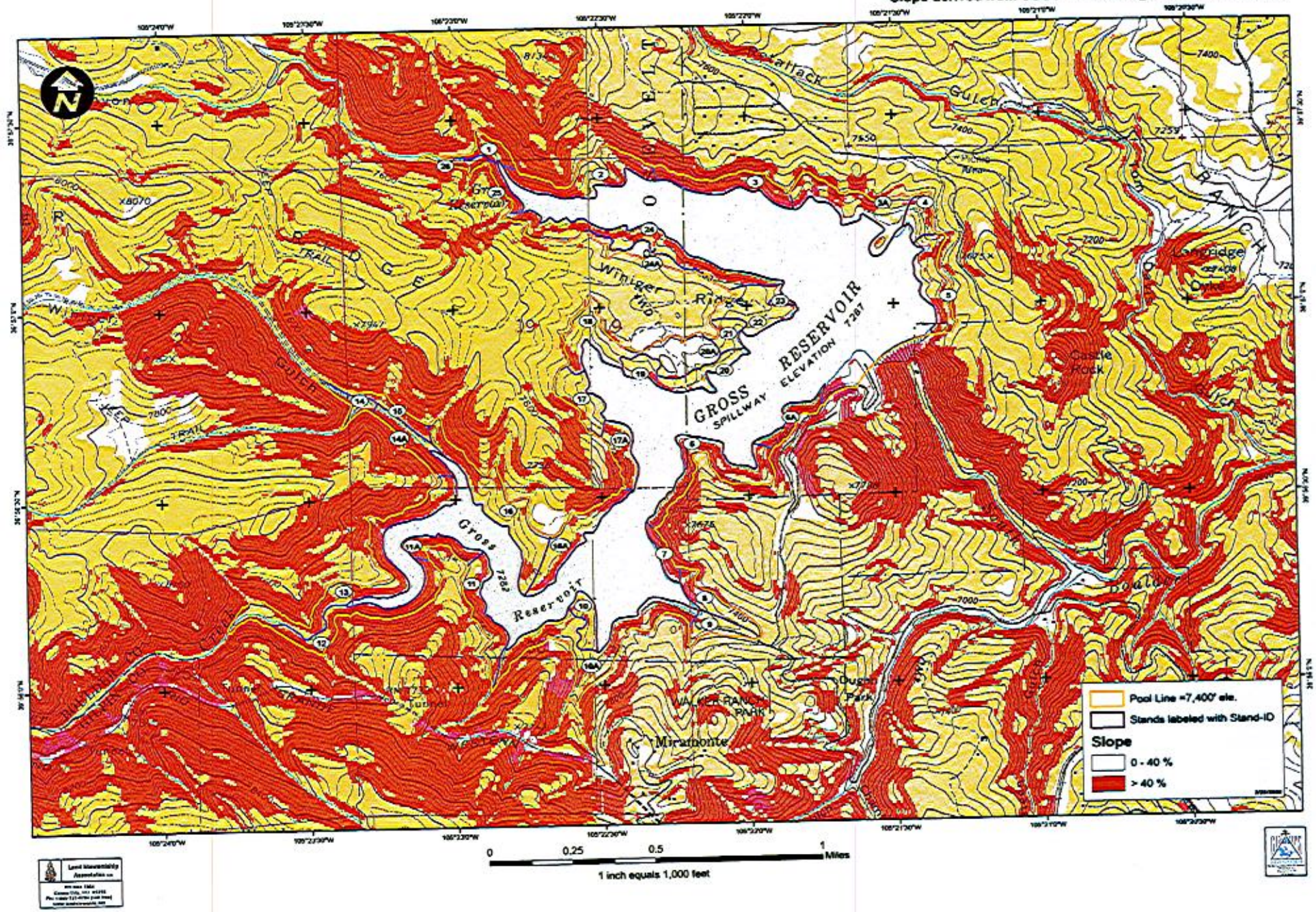
Table 6: Summary of Costs for Tree and Residue Removal and Utilization Reduction ($)

Tree Removal Costs*	Residue Removal Costs **			Tree & Residue Removal Costs	Utilization Savings Reduction***	Total Costs****
	Air Curtain Destructors	Grind & Landfill	Whole Tree To Landfill			
$ 1,782,100	$ 1,177,517			$ 2,959,617	$ 688,758	$ 2,270,859
$ 1,782,100		$ 3,791,050		$ 5,573,150	$ 1,995,525	$ 3,577,625
$ 1,782,100			$ 4,728,800	$ 6,510,900	$ 2,491,400	$ 4,019,500

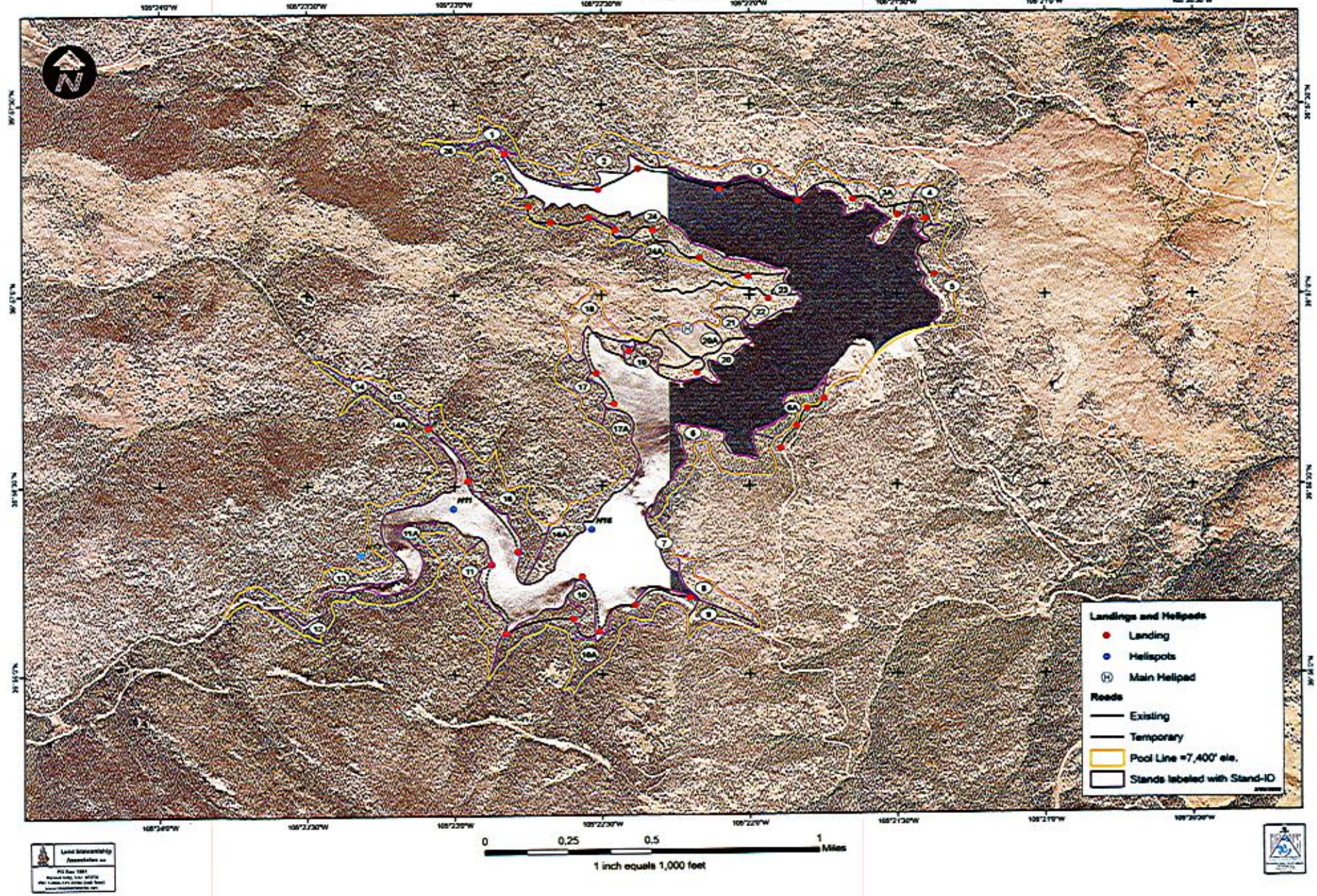
* From Table 2.
** From Table 4—includes load and haul costs to landfill.
*** In addition to savings from Table 5, utilization reduction includes $100,000 from product sales assuming 10,000 tons at a market value of $10/ton.
**** Does not include costs associated with improvement of the Winiger Ridge road (#359)

Map A - Slope, Pool Line & Stands - Gross Reservoir Area

Slope derived from USGS 10 meter digital elevation models



Map B - 2005 NAIP aerial with Stands, Landings, Roads and Helispots - Gross Reservoir Area



APPENDIX II: REFERENCES

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Timberjack Harvesting Machine Sales Manual TPBS-1032-9-97

Wenger, Karl F. 1984 "Forestry Handbook" second edition. Society of American Foresters.

Zahn, Susan, 2005, "The Use of Air Curtain Destructors for Fuel Reduction and Disposal", USFS, Fire Management Tech Tips, 5100, 0551 1303P-SDTDC.

APPENDIX III: LIST OF POTENTIAL OPERATORS/MILLS

Mill Creek Enterprises

125 W. Swallow Road Fort Collins, CO 80525 970-207-9428	e-mail	andreMCE@Juno.com
	website	

PRODUCTS: High-quality mulch derived from Colorado slash.

Morgan Timber Products

5722 W. County Rd. 54E Bellvue, CO 80512-7101 970-484-4065	e-mail	mtpksm@hotmail.com
	website	

PRODUCTS: Western Rail fencing (2,3 &4 rail) both massive and standard size. Field posts, rails, barnpoles, houselogs, handrail, security fence, privacy fence, timbres, specialty wood products, firewood, peelings, chips, mulch.

Rocks & Pines Forest Products

e-mail	rocksandpines@juno.com
website	

PRODUCTS: Treated and untreated fence posts, corral poles, barn poles, log railings and buck fence. Pole gates and hardware. Western rail/tenon-jointed 2, 3 and 4 fencing. Burled character logs, furniture materials, mulch and livestock bedding from shavings. Firewood in cords or bundled.

Renewable Fiber

8395 U.S. Hwy. 85 P.O. Box 205 Fort Lupton, CO 80621 303-857-0763	e-mail	cspaulding@renewablefiber.com
	website	www.renewablefiber.com

PRODUCTS: Compost and soil products; mulch and bark products; rock products; edging and supplies, animal bedding; landscape timbers; truckload quantities of firewood; and bioenergy fuel.

United Wood Products Inc.

7860 Diagonal Hwy. Longmont, CO 80503-8760 303-652-2872	e-mail	uwp@unitedwoodproductsinc.com
	website	unitedwoodproductsinc.com

PRODUCTS: Rough-sawn pine, aspen, slabwood, custom sawing and machining, specialty fencing, tongue & groove aspen & pine. Log-rail systems (unpeeled, machine-peeled and hand-peeled) made to fit. Logs with bark, machine peeled or hand-peeled, custom ripping, grooving and cutting of logs. Unpeeled, machine-peeled or hand-peeled posts, poles or rails. Western rail or tenon-joint fence, buck fence, log gates and hardware, firewood, mulch, animal bedding and wood chips.

Armstrong Helicopters, LLC

1251 Haystack Dr. Castle Rock, CO 80104 877-777-9188	e-mail website

PRODUCTS: Flies UH1-F/H – a military version of Bell 210

Precision Helicopters

HCR 85, Box 139X Bonners Ferry, ID 83805 208-267-2169	e-mail website

PRODUCTS: Flies UH1-H AND Kaman HH43 B/F

Swanson Group Aviation

2794 Foothill Blvd Grants Pass, OR 97526 541-494-7600	e-mail website

PRODUCTS: Flies Kaman K-Max – payload to 6,000 lbs but costs similar to Bell 210

Intermountain Resources, LLC

11925 6530 Road Montrose, CO 81401 970-249-0812	e-mail website

PRODUCTS: Uses all species but aspen. Has conventional, feller/buncher and cable

Rue Logging, Inc.

PO Box 155 South Fork, CO 81154 719-873-5862	e-mail website

PRODUCTS: Conventional and feller/buncher logging, also has Hydroax

APPENDIX IV: RESIDUE VOLUME CALCULATIONS

Stand 5 (14 acres) (Match 47A)

SPECIES	DBH (INCHES)	HEIGHT (FEET)	TREES/ ACRE	WEIGHT/ TREE	#/ ACRE	TOTAL TONS
Doug fir	4	30	114	190	21660	
Doug fir	7	40	38	488	18544	
Doug fir	8	45	28	718	20104	
Ponderosa	8	35	28	718	20104	
Doug fir	10	48	18	958	17244	
Doug fir	12	50	31	1425	44175	
Total			257		141831	992.88

Stand 19 (4 acres) (Match 49A)

SPECIES	DBH (INCHES)	HEIGHT (FEET)	TREES/ ACRE	WEIGHT/ TREE	#/ ACRE	TOTAL TONS
Ponderosa	11	30	30	1176	35280	
Ponderosa	12	32	51	1514	77214	
Ponderosa	13	22	22	1790	39380	
Ponderosa	14	31	37	2123	78551	
Total			140		230425	460.84

Stands 4 & 7 (10 acres) (Match 54A)

SPECIES	DBH (INCHES)	HEIGHT (FEET)	TREES/ ACRE	WEIGHT/ TREE	#/ ACRE	TOTAL TONS
Ponderosa	8	22	28	718	20104	
Doug fir	8	20	28	718	20104	
Doug fir	9	31	45	839	37755	
Rocky Mtn Juniper	10	26	18	958	17244	
Doug fir	17	35	6	3320	19920	
Total			125		115127	575.60

Stand 24 (31 acres) (Match 58B)

SPECIES	DBH (INCHES)	HEIGHT (FEET)	TREES/ ACRE	WEIGHT/ TREE	#/ ACRE	TOTAL TONS
Ponderosa	4	17	458	190	87020	
Doug fir	4	15	229	190	43510	
Ponderosa	6	20	102	399	40698	
Ponderosa	7	20	299	546	163254	
Doug fir	8	21	57	718	40926	
Ponderosa	12	24	25	1514	37850	
Total			1170		413258	6,405.53

Stands 10, 11 & 17 (44 acres) (Match 60A)

SPECIES	DBH (INCHES)	HEIGHT (FEET)	TREES/ ACRE	WEIGHT/ TREE	#/ ACRE	TOTAL TONS
Ponderosa	8	35	57	718	40926	
Ponderosa	9	38	136	839	114104	
Ponderosa	10	40	37	958	35446	
Ponderosa	11	40	30	1176	35280	
Ponderosa	13	44	22	1790	39380	
Total			282		265138	5833.08

Stands 14 & 23 (14 acres) (Match 65A)

SPECIES	DBH (INCHES)	HEIGHT (FEET)	TREES/ ACRE	WEIGHT/ TREE	#/ ACRE	TOTAL TONS
Doug-fir	3	18	1,018	123	125214	
Doug-fir	4	18	229	190	43510	
Doug-fir	7	32	38	546	20748	
Ponderosa	8	17	28	718	20104	
Ponderosa	12	20	12	1514	18168	
Doug fir	13	25	11	1790	19690	
Doug fir	14	27	10	2123	21230	
Ponderosa	22	55	4	7286	29144	
Total			1,350		297808	2084.60

Stands 3,3A,8,15,20 & 22 (68 acres) (Match 65B)

SPECIES	DBH (INCHES)	HEIGHT (FEET)	TREES/ ACRE	WEIGHT/ TREE	#/ ACRE	TOTAL TONS
Ponderosa	5	16	147	286	42042	
Ponderosa	6	17	102	399	40698	
Ponderosa	10	15	37	958	35446	
Ponderosa	17	30	13	3320	43160	
Ponderosa	21	35	8	6392	51136	
Total			307		212482	7224.32

Stands 2,13,16,21 & 25 (99 acres) (Match 103A)

SPECIES	DBH (INCHES)	HEIGHT (FEET)	TREES/ ACRE	WEIGHT/ TREE	#/ ACRE	TOTAL TONS
Ponderosa	4	14	229	190	43510	
Ponderosa	5	16	147	286	42042	
Ponderosa	6	28	102	399	40698	
Ponderosa	7	25	75	546	40950	
Ponderosa	8	30	57	718	40926	
Ponderosa	9	35	45	839	37755	
Doug fir	10	40	37	958	35446	
Doug fir	12	44	25	1514	37850	
Total			717		319177	15799.41

Stand 9 (7 acres) (Match 107A)

SPECIES	DBH (INCHES)	HEIGHT (FEET)	TREES/ ACRE	WEIGHT/ TREE	#/ ACRE	TOTAL TONS
Ponderosa	7	30	75	546	40950	
Ponderosa	9	32	45	839	37755	
Ponderosa	10	34	37	958	37446	
Ponderosa	11	35	61	1176	71736	
Total			218		187887	657.58

Stand 6 (25 acres) (Match 108)

SPECIES	DBH (INCHES)	HEIGHT (FEET)	TREES/ ACRE	WEIGHT/ TREE	#/ ACRE	TOTAL TONS
Ponderosa	6	12	102	399	40698	
Doug fir	6	16	102	399	40698	
Doug fir	7	16	75	546	40950	
Ponderosa	9	23	45	839	37755	
Ponderosa	10	32	37	958	37446	
Doug fir	12	25	25	1514	37850	
Total			386		235397	2942.60

Stands 1, 10A, 12 & 26 (54 acres) (Match 109)

SPECIES	DBH (INCHES)	HEIGHT (FEET)	TREES/ ACRE	WEIGHT/ TREE	#/ ACRE	TOTAL TONS
Ponderosa	6	12	102	399	40698	
Ponderosa	8	19	57	718	40926	
Doug fir	9	22	45	839	39105	
Doug fir	11	24	30	1176	35280	
Ponderosa	16	28	14	2912	40768	
Total			248		196777	5313.06

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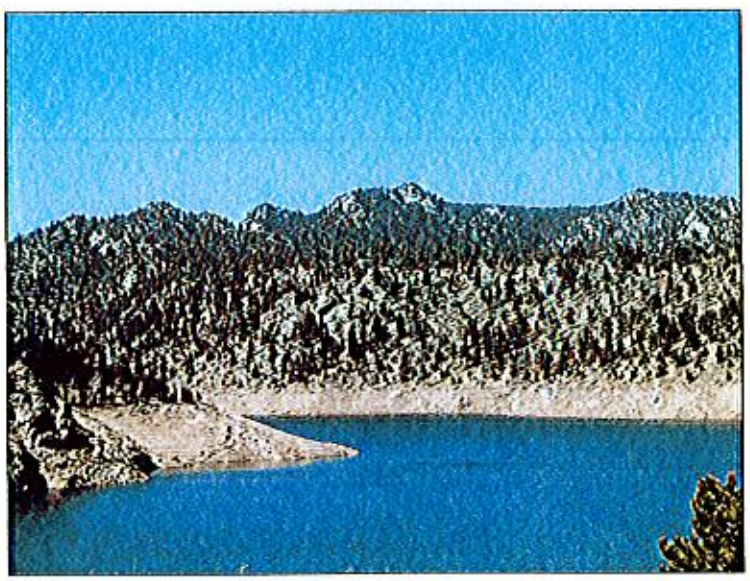
SUPPLEMENT

TO

GROSS RESERVOIR

TREE REMOVAL PLAN FOR POOL ENLARGEMENT



October, 2008

Prepared by Land Stewardship Associates, LLC

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Table of Contents

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INTRODUCTION

The Colorado State Forest Service and Denver Water Department asked Land Stewardship Associates (LSA), LLC, to develop an alternative that involved greater use of helicopters for tree removal and elimination of temporary road construction below the current high water level of 7,287'. In addition, LSA was asked to evaluate a "green option" for residue recycling and identify haul/transportation routes for ingress and egress to the various stands. This report addresses the above concerns and should be considered a "supplement" to the original report titled "Gross Reservoir Tree Removal Plan for Pool Enlargement", February and July, 2008. The original report will be referred to as the "Plan" in this Supplement. This Supplement needs to be used in conjunction with the Plan, because some of the discussions reference material displayed in the Plan. While LSA prepared the report, a "thank you" goes to Chuck Dennis, Colorado State Forest Service, who did some of the field work, i.e. evaluated needs for access and reconstruction along FR 359 and field observations of the John Deere Slash Bundler, 1490D demonstration at Silverthorne.

ALTERNATIVE TREE REMOVAL METHOD

Six stands involving 85 acres were converted from cable (24 & 6A) and hand fall/grapple skidder (2, 3, 7 & 11) logging systems to a helicopter system (see Plan Maps A and B for location of Stands). All temporary roads below the high water line of 7,287' were removed, and new temporary roads were added as needed above the 7,287" level.

Table S1: Alternative Tree Removal Method for Stands contains the results of the **'LOGCOST 8.0'** analysis. Costs increased approximately $ 306,500 by converting to helicopter systems. Temporary roads above the high water line of 7,287' are incorporated in the cost estimates. The costs do not include reconstruction costs for the Winiger Ridge roads.

Map S1: Temporary Roads, Landings & Helispots for Alternative Tree Removal provides a display of the new landings, temporary roads and helispots. In addition, it identifies primitive roads on Winiger Ridge that will need some rebuilding. Discussions with USDA Forest Service indicate the Arapaho/Roosevelt National Forest is willing to work with, and permit, the Denver Water Department to do the reconstruction.

The logging systems analysis assumes that all whole tree logs would be lifted and placed at a landing near the main helipad. The helipad would be located at a favorable site in or adjacent to Stand 20A. The blue dots labeled as helispots on *Map* S1 are also called "pivot points" and are used to determine the most efficient routes for helicopters. In locating these helispots or pivot points, consideration was given to identifying areas with relatively flat ground that could be used as temporary or intermediate helicopter landings if necessary.

"GREEN" OPTION FOR RESIDUE RECYCLING

New technology has provided the opportunity to recycle slash more efficiently by use of a "slash bundler". Using a boom to place the slash, the bundler wraps/bundles the slash with nylon or bio-degradable sisal string and cuts the "slash log" to a predetermined length. The bundles are easier to handle and haul to recycling facilities. The bundling can reduce the volume by as much as 50 to 80%. In addition, by letting the bundles dry at landings, the ultimate hauling weight can be reduced substantially.

As Plan, Table 4 indicates, the logging will produce about 50,000 tons of residue, which involves roughly ½ being tree-top slash and the other ½ being boles with firewood and lumber in it. The slash will be placed in landings next to the helipad for helicopter logging or on the field landings for hand fall/grapple

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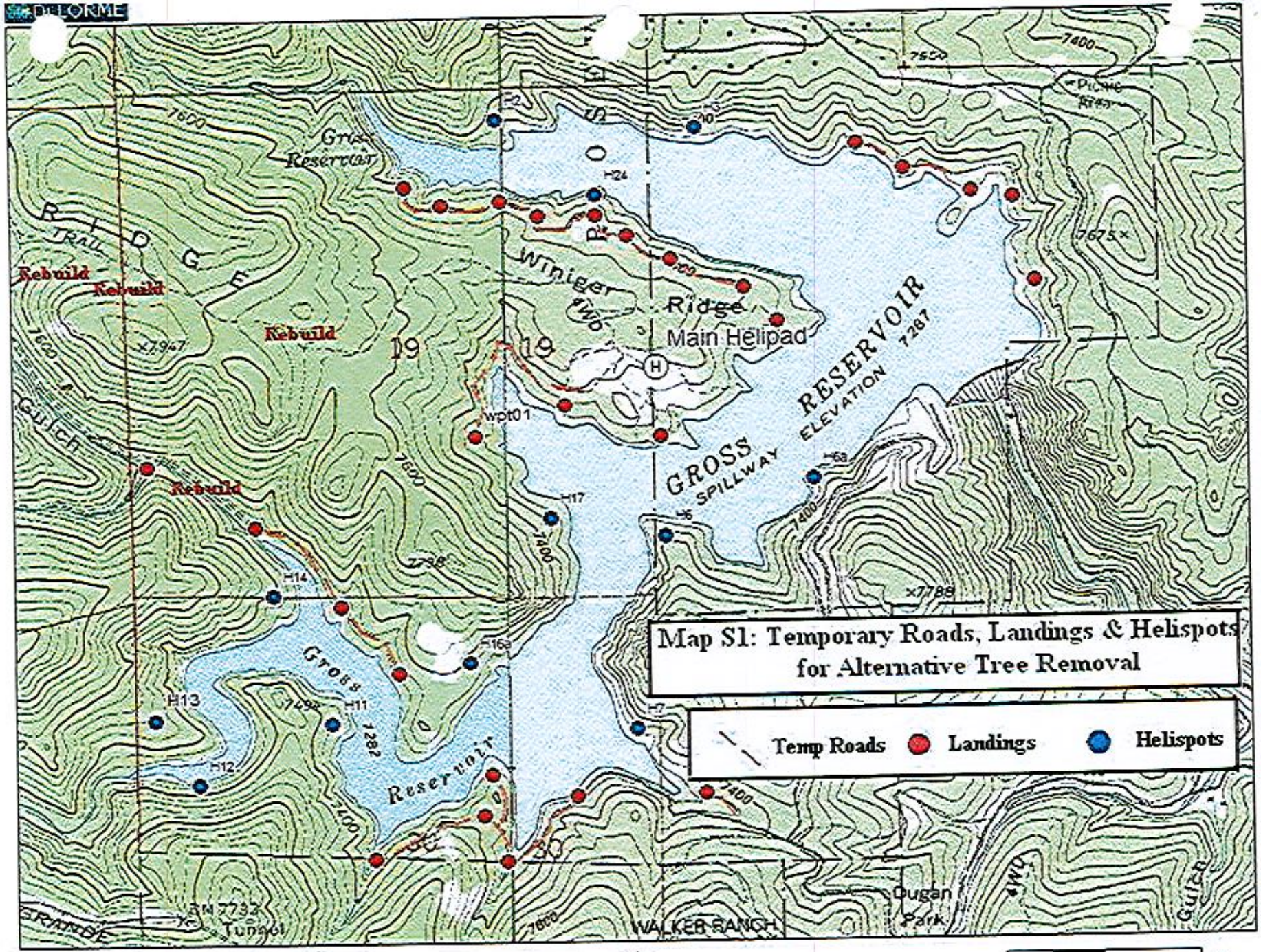
Table S1: Alternative Tree Removal Methods for Stands

Stand ID	Slope (%)	Acres*	Dominant Vegetation**	Stems (#/AC)	Merch Vol (CCF)***	Tree Removal Method	Costs ($)	Match**** (Tract #)	Comments
1	Mix	6	J, PP, DF, Shrub	248	0	Hydro-ax	3,750	109	Not loggable
2	Mix	20	DF, PP	717	246	**Helicopter #**	182,000	103A	
26	>40	5	J, PP, DF, Shrub	248	0	Hydro-ax	3,000	109	Not loggable
25	>40	3	J, PP, DF, Shrub	717	0	none	0	103A	Cliff, hand fell a few trees
3	>40	13	PP,DF,J	307	66	**Helicopter #**	49.000	65B	
3A	Mix	20	PP,DF,J	307	105	Hand fall, grapple skidder	28,800	65B	
4	<40	6	DF, PP, J	125	31	Hand fall, grapple skidder	6,000	54A	
24	>40	27	DF, PP	1,170	76	**Helicopter #**	153,700	58B	
24A	<40	8	DF, PP	1,170	18	Hand fall, grapple skidder	15,550	58B	
5	Mix	14	DF, PP	257	170	Hand fall, grapple skidder	37,350	47A	
22	<40	15	PP	307	75	Feller/buncher	19,750	65B	
18	<40	15	Shrub, Grass				0	Savanna	No treatment
23	<40	1	PP, DF	1,350	6	Hand fall, grapple skidder	4,300	65A	
21	<40	6	PP, DF	717	70	Feller/buncher	16,800	103A	
20	<40	8	PP	307	41	Feller/buncher	10,900	65B	
19	<40	4	PP	140	53	Feller/buncher	3,750	49A	
16	<40	28	PP, DF	717	352	Hand fall, grapple skidder	102,950	103A	
16A	Mix	15	PP, DF	717	194	Helicopter	114,600	103A	
14	<40	5	PP, DF	1,350	25	Hand fall, grapple skidder	16,100	65A	
14A	>40	10	PP, DF	1,350	45	Helicopter	77,400	65A	
15	>40	6	PP	307	30	Hand fall, grapple skidder	7,600	65B	
6	>40	20	PP, DF	386	126	Helicopter	85,800	108	
6A	>40	6	PP, DF	386	55	**Helicopter #**	36,250	108	
13	Mix	35	PP, DF, J, Shrub	717	427	Helicopter	442,600	103A	
7	>40	4	DF, PP, J	125	21	**Helicopter #**	8,000	54A	
11	Mix	15	PP, DF	282	360	**Helicopter #**	239,300	60A	
11A	>40	7	PP, DF	282	180	Helicopter	74,350	60A	
12	>40	17	DF, PP	248	91	Helicopter	102,200	109	
8	<40	10	PP	307	47	Feller/buncher	12,550	65B	
10	<40	6	PP	282	159	Hand fall, grapple skidder	32,500	60A	
10A	Mix	31	DF, PP	248	161	Hand fall, grapple skidder	43,000	109	

Table S1: Recommended Tree Removal Methods for Stands (continued)

Stand ID	Slope (%)	Acres*	Dominant Vegetation**	Stems (#/AC)	Merch Vol (CCF)***	Tree Removal Method	Costs ($)	Match**** (Tract #)	Comments
9	<40	8	PP	218	84	Feller/buncher	8,550	107A	
17	<40	12	PP	282	279	Hand fall, grapple skidder	68,400	60A	
17A	>40	9	PP	282	231	Helicopter	121,500	60A	
20A	<40	15	Grass, Rock, Shrub				0	Savanna	Helipad, ACDs, Log decks
Totals		**430**			**3,824**		**$2,088,650**		

* Includes removing trees to 7,410', or 10 feet above the new pool level of 7,400'.
** PP=ponderosa pine, DF=Douglas fir, J=Rocky Mountain juniper.
*** Merchantable Volume in Hundred Cubic Feet, assuming trees with 8" dbh and 20' height
**** Tracts from "Gross Reservoir Forest Management Plan Update", May 22, 2005.
# New helicopter logging stands to remove temporary roads from below the 7,287" high water level.



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www.delorme.com

skidder stands (see *Map S1: Gross Reservoir Temp Roads, Landings and Helispots* for location of the landings).

John Deere 1490D Slash Bundler

Using the manufacturer's studies for the John Deere 1490D Slash Bundler (see *Appendix III*) and conservative or low productivity data (15 bundles/hour), which indicates bundling costs of about $22.16/ton, the cost of bundling 25,000 tons of tree tops slash would be about $554,000 Assuming that the bundler will reduce volume of slash by 30 percent, hauling costs would involve about 1,537 round trips costing $307,434. With tipping fees assumed to be $7/yard (from A-1 Organics at Platteville) or $1,065,260, **total costs for bundling, hauling and tipping the bundled tops would be about $1,619,260.**

Further assuming that the other 25,000 tons of the slash (boles) is utilized for firewood and sawtimber it would take about 926 round trips to the mills, costing $185,200. With a conservative market value of $10/ton, as assumed in the Plan, and that the boles would yield about 10,000 tons of merchantable material, $100,000 could be applied to the hauling costs, reducing hauling to $85,200. Adding this to the above bundling/hauling/tipping costs for tree tops, would indicate that **total costs for bundling, hauling and tipping the tops, and hauling and selling part of the boles would be about $1,704,460.**

Adding the original Plan's logging cost of $1,782,000, total cost is $3,486,460, which is about the same as the Grind and Landfill total costs (see Plan Table 6, last column). Using the alternative logging costs of $2,088,650 from *Table S1: Alternative Tree Removal Methods for Stands*, total costs for logging more with helicopters and removing the residue tree tops by bundling and utilizing some of the tree boles for lumber, **total costs are estimated at $3,793,110.**

It should be noted that the bundler is new technology and at this time there are no operators in Colorado that have a bundler. However, several contractors within the State have indicated an interest in purchasing a bundler. For future reference, *Appendix II* of this Supplement is a list of contractors for each of the Front Range CSFS Districts.

Also, markets for bundler products have not been developed. For example, landscape material producers have indicated that they would like the material but would charge a tipping fee at their manufacturing site. However, over time it is hoped that markets would be developed, such as landscape chips and ground cover, pellets for fuel and maybe even soil/ditch erosion barriers.

In general, it should be noted that the forest products markets are highly volatile, especially in this time of economic downturn. For example, at least one mill indicated they might be willing to pay up to $30/ton for pine depending on the condition of the timber. These opportunities should be evaluated prior to implementing the project.

TRANSPORTATION

Temporary Roads

Temporary roads are needed to log Stands 3A, 4, 5, 8, 10, 10A, 16, 17, 18, 19, 24 and 24A and are shown on *MapS1*. Costs for the temporary roads are estimated at $1.00/foot and are included in the logging system costs.

Long haul log forwarders may be a benefit on this project. Cost of a long haul log forwarder is about $360,000.

Access/Haul Routes

Gross Reservoir should be accessed primarily from State Highway (SH) 72 which connects with SH 93 between Golden and Boulder. An alternative route on Flagstaff Road can be used, however the distance to SH 93 through the mountains and foothills is longer.

The **NE** and **SE Haul Routes** use Gross Dam Road. Gross Dam Road intersects SH 72 at Crescent Village and goes north to the reservoir. Denver Water maintenance buildings in Nineteen Gulch are along Gross Dam Road and are about 3 miles north of SH 72. The **Winiger Ridge Haul Route** uses County Road (CR) 97, going north, which is about ¼ mile north of Pinecliffe along SH 72. See *Table* S2:*Stands and Volumes for Haul Routes* for a summary.

NE (Northeast) Haul Route – Existing and new temporary roads for stands 3A, 4 and 5 will access Gross Dam Road close to the intersection of Gross Dam Road and Flagstaff Road. Trucks and equipment would go south about 4.5 miles on Gross Dam Road to SH 72.

SE (Southeast) Haul Route – New temporary roads for Stands 8, 9, and 10A will be accessed by using the boat ramp road, which runs south and east of the reservoir for about 1.5 miles and connects with Gross Dam Road at the maintenance building sites in Nineteen Gulch. Trucks and equipment would go south for about 3 miles on Gross Dam Road to SH 72.

Winiger Ridge (West) Haul Route – The remaining stands, main helipad, possible location for ACD's and general staging areas, landings and log decks, etc. will be accessed on Forest Road (FR) 359 (sometimes called Winiger Ridge Road). Going west and south, the route goes about 8 miles from FR 359 to CR 68 and CR 123 to reach CR 97, which connects with SH 72 near Pinecliffe. CR 97E has a private land gate on it so it is not recommended for access to the old Winiger Gulch road or stands. A new temporary road will likely need to be constructed from the old Winiger Gulch road to the Winiger Ridge road (FR 359). This temporary road is identified to "rebuild" on *Map S1*.

Sections of FR 359 will need rebuilding/reconstruction on some turns and grades. These areas are identified as "rebuild" on *Map S1*. The costs of this reconstruction is not included in this Supplement or the original Plan.

Table S2: Stands and Volumes for Haul Routes

Route	Stands	Haul Volume (tons)
NE (northeast)	3A,4,&5	3,462
SE (southeast)	8,9,10,&10A	5,565
Winiger Ridge (west)	2,3,6,6A,11,11A,12,13,14,14A,15,16, 16A, 17,17A,19,20,21,22,23,24&24A	44,572

SUMMARY OF METHODS AND COSTS

Table 3:Summary of Costs for the Alternative Tree Removal Method, Residue Removal Options including use of Bundler, and Utilization Reduction ($) displays the costs for tree removal using more helicopter logging, options for residue removal including use of a bundler for tree tops, and savings resulting from product utilization. The costs do not include improvement of the Winiger Ridge road (Forest Road 359). **In general, total costs range from $2.58 million for tree removal combined with product utilization and use of Air Curtain Destructors to as much as $6.82 million for tree removal and whole tree haul to a landfill without product utilization. Total costs when using the "Green Option" is similar in cost to chipping and hauling to the landfill.** Table S3 can be used in conjunction with Table 6 in the original Plan to obtain a summary of information on use of cable and other more conventional logging systems.

Table S3: Summary of Costs for the Alternative Tree Removal Method, Residue Removal Options including use of Bundler, and Utilization Reduction ($)

Alternative Tree Removal Costs*	Residue Removal Costs ($) **				Tree & Residue Removal Costs ($)	Utilization Savings*** Reduction ($)	Total Costs**** ($)
	Air Curtain Destructor	Grind & Landfill	Whole Tree To Landfill	Bundle Tops Utilize Boles			
$2,088,650	1,177,517				$ 3,266167	$ 688,758	$ 2,577409
$2,088,650		3,791,050			$ 5,879,700	$ 1,995,525	$ 3,884,175
$2,088,650			4,728,800		$ 6,817,450	$ 2,491,400	$ 4,326,050
$2,088,650				1,704,460 #	$3,793,110 #	0	$3,793,110

* From Table 1S.

** From Plan Table 4 for ACD's, Grind & Landfill and Whole Tree to Landfill—includes load and haul costs to landfill.

*** In addition to savings from Table 5, includes $100,000 from product sales assuming 10,000 tons at a market value of $10/ton.

**** Does not include costs associated with improvement of the Winiger Ridge road (FR 359)

\# Includes Utilization Savings.

APPENDIX I – CONTRACTOR LISTS

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Woodland Park Contractor List

Work Phone	Fax	Cell	Email	Web Address	Services
(719) 687-2870		(719) 207-2647			Large scale transplant sales
(719) 531-0929			jmcgannon@msn.com		Forest Management plans, Landscape damage appraisals, General natural resource management
(719) 684-2333					Revegetation/forest management, sick tree diagnosis, windbreak design, home wildfire protection, landscape design, erosion control
(719) 630-3209			beckywegner@mountainnightree.com		Sick tree inspections, tree damage appraisals, management plans, timber marking
		(719) 661-4603	chapeljason@yahoo.com		Tree removal
(303) 838-5312					Forest Thinning, pruning, tree transplanting, fire mitigation
(719) 836-7166					Bug tree removal, defensible space, fire mitigation/general thinning
(719) 761-7663	(206) 339-5637	(719) 761-7663	wwoodreul@aim.com		Tree removal/purning (included MPB & hazard trees). Chipping, defensible space, firewood sales-splitting, forest thinning residential and commercial.
(719) 481-4662	(719) 481-4662				Slash & hazard tree removal, dwarf mistletoe control, wildland fire safety consultations, free estimates
(719) 684-2093	(719) 587-5687	(719) 237-3911			bark beetle removal, wildfire mitigation, has an ASB skidloader with a mulching bull head attachment and grapple attachment
(303) 665-3473			rod@anchorpointgroup.com	www.AnchorPointGroup.com	Forest Ag tax plans, Community Wildfire Prevention Plans, Forest Mgmt. plans, Prescribed fire planning & implementation, fire training
(719) 395-2696		(719) 337-2756		www.aquaticalt.com	Forest thinning, erosion control, fire mitigation, brush removal
(719) 684-2336					17 yrs. Exp. In Teller, Park, & El Paso counties.
(719) 686-0249					Fire mitigation, grinding, earthwork (i.e. erosion control)
(719) 596-1645					Black Forest, Monument, Calhan
(719) 495-8328		(303) 660-9662			Tree spraying
(719) 494-4494					Transplanting
(719) 748-0033	(719) 748-0007		jonathan@uppersouthplatte.net		Upper South Platte Watershed, fuel mitigation, fire rehab
(970) 214-7677			coloradoforestmanagement@comcast.net	doforestmanagement/	Forest stewardship management plans, Forest ag management plans
(719) 237-7016			bostoncolorado@peakinet.net		timberframe sturctures, log railing, hardwoods, custom beams from thinning operations
(719) 481-4916					Gardening, landscaping, forestry. Dwarf mistletoe/mountain pine beetle detection, marking for thinning, planting, management plans
(719) 638-1210	(719) 638-1233	(303) 755-7452	brett.lemain@davey.com	www.davey.com	Residential & Commercial: Insect & Disease control, lawn aeration, fertilization & weed control, tree & shrub pruning, removal, cabling
(719) 687-0781			DivideTimber@aol.com		
(303) 205-1915			mbw9245@comcast.net		Certified Forester. Forest inventory, wildfire mitigation, land use planning
(719) 494-1620		(719) 659-3383	csprings@fireready.com	www.fireready.com	Wildfire resistant landscaping, defensible space, wildfire protection, tree & brush removal, large capacity chipping service
(719) 539-4944				salida@fireready.com	Wildfire mitigation, fuel reduction, chipping service, tree thinning, forest clean-up
(719) 686-0402		(970) 209-3383	graybros2005@msn.com		MPB treatment, hazardous tree removal, defensible space, lot clearing, chipping, thinning
(719) 783-4250		(719) 429-4404	ian@greenleafforestry.com	m	Full forest management planning, operations, and lumber/wood processing/manufacturing.
(719) 748-5062		(719) 510-1689			Tree & brush removal/trimming, chipping
(719) 593-9610			anodk@aol.com		Fire hazard mitigation, thinning, pruning
(719) 687-2177			tkiweaver@aol.com		Thinning, dwarf mistletoe control/removal, mountain pine beetle control/removal, chipping
(719) 837-2422					Logging, log homes, hand railings, siding, rough saw timber, firewood
(877)-674-8733	(303)-674-8733		mike@lamtree.com		Fuel reduction, timber stand improvement
(719) 382-0522		(719) 290-3610	merantwo@earthlink.net		Fire mitigation, forest health, onsite miling & preparation of firewood-using logging horses.
(303) 646-3647		(303) 646-3369			Thinning, defensible space, chipping
(719) 630-3209			beawegner@adelphia.com		Trimming/removals, tree surgery, insect & disease diagnosis /control, hazard tree evaluation, tree appraisal/evaluation, soil & DED injections
(719) 651-3667			renegadeexe@aol.com		Fuel mitigation, MPB removal, planting, thinning
(719) 579-9103		(719) 491-4626	scott@adelphia.net	www.rockytop.us	Land clearing, tub grinding
(719) 673-5662		(719) 650-0151	ruelogging@yahoo.com		Tree thinning, hydro mowing
	(719) 207-0468				Wildfire mitigation, thinning, insect & disease detection, Timber Mgmt. plans, raking with skidder
(719) 687-6611			MPineBeetle@aol.com		Licensed by CO Dept. of Ag., tree spraying/insect control, spring/fall tree fertilization, micro-injection
		(719) 492-8129			tree to 2500 acres.
(719) 481-2331			gregwiggins@msn.com		Thinning, pruning, marking, insect & disease, forest management, reforestation, fire mitigation, dspace, native grass seeding
(970) 921-5460	(970) 921-5461		info@westrangereclamation.com		Precommercial thinning, mastication projects, fuels reduction
(970) 221-1336			billgherard@comcast.net		Forest management plans, I/D survey and treatment, timber sale marking and administration, wildfire hazard reduction

Woodland Park Contractor List

hsultant/Contracto	Consultant	Spraying	Contractor	Business Name	First Name	Last Name	Address	City	State	Zip
65	FALSE	FALSE	TRUE		Jim	Subler	P.O. Box 6865	Breckenridge	CO	80424
61	TRUE	FALSE	FALSE		Jim	McGannon	PO Box 51223	Colorado Springs	CO	80949-1223
64	TRUE	FALSE	FALSE		Steve	Spaulding	PO Box 96	Green Mountain Falls	CO	80819
67	TRUE	FALSE	TRUE	Mountain High Tree Service, Inc.	Becky	Wegner	906 Canopus Drive	Colorado Springs	CO	80906
60	FALSE	FALSE	TRUE		Jason	Chappell	140 Trail Creek Rd.	Lake George	CO	80827
23	FALSE	FALSE	TRUE		Jim	Green	PO Box 193	Buffalo Creek	CO	80425
50	FALSE	FALSE	TRUE		Dean	Wierth	PO Box 69	Hartsel	CO	80449
102	FALSE	FALSE	TRUE	AA Forestry LLC	Raul	Acosta	4275 Gracewood Dr.	Colorado Springs	CO	80920
1	FALSE	FALSE	TRUE	A-C	Gasper	Blea	PO Box 868	Monument	CO	80132
98	FALSE	FALSE	TRUE	American Wildfire Mitigation Service	Andy	Pittman	PO Box 323	Green Mountain Falls	CO	80819
55	TRUE	FALSE	FALSE	Anchor Point Group	Rod	Morega	3775 Iris Ave., Suite 2A	Boulder	CO	80301
4	FALSE	FALSE	TRUE	Forest Technologies	Hal	Hagan	PO Box 160	Nathrop	CO	81236
91	TRUE	FALSE	FALSE	B&B Forest Consultants	Dennis	Will	8910 Chipita Park Rd.	Chipita Park	CO	80809
6	FALSE	FALSE	TRUE	Baker Site Development	Terry	Baker	PO Box 4047	Woodland Park	CO	80866
69	FALSE	TRUE	FALSE	Bob Runco Tree Surgeon	Albert	Godec	2626 Gunnison Street	Colorado Springs	CO	80909
9	FALSE	FALSE	TRUE	C Lazy T Spraying Service, LLC	Greg	Cole	15680 Eastonville Road	Elbert	CO	80106
10	FALSE	FALSE	TRUE	C Lazy T Tree Movers	Suzy	Cole	6074 CR 82	Elbert	CO	80106
101	FALSE	FALSE	TRUE	Coalition for the Upper South Platte	Jon	Bruno	P.O. Box 726	Lake George	CO	80829
57	TRUE	FALSE	FALSE	Colorado Forest Management	Stefan	Rainold, MS	3290 Newland St.	Wheat Ridge	CO	80033
94	FALSE	FALSE	TRUE	Colorado Log & Wood Products, LLC	David	Boston	PO Box 7176	Woodland Park	CO	80863
56	TRUE	FALSE	FALSE	Coons Country Gardens	Suzanne	Coons	727 Meadow Lane	Palmer Lake	CO	80133
71	FALSE	TRUE	TRUE	Davey Tree & Lawn Care	Brett	LeMaire	PO Box 50704	Colorado Springs	CO	80949
15	FALSE	FALSE	TRUE	Divide Timber	Mike	Isele	1644 Cedar Mountain Road	Divide	CO	80814
104	TRUE	FALSE	FALSE	Double W Services, Inc.	Bill	Williams	969 Carr St.	Lakewood	CO	80214
18	TRUE	FALSE	TRUE	Fire Ready	Andrew	Notbohm	845 E. Kiowa St.	Colorado Springs	CO	80903
19	FALSE	FALSE	TRUE	Fire Ready	Angie	Jensen	PO Box 315	Salida	CO	81201
79	FALSE	FALSE	TRUE	Gray Brothers	Shane	Gray	1430 Evergreen Heights	Woodland Park	CO	80863
80	TRUE	FALSE	FALSE	Greenleaf Forestry and Wood Products	Len	Lankford	1500 Rosita Road	Westcliffe	CO	81252
24	FALSE	FALSE	TRUE	Hanson Tree Service	Ira	Hanson	PO Box 243	Florissant	CO	80816
25	FALSE	FALSE	TRUE	Horti Care Tree & Shrub	Greg	Eno	7160 Alpenwood Way	Colorado Springs	CO	80918
26	FALSE	FALSE	TRUE	K & K Tree Service/Chipping	Korey	Weaver	515 East South Avenue	Woodland Park	CO	80863
28	FALSE	FALSE	TRUE	L & M Havens Logging, LLC			PO Box 153	Hartsel	CO	80449
	FALSE	FALSE	TRUE	LAM Tree Service, Inc.	Mike	Goldblatt	P.O. Box 2486	Evergreen	CO	80437
95	FALSE	FALSE	TRUE	Marantwo, LLC	Carl & Elizabeth	Evans	13825 Old Pueblo Rd.	Fountain	CO	80817
32	FALSE	FALSE	TRUE	Miller Tree Service	Jobe	Miller	PO Box 104	Elizabeth	CO	80107
62	TRUE	FALSE	TRUE	Mountain High Tree Service, Inc.	Al	Wegner	906 Canopus Drive	Colorado Springs	CO	80906
7	FALSE	FALSE	TRUE	Renegade Excavating	Ben	Burdick	P.O. Box 116	Yoder	CO	80864
84	FALSE	FALSE	TRUE	Rocky Top Resources, Inc.	Scott	Piggot	1755 E. Las Vegas	Colorado Springs	CO	80903
36	FALSE	FALSE	TRUE	Rue Logging, Inc.	Brian	Rue	PO Box 155	South Fork	CO	81154
42	FALSE	FALSE	TRUE	Timberland Management Services	Dan	Estep	13580 County Rd. 140	Salida	CO	81201
43	FALSE	TRUE	TRUE	Timberline Spraying & Services	Don	Doty	175 Elk Park Rd.	Woodland Park	CO	80863-8974
45	TRUE	FALSE	TRUE	Tree Masters	John	Pwansky	PO Box 3249	Monument	CO	80132
49	FALSE	FALSE	TRUE	Tri-Lakes Timber Management	Greg	Wiggins	17815 Saddlewood Road	Monument	CO	80132
76	FALSE	FALSE	TRUE	West Range Reclamation, LLC	Stephanie	Neff	36702 Fruitland Mesa Road	Crawford	CO	81415
68	TRUE	FALSE	FALSE	Woodland Management Consultants	Bill	Gherardi	PO Box 10	Fort Collins	CO	80522

Colorado State FOREST SERVICE

Boulder District 303-823-5774

Updated 06-22-2007

The Colorado State Forest Service-Boulder District maintains this list as a service to its customers only. This list is comprised of known forest contractors that have indicated the capability and interest to offer the services listed below. The list is updated periodically for additions and changes. CSFS does not specifically recommend any of the contractors on this list. No endorsements and no representation for services are implied by the presence or absence of a possible contractor name. Please contact the contractors directly for pricing, bonding or insurance, professional qualifications, and previous customer referrals.

* For more information pertaining to marketing local wood products reference www.coloradoforestproducts.org

FORESTRY CONTRACTORS

CONTRACTOR NAME	ADDRESS	CONTACT INFORAMATION	Consulting Forester	General Tree Cutting	Logging/ Salvage	Chipping, Slash Removal	Defensible Space	Forest/fire Management Plans	Prescribed Fire	MPB Diagnosis & Removal	Insect, Disease, & Weed Spraying	Sawmills & Wood Processing	Fire Rehab	Wood Product Purchasing	Insured
ALTA Tree Services Walter Chapman	P.O. Box 35 Nederland, CO. 80466	303-258-0354 (phone)		X	X	X	X	X		X		X		X	X
Anchor Point Group Rod Moraga	3775 Iris Ave. Suite 2A Boulder, CO. 80301	303-665-3473 (phone) 720-221-8016 (fax) info@AnchorPointGroup.com	X				X	X	X				X		X
Andrews Lawn Care Rob & Ellen	P.O. Box 4789 Boulder, CO 80306	303-447-2050 (phone) robandeljames@comcast.com		X		X	X								X
Arbor-Care Tree Company, Inc. Chad Ferry	P.O. Box 160 Louisville, CO. 80027	303-664-9217 (phone)		X		X	X			X					X
				X	X	X	X			X			X		

CONTRACTOR NAME	ADDRESS	CONTACT INFORAMATION	Consulting Forester	General Tree Cutting	Logging/ Salvage	Chipping, Slash Removal	Defensible Space	Forest/Fire Management Plans	Prescribed Fire	MPB Diagnosis & Removal	Insect , Disease, & Weed Spraying	Sawmills & Wood Processing	Fire Rehab	Wood Produ Purchasing	Insured
Beaver Envy Scott Deyo	P.O. Box 396 Rollinsville, CO. 80474	303-258-3863 (phone) deyosa@highstream.net													
Big Rocks Excavating Josh Camp	P.O. Box 7086 Golden, CO 80403	303-642-7272 (phone) 303-642-7059 (fax)		X	X	X	X			X		X	X		X
Blue Mountain Environmental Consulting, LLC Matt Tobler	937 Mallard Drive Fort Collins, CO 80521	970-224-0851 (phone) 970-224-0851 (fax) matt@bluemountain1.net	X				X	X					X		X
Boulder Mountain Fire Protection District Steve Lynn	1905 Linden Drive Boulder, CO 80304	303-440-0235 (phone) 303-859-4661 (cell) 303-440-5247 (fax) mitigation@bouldermountainfire.org		X		X	X			X			X		X
Bustamante Wood Products Abe Bustamante	P.O. Box 264 Mead, CO. 80542	303-652-3394 (phone) 303-775-5552 (cell)		X	X	X		X		X		X		X	X
Colorado Forest Management Stefan Reinold	3290 Newland Street Wheat Ridge, CO 80033	970-214-7677 (phone) coloradoforestmanagement@comcast.net	X												
Davey Tree Brian O'Niel	P.O. Box 1396 Boulder, CO. 80306	303-449-2525 (phone) 303-413-1042 (fax)		X		X	X	X		X	X				X

CONTRACTOR NAME	ADDRESS	CONTACT INFORAMATION	Consulting Forester	General Tree Cutting	Logging/ Salvage	Chipping, Slash Removal	Defensible Space	Forest/Fire Management Plans	Prescribed Fire	MPB Diagnosis & Removal	Insect, Disease, & Weed Spraying	Sawmills & Wood Processing	Fire Rehab	Wood Product Purchasing	Insured
Daylight Again Farm David Lasky	3660 Sugarloaf Road Boulder, CO 80302-9296	303-588-3440 (phone) davidlasky@sugarloaf.net		X	X	X	X			X		X			
Diamond Tree Service Howard Burkhart	P.O. Box 3781 Estes Park, CO 80517	970-586-4735 (phone) 970-577-0279 (fax)		X	X	X	X	X	X	X					X
Double W Services, Inc Bill Williams	969 Carr Street Lakewood, CO 80214	303-205-1915 (phone) mbw9245@comcast.net	X					X							
Ecoscape Environmental Design, LLC Bill Melvin	P.O. Box 704 Boulder, CO 80306	303-447-2282 (phone) Bill@EcoscapeDesign.com	X	X	X	X	X	X		X		X	X	X	X
Firewise Landscaping Joe Turner	140 Judson Street Longmont, CO. 80501	1) call 1-800-800-8664 2) give pager #303-890-9151 3) Leave detailed message joseph_3568@msn.com		X		X	X	X	X	X			X		X
Foothills Vegetation Management Mike Wilkinson	19394 Silver Ranch Road Conifer, CO 80433	303-679-5424 (phone) 303-697-4229 (fax) wilkandson@aol.com									X				
High Timber Firewood & Logging Co. Phil & Jane Pitzer	P.O. Box 222 Nederland, CO. 80466	303-258-7942 (phone) 303-258-3179 (fax) HTFLPitzer@aol.com		X	X	X	X	X		X	X	X		X	X
Lumberjacks Logging and Firewood, Inc.	P.O. Box 547 Pinecliffe, CO. 80471	303-642-0953 (phone)		X	X	X	X	X		X		X		X	X

CONTRACTOR NAME	ADDRESS	CONTACT INFORAMATION	Consulting Forester	General Tree Cutting	Logging/ Salvage	Chipping, Slash Removal	Defensible Space	Forest/Fire Management Plans	Prescribed Fire	MPB Diagnosis & Removal	Insect, Disease, & Weed Spraying	Sawmills & Wood Processing	Fire Rehab	Wood Product Purchasing	Insured
Natalie Davidson		natalie@ionsky.com													
Morgan Timber Products Mark A. Morgan	5722 W. County Rd. 54E Bellvue, CO. 80512-7101	970-484-4065 (phone) 970-484-4065 (fax) mtpksm@hotmail.com		X	X	X	X			X		X		X	X
Mountain High Contracts Joe Phillips	P.O. Box 99 Central City, CO 80427	303-582-5052 (phone) 303-582-3990 (fax) mountainhighcontracts@earthlink.net		X	X	X	X	X		X		X		X	X
Native Ecology, Inc. Barry Bennett	P.O. Box 976 Nederland, CO. 80466	303-258-1753 (phone) barry@nativeecology.com	X	X		X	X	X		X			X		X
Natural Resource Services, Inc. Steve C. Johnson	P.O. Box 19332 Boulder, CO 80308-2332	303-915-3211 (phone) 720-652-4792 (fax) stevej@nrsiservices.com	X			X		X							X
Olmsted Consulting Ed Olmsted	1065-B West 112 Avenue Westminster, CO 80234	(Steps 1-3 for message) 303-452-8643 (phone) edo68@aol.com	X					X							
St. Vrain Arbor Care John Robins	1361 Francis Street #B103 Longmont, CO. 80501	303-772-3136 (phone) 303-710-6065 (cell) 303-682-0399 (fax) info@stvrainarborcare.com		X			X	X		X	X		X		X
Veleta Corporation Damien Davis	P.O. Box 1329 Conifer, CO 80433	303-697-1561 (phone) 303-697-2719 (fax) veletacorp@earthlink.net		X	X	X	X								X

Fort Collins District
5060 Campus Delivery
Bldg 1052, CSU Fthls
Fort Collins, CO
80523-5060
970-491-8660
970-491-8645 fax

Colorado State FOREST SERVICE

The Colorado State Forest Service-Fort Collins District maintains this list as a service to its customers only. This list is comprised of known forest contractors that have indicated the capability and interest to offer the services listed below. The list is updated periodically for additions and changes. CSFS does not specifically recommend any of the contractors on this list. No endorsements and no representation for services are implied by the presence or absence of a possible contractor name. Please contact the contractors directly for pricing, bonding or insurance, professional qualifications, and previous customer referrals.

FORESTRY CONTRACTORS

CONTRACTOR NAME	ADDRESS	PHONE / E-MAIL / WEB SITE	Consulting/ Forest Mgt Plans	General Tree Cutting	Logging/ Salvage	Chipping, Slash Removal	Defensible Space	Fire Mitigation Plans	MPB Diagnosis & Removal	Insect & Disease Spraying	Sawmills & Wood Processing	Pile Burning	Christmas Trees/ Transplants
Advanced Forestry William K. Olsen	247 Falls Creek Dr. Bellvue, CO 80512	970-495-1719 http://www.wkolsen.com/ wkolsen@wkolsen.com	X										
Alpine Forest Mgt, LLC Scott Strickland	3912 Elmhurst Drive Fort Collins, CO 80526	cell 970-631-4672 morbark@earthlink.net	X	X		X	X	X	X	X		X	
Alpenfire, LLC. Geoff Butler	4617 Regency Dr. Fort Collins, CO 80526	970-217-8495 E-mail: gbutler@alpenfire.com	X				X	X					
Alta Tree Services Walter Chapman	P.O. Box 35 Nederland, CO 80466	303-258-0354		X	X	X	X	X	X		X		
Anchorpoint Group, LLC Rod Moraga	3775 Iris Avenue, Suite 2A Boulder, CO 80301	303-665-3473 www.anchorpointgroup.com info@anchorpointgroup.com	X					X	X			X	
Arborworks Jason Jones	400 E Hemlock Fort Collins, CO 80524	970-221-1287		X		X		X	X				
Benninghoff & Company Bruce Benninghoff	7109 W Frost Dr. Littleton, CO 80128	303-978-1284 Email benn-co@comcast.net http://benn-co.home.comcast.net	X					X					
Blue Mountain Environmental Consulting MattTobler, M.S.	937 Mallard Dr. Fort Collins, CO 80521	970-224-0851 matt_tobler@yahoo.com www.bluemountain1.net	X					X					
Brown & Associates Environmental Consultants Karl Brown		303-202-4240	X		X		X	X	X			X	
Colorado Forest Management Stefan Reinold, MS	3290 Newland St. Wheat Ridge, CO 80033	970-214-7677; coloradoforestmanagement @comcast.net; home.comcast.net/~coloradoforestmanagement	X										
Colorado Total Maintenance Joe Cordova	2240 S. Kalamath St Denver, CO 80223	303-975-9399 x12; www.coloradototal.com; ctm-ctg@coloradototal.com		X	X	X	X	X					
Colorado TreeScapes, Inc. Griff Gehring	P.O. Box 261635 Littleton, CO 80163	303-770-4155; Fax:303-248-9331 griffgehring@hotmail.com	X	X	X	X	X	X	X	X	X		X
D + D Logging Dan Barnica	14857 Left Hand Canyon Jamestown, CO 80455	303-459-3277		X		X	X	X					
Dahl Environmental Services, LLC Bjorn Dahl	23890 Genesee Village Rd Golden, CO 80401	303-526-2822; Cell: 720-560-3714; Fax: 303-526-5197 bdahl@dahlservices.com www.dahlservices.com	X					X	X				
Davey Tree and Landscape Co. Brian O'Niel	P.O. Box 1396 Boulder, CO 80306	303-449-2525 Ext-300 brian.oniel@davey.com	X	X			X	X	X				

CONTRACTOR NAME	ADDRESS	PHONE / E-MAIL / WEB SITE	Consulting/ Forest Mgt Plans	General Tree Cutting	Logging/ Salvage	Chipping, Slash Removal	Defensible Space	Fire Mitigation Plans	MPB Diagnosis & Removal	Insect & Disease Spraying	Sawmills & Wood Processing	Pile Burning	Christmas Trees/ Transplant
Double W Services, Inc. Bill Williams		303-205-1915 mbw9245@comcast.net	X					X					
Down to Earth Tree & Landscape Richard Sairow	517 Wood St. Fort Collins, CO 80521	970-472-8733		X		X	X					X	
Ecoscape Environmental Design Bill Melvin	P.O. Box 704 Boulder, CO 80306	303-447-2282; fax 303-447-8699 www.ecoscapedesign.com bill@ecoscapedesign.com	X	X	X	X	X	X	X				
EnConlil Mark K. Hannon	13420 W. 58th Ave Arvada, CO 80002	303-467-3221	X		X		X	X	X			X	
Environmental Forestry Services LLC. George Hawes	P.O. Box 10,000 Suite 261 Silverthorne, CO 80498	Office: 360-733-9312; Cell: 360-739-3318; Fax: 866-227-7065 www.environmentalforestryservices.com george@environmentalforestryservices.com	X	X	X	X	X	X	X	X		X	
Fire Break Tree Service, LLC Drew Chase	307 Hawthorn Drive Loveland, CO 80538	970-581-5460, 303-431-1902 drew@firebreaktree.com; www.firebreaktree.com	X	X	X	X	X	X	X			X	
Fire Ready Tony Mahon	5201 Greenview Dr. Fort Collins, CO 80525	970-481-0814; fortcollins@fireready.com; www.fireready.com	X		X	X	X	X	X	X		X	
Fire Specialist Inc. Herman Ball	2467 N 119th St. Lafayette, CO 80026	303-665-2588	X					X					X
Firewise Landscaping Joe Turner	140 Judson St. Longmont, CO 80501	1-800-800-8664 lv message pager 303-890-9151 Joseph_3568@msn.com	X	X		X	X	X	X			X	
Firewise Forest Mgt. Inc Jeff Smith	1938 Harney St. Laramie WY, 82070	(307)760-0339 firewisejeff@gmail.com		X		X	X		X	X			
Front Range Forestry, LLC James White	P.O. Box 694 Fort Collins, CO 80522	970-224-2037, Cell: 970-222-4438 frontrangeforest@msn.com		X	X	X	X		X				
Green-Lein PGM, LLC Candace Leingang	PO Box 66 Windsor CO 80550-0066	970-686-0965, Fax: 970-686-0955 greenlein@cybersafe.net		X					X	X			
High Plains Log & Timber Greg Tyler	P.O.Box 336663 Greeley, CO 80633	cell 970-381-2775 bdogforestry@yahoo.com					X	X					
High Timber Firewood and Logging; Phil & Jane Pitzer	P.O. Box 222 Nederland, CO 80466	303-258-7942, Fax: 303-258-3179 www.high-timber.com HTFLPitzer@aol.com		X	X	X	X	X	X				
Land Stewardship Associates, LLC Donnie Sparks	P.O. Box 1904 Canon City, CO 81215-1904	719-275-0992 donniesparks@bresnan.net www.landstewards.net	X				X	X					
Long, Keith	13031 WCR 88 Pierce,. CO 80650	970-420-1917 cell 970-834-1184 home		X	X	X	X						
Lumberjacks Logging & Firewood, Inc.; Jack Davidson	P.O. Box 646 Pinecliffe, CO 80471	303-642-0953 www.lumberjacksbest.com natalie@ionsky.com	X	X	X	X	X	X	X				
Mike's Tree Service Adam Strong	PO Box 4420 Estes Park, CO 80517	970-586-7546		X		X	X		X				
MK Services Mark Phipps	14700 North Couty Road 7 Wellington, CO 80549	970-568-9211		X		X	X		X				

CONTRACTOR NAME	ADDRESS	PHONE / E-MAIL / WEB SITE	Consulting/ Forest Mgt Plans	General Tree Cutting	Logging/ Salvage	Chipping; Slash Removal	Defensible Space	Fire Mitigation Plans	MPB Diagnosis & Removal	Insect & Disease Spraying	Sawmills & Wood Processing	Pile Burning	Christmas Trees/ Transplant
Morgan Timber Products Mark Morgan	2532 W. County Rd. 54G Fort Collins, CO 80524	970-484-4065; 970-224-3877 mtpksm@hotmail.com	X		X	X	X	X	X		X		
Natural Resource Consultants James E. Ficke	PO Box 3418 Steamboat Springs, CO 80477	970-879-8319	X					X				X	
Nix, Tim	320 East Plum, Apt B Fort Collins, CO 80524	970-846-7309		X	X	X	X	X	X			X	
Oberle Envtl. Services Matthew & Sue Oberle	832 Timber Ln. Fort Collins, CO 80521	970-493-5672	X										
Rocky Mountain Tree Services Mark Berard	PO Box 1334 Loveland, CO 80539	970-225-9596		X									
S. Edwards Inc Sally Edwards	442 Truman Dr. Fort Collins, CO 80525	970-593-0501	X	X			X	X	X				
Short Forestry LLC Bruce Short	40 Chico Camino St. Monte Vista CO 81144	719-852-0552; Cell: 303-819-6901 www.shortforestry.com stumpjumper@bresnan.net	X					X					
St. Vrain Arbor Care John Robbins	1361 Francis St. Longmont, CO 80501	303-772-3136, Fax: 303-682-0399 www.stvrainarborcare.com info@stvrainarborcare.com	X	X	X	X	X	X	X				
Steve's Tree and Chimney Service Steve Suchoki	12933 Appaloosa Ave. Wellington, CO 80549	970-568-3181 Cell: 970-481-9629	X	X	X	X	X	X	X				
Swingle Tree, Lawn & Landscape Care	1805 E Lincoln Ave. A3 Fort Collins, CO 80524	970-221-1287 www.swingletree.com		X		X	X		X	X			
Timberscapes Brad Crawford	38568 WCR 13 Fort Collins, CO 80524	970-224-3005, Cell: 970-443-1733 mtnjem@msn.com		X		X	X						
Timberwolf Enterprise Rich Palestro	311 Warrick St. Frederick, CO 80530	303-775-6585		X	X	X			X			X	
United Wood Products Inc. Raul & Fred Bustamante	7860 Diagonal Hwy. Longmont, CO 80503-8760	303-652-2872, Fax: 303-652-2286 unitedwoodproductsinc.com									X		
Waterwise Landscaping Chris Meglen	919 Kingston Dr Fort Collins, CO 80525	970-402-7428				X							
West Range Reclamation, LLC Cody Neff	36702 Fruitland Mesa Rd Crawford, CO 81415	970-921-5460 Fax 970-921-5461 cody@westrangereclamation.com www.westrangereclamation.com	X	X	X	X	X	X	X			X	
Wildland Fire Associates Matthew Scoggins	118 West Main St Rangely CO 81648	970-675-2225, Fax: 970-675-2220 steve@wildlandfireassociates.com					X	X				X	
Woodland Mangement Bill Gherardi	P.O. Box 10 Fort Collins, CO 80522	970-221-1336 billgherardi@comcast.net	X						X				
Work-A-Haulics, Inc	820 E. County Rd. 58 Fort Collins, CO 80524	970-484-0888 work_a_haulics@msn.com		X		X	X					X	

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FRANKTOWN DISTRICT CONTRACTOR LIST

The Colorado State Forest Service-Franktown District maintains this list as a service to its clients only, and makes no representations for the services provided by the individuals or firms included on this list.

This list is comprised of known forest contractors in the Franktown District area (Douglas, Elbert, Lincoln, and E. Arapahoe Counties) that have indicated an interest or capability to offer the services stated below. This list is updated as conditions or changes to the available contractor base occur.

Please contact the contractors directly for pricing, bonding or insurance, professional qualifications, and previous customer referrals. CSFS does not specifically recommend or endorse any contractors on this list.

This list is provided as a local directory only, and no endorsements are implied by the presence or absence of a possible contractor's name. **You should always ask for proof of current commercial licensing of any spray applicator by the State of Colorado's Department of Agriculture.**

TREE SPRAY SERVICE CONTRACTORS Current as of: July 3, 2007

Name	Address	Phone Number
A-1 Tree Service	7733 S. Ames Way Littleton, CO 80128	(303) 933-4811
American Tree	17355 W. 57th Avenue Golden, CO 80403	(303) 456-6898
Arbor Pro Tree Experts Co. Inc	6405 W. Mississippi Ave. Lakewood, CO 80226	(303) 935-0005 West office (303) 759-1116 East office
Arborist Arms Tree Co.	6360 S. Kendall Littleton, CO 80123	Ph. (303) 738-1999 Fax (303) 738-9978
C Lazy T Spraying Service	11527 East Smith Road Elbert, CO 80106	(303) 660-9662 office (303) 475-7534 cell
Integrated Lawn and Tree Care	3108 Beacon Street Colorado Springs, CO 80918	(719) 528-5296 Website: www.healthylawn.net
Quality Tree Service Inc.	2640 W. Union Ave. Englewood, CO 80110	(303) 798-4773
Rocky Top Resources Scott Piggot	1755 E. Las Vegas Street Colorado Springs, CO 80903	(719) 579-9103
Shady Tree and Lawn Service	11348 E. Oxen Road Parker, CO 80138	(303) 805-8497
Swingle Tree and Landscape Care	8585 E. Warren Ave. Denver, CO 80203	(303) 306-3123
T-P Enterprises	5055 E. 39 Ave. Denver, CO 80203	(303) 377 1215
TruGreen ChemLawn	12445 Dumont Way Littleton, CO 80122	(303) 791 1444
Wilhelm-Davey Tree & Lawn Care	2000 S. Quebec St. Denver, CO 80231	(303) 750-9273

TREE SERVICE COMPANIES IN LINCOLN/E. ARAPAHOE COUNTIES

Name	Address	Phone Number
Crimson Tree Service	35850 Wagner Lane Calhan, CO 80808	(719) 541-2650
Green Horizons Turf and Tree Care Ltd.	429 Loveland Ave. Flagler, CO 80815	(719) 765-4321
Vision Services Thomas Stoumbaugh	P.O. Box 15 Deer Trail, CO 80105	(303) 769-4761 (720) 281-2361 or *2362

LANDSCAPE ARBORISTS, TREE PRUNING & REMOVAL COMPANIES

Name	Address	Phone Number
Arbor Pro Tree Experts Co. Inc	6405 W. Mississippi Ave. Lakewood, CO 80226	(303) 935-0005 West office (303) 759-1116 East office
Arborist Arms Tree Co.	6360 S. Kendall Littleton, CO 80123	(303) 738-1999
C Lazy T Spraying Service	11527 East Smith Road Elbert, CO 80106	(303) 660-9662 office (303) 475-7534 cell
Integrated Lawn and Tree Care	3108 Beacon Street Colorado Springs, CO 80918	(719) 528-5296 Website: www.healthylawn.net
Quality Tree Service Inc.	2640 W. Union Ave. Englewood, CO 80110	(303) 798-4773
Rocky Top Resources Scott Piggot	1755 E. Las Vegas Street Colorado Springs, CO 80903	(719) 579-9103
Shady Tree and Lawn Service	11348 E. Oxen Road Parker, CO 80138	(303) 805-8497
Swingle Tree and Landscape Care	8585 E. Warren Ave. Denver, CO 80203	(303) 306-3123
The Tree Guy Sean T. Searle	2565 Burnt Oak Dr. Franktown, CO 80116	(303) 521-6717
TruGreen ChemLawn	12445 Dumont Way Littleton, CO 80122	(303) 791 1444
Wilhelm-Davey Tree & Lawn Care	2000 S. Quebec St. Denver, CO 80231	(303) 750-9273

FIRE MITIGATION, FUELS REDUCTION & REMOVAL COMPANIES

Name	Address	Phone Number
Firestorm Wildland Mitigation, LLC Keith Long & Rob Leonard		(303) 646-2192 Keith (720)219-3336 cell Rob (303) 717-8592 cell
FireWise Colorado Susan Oliver	P.O. Box 242 Larkspur, CO 80118	(303) 681-0880
Horticare Greg Eno	7160 Alpenwood Way Colorado Springs, CO 80918	(719) 593-9610 (719)440-4649 cell
Horton Ground Control, LLC Chris Horton	P.O. Box 194 Larkspur, CO 80118	(303) 681-0541 (303) 589-1771 cell
Rampart Fire Services, LLC Denny Van Why	905 Bowstring Road Monument, CO 80132	(719) 481-1665 office (720) 235-9867 cell
Rampart Landscape and Arbor Service	P.O. Box 343 Castle Rock, CO 80104	(303) 681-2085 (719) 488-8817
Rocky Top Resources Scott Piggot	1755 E. Las Vegas Street Colorado Springs, CO 80903	(719) 579-9103
The Tree Guy Sean T. Searle	2565 Burnt Oak Dr. Franktown, CO 80116	(303) 521-6717
Tree Masters John Psensky	P.O. Box 3249 Monument, CO 80132	(719) 492-8129
Twisted Timber Russell Graves and sons	4313 E. Bennington Ave. Castle Rock, CO 80104	(303) 814-1172
Fire Ready Andrew Notbohm	845 E. Kiowa Street Colorado Springs, CO 80903	(719) 659-3383
Colorado Total Maintenance Joe Cordova, Vice President	P.O. Box 118 Englewood, CO 80151	Ph. (303) 975-9399 Fax (303) 975-1323

APPENDIX II – MANUFACTURER'S STUDIES

Prepared by: Mike Schmidt
Manager, Forestry Renewables
John Deere Construction & Forestry
563-340-2471
SchmidtJamesM@JohnDeere.com

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- MACHINE COST ANALYSIS -

DEALER : Any
MACHINE: 1490D Eco III Energy Harvester
DATE: June 2008
Prepared by:

GENERAL MACHINE INFORMATION:

1.	Machine life (Years)	5	
2.	Scheduled hours per shift	10	
3.	Shifts per day	1	
4.	Operating days per year	200	
5.	Mechanical availability (%)	85.0	
6.	Operational utilization (%)	85.0	
7.	Efficiency factor (%), (PMH/SMH)	72.3	(5) * (6)
8.	Scheduled machine hours / year (SMH)	2,000	(2) * (3) * (4)
9.	Productive machine hours / year (PMH)	1,445	(8) * (7)
10.	Useful life of machine (PMH)	7225.0	(1) * (9)

FIXED COST:

Capital cost information:

11.	Purchase price, delivered		$550,000	
12.	Salvage value at end of life (%)		20	
13.	Interest rate (%)		6.00	
14.	Salvage value at end of life		$110,000	(11) * (12)
15.	Depreciated amount		$440,000	(11) - (14)
	Capital Recovery Depreciation, CRD (includes interest cost):			: CRD = ((15)*CRF) + ((14)*(13)) : CRF = Capital Recovery Factor =
16.		($/year)	$111,054	: (13)*(1+(13))^(1) / (1+(13))^(1)
17.		($/PMH)	$76.85	(16) / (9)

Machine licensing and insurance:

18.	License ($ per year)	$0	
19.	Insurance (% of purch., per year)	1.5	
20.	Insurance ($ per year)	$8,250	(11) * (19)
21.	License and insurance ($/PMH)	$5.71	((18) + (20)) / (9)

22.	**TOTAL FIXED COST:**	**($ per year)**	**$119,304**	(16) + (18) + (20)
23.		**($ per month)**	**$9,942**	(22) / 12
24.		**($/PMH)**	**$82.56**	(22) / (9)

VARIABLE COST:

Machine variable cost:

25. Service and repair (mat. and labour) over useful life (% of deprec. amount)	65	
26. Fuel consumption (Units/PMH)	3.0	
27. Fuel cost per unit	$4.50	
28. Hyd. oil & lube cost ($/PMH)	$2.52	30% of fuel
29. Service and repair cost for life	$286,000	(25) * (15)
30. Service and repair cost ($/PMH)	$39.58	(29) / (9)
31. Fuel cost ($/PMH)	$13.50	(26) * (27)
32. Total machine variable cost ($/PMH)	**$55.60**	(28) + (30) + (31)

Operator cost:

33. Operator wages ($/SMH)	$15.00	
34. Fringe benefits (% of wages)	35.0	
35. Total operator cost: ($/SMH)	$20.25	(33) * (1 + (34))
36. ($/PMH)	**$28.03**	(35) / (7)

37. TOTAL VARIABLE COST ($/PMH)	**$83.63**	(32) + (36)

38. TOTAL OPERATING COST ($/PMH)	**$166.20**	(24) + (37)

PRODUCTION DATA:	**LOW**	**AVERAGE**	**HIGH**	
39. Productivity (bundles per hour)	15	25	35	
40. Cubic unit type (.5 bundles)	0.6	0.6	0.6	
41. Bundles per 'unit' (ton)	2.0	2.0	2.0	
42. Productivity ('units'/PMH)	7.50	12.50	17.50	(39) / (41)
43. Production per year (units)	10,838	18,063	25,288	(42) * (9)

44. TOTAL OPERATING COST: per 'ton'	**$22.16**	**$13.30**	**$9.50**	(38) / (42)
				(44) / 0.415
				(44) / 0.353
				(44) / 0.208

Draft FERC Hydropower License Amendment Application Gross Reservoir Hydroelectric Project FERC Project No. 2035

ATTACHMENT E-2

GROSS RESERVOIR RECREATION RELOCATION PLAN

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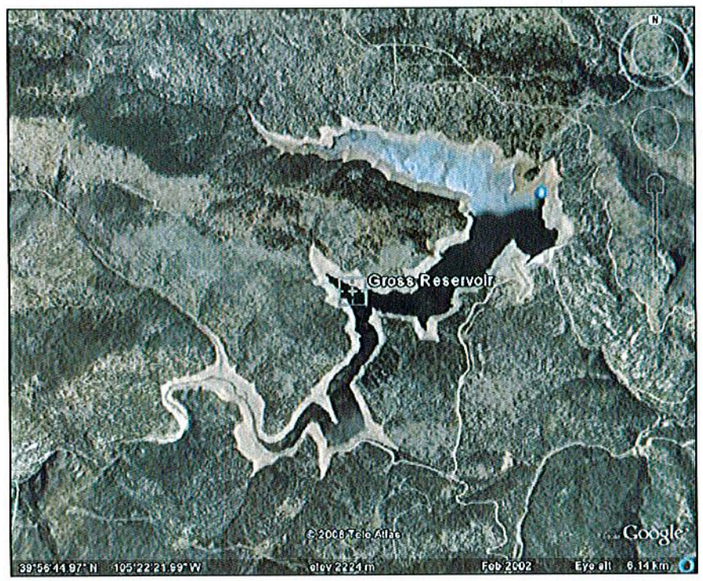
GROSS RESERVOIR

-RECREATION RELOCATION PLAN-
DENVER WATER DEPARTMENT

MAY 2008



SHEET INDEX

SHAPINS
Belt Collins

PLANNING
URBAN DESIGN
LANDSCAPE ARCHITECTURE

1818 SIXTEENTH STREET
BOULDER, COLORADO 80302
303.442.4588 FAX 303.786.8026

SITING CRITERIA NOTES:

1. LOCATIONS OF INDIVIDUAL RECREATION COMPONENTS SUCH AS TRAILS, PICNIC TABLES AND SHELTERS ARE AT A CONCEPTUAL LEVEL ONLY. IMPLEMENTATION OF THIS PLAN WILL REQUIRE FURTHER STUDY TO DETERMINE THE EXACT LOCATIONS OF RELOCATED RECREATION AMENITIES.
2. INDIVIDUAL PICNIC TABLE SITES WERE ASSIGNED A 50' OR A 100' BUFFER BASED ON THE LOCATION OF THE SPECIFIED AREA, THE SENSITIVITY OF THE SURROUNDING ENVIRONMENT, AND CONSIDERATION TO THE USER EXPERIENCE BEST SUITED FOR THE SITE. 100' BUFFER (SEE NOTE) WERE UTILIZED IN AREAS WHERE THE SURROUNDING ENVIRONMENT WAS MORE SUSCEPTIBLE TO IMPACTS ASSOCIATED WITH RECREATIONAL USE AND IN AREAS (SUCH AS HIKE IN PICNIC AREAS) WHERE THE USER MAY PREFER A LESS CROWDED VISITOR EXPERIENCE. 50' BUFFERS WERE USED IN AREAS WHERE HIGH CONCENTRATION OF USE WILL OCCUR , SUCH AS THE BOAT PUT-IN) OR WHERE THE SURROUNDING ENVIRONMENT IS LESS LIKELY TO BE IMPACTED BY HEAVY USE.
3. PARKING AREAS WERE SITED IN CLOSE PROXIMITY TO RELOCATED FACILITIES AND PROPOSED TRAILS.
4. LAYOUT OF PARKING AREAS SHOWN ON PLANS IS CONCEPTUAL ONLY.
5. LOCATION OF FISHING ACCESS POINTS WILL REQUIRE FIELD VERIFICATION, IDEALLY AFTER THE WATER LEVEL HAS BEEN RAISED.

NOTE:

100' BUFFER FOR INDIVIDUAL PICNIC SITES IS A STANDARD USED BY THE US FOREST SERVICE "FOR PRIVACY AND TO PREVENT OVERUSE OF SITE" (FOREST SERVICE HANDBOOK, PAGE 76). THE BUFFER IS GRAPHICALLY REPRESENTED ON THE MAPS BY A 200' DIAMETER CIRCLE (FOR THE 100' BUFFER) OR A 100' DIAMETER CIRCLE (FOR A 50' BUFFER).

SELECTION CRITERIA USED IN IDENTIFYING NEW RECREATION ACCESS AREAS:

1. TOPOGRAPHY & SOILS
   ARES WERE IDENTIFIED WHICH HAD FLATTER TOPOGRAPHY AND BUILDABLE SOILS.

2. CHARACTER
   AREAS WERE IDENTIFIED WHICH WERE ATTRACTIVE, MINIMALLY DISTURBED, AND HAD INTERESTING SITE CHARACTER. THE FOLLOWING ATTRIBUTES WERE IMPORTANT FACTORS IN THE SITING OF NEW FACILITIES:

   -FORESTED
   -VIEWS TO THE RESERVOIR
   -VIEWS TO OUTCROPS AND OTHER INTERESTING SITE PHENOMENA
   -BUFFERED FROM UGLY DAM INFRASTRUCTURE
   -BUFFERED FROM ADJACENT RESIDENTIAL LAND USES

3. VISITOR COMFORT
   AREAS WERE IDENTIFIED WHICH HAD COMFORTABLE MICROCLIMATES AFFORDED BY MATURE VEGETATION AND WHICH WERE PROTECTED FROM WINDS.

4. ACCESS
   AREAS WERE IDENTIFIED WHICH HAD GOOD TRAIL ACCESS OR WHICH WOULD BE ACCESSIBLE VIA NEW TRAIL INFRASTRUCTURE.
   AREAS WERE IDENTIFIED WHICH HAD GOOD VEHICULAR ACCESS OR WHICH COULD BE ACCESSIBLE VIA NEW ROADS IF NECESSARY.
   AREAS WERE IDENTIFIED WHICH WOULD BE EASILY ACCESSIBLE TO SERVICE VEHICLES VIA CURRENT ROADS OR NEW ROADS IF NECESSARY.
   AREAS WERE IDENTIFIED WHICH WOULD PROVIDE VISITORS WITH ACCESS TO THE WATER FOR FISHING, BOATING, OR OTHER RECREATIONAL OPPORTUNITIES.

5. ENVIRONMENTAL
   AREAS WERE IDENTIFIED WHICH MINIMALLY IMPACTED VIEWS, EROSION, AND habitat.

COMPARATIVE FACILITY CHART:

FACILITY TYPE	CURRENT QUANTITY	PROPOSED QUANTITY
DEVELOPED PICNIC SITE	40	50
GROUP PICNIC SITE	7	6
FISHING ACCESS	2	4
NUMBER OF PARKING SPACES	85	88
DEVELOPED OVERLOOK	2	5

SHAPINS
Belt Collins

PLANNING
URBAN DESIGN
LANDSCAPE ARCHITECTURE

1618 SIXTEENTH STREET
BOULDER, COLORADO 80302
303.442.4588 FAX 303.786.8026

GROSS RESERVOIR
-RECREATION RELOCATION PLAN-
DENVER WATER DEPARTMENT

Revisions:

Project #:0804598
Drawn By:EP
Checked By:JS

Date: 05.06.08

Sheet Title:

NOTES

Sheet Number:

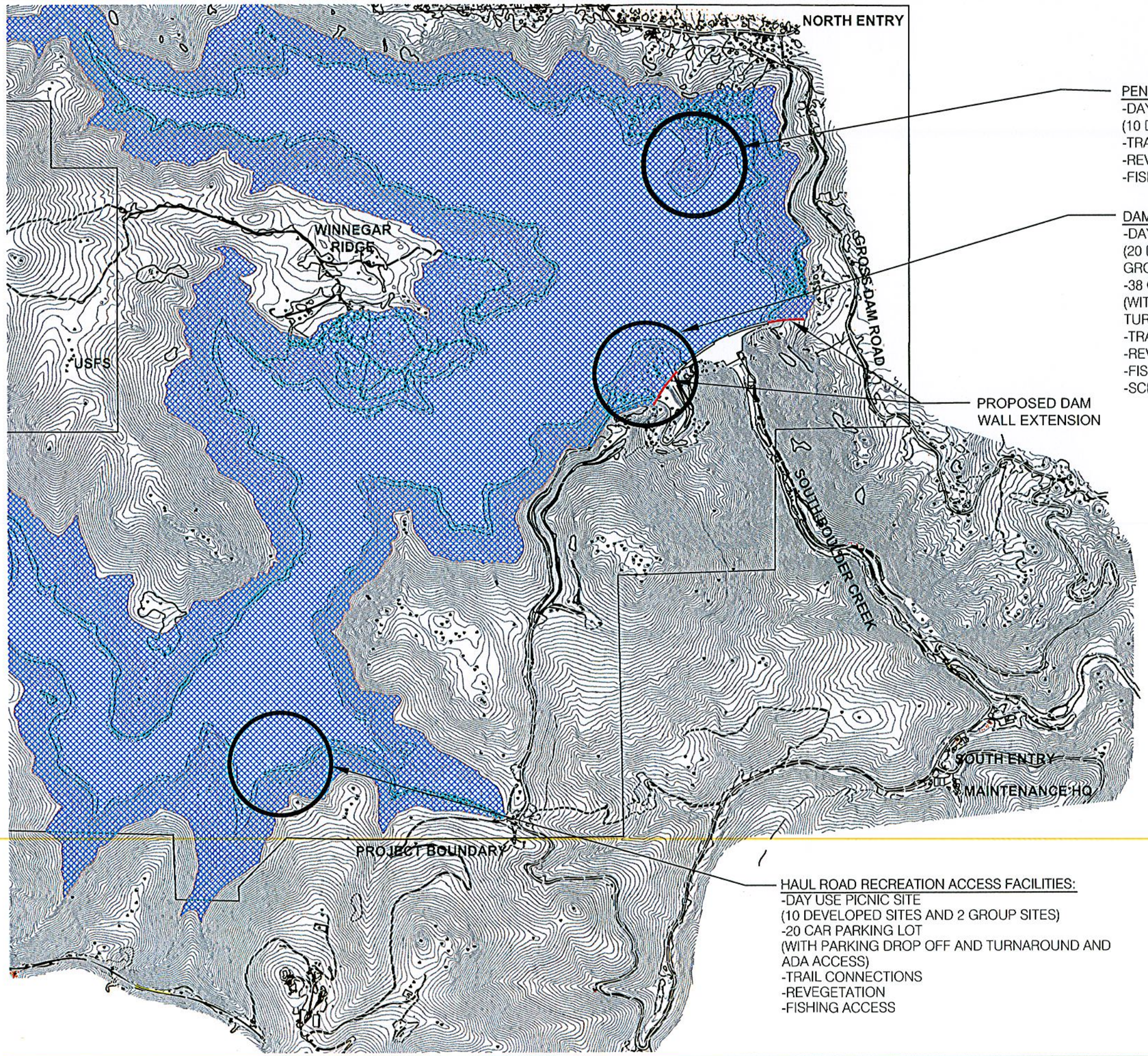
L0

SHAPINS
Belt Collins

PLANNING
URBAN DESIGN
LANDSCAPE ARCHITECTURE

1818 SIXTEENTH STREET
BOULDER, COLORADO 80302
303.442.4588 FAX 303.786.8026

GROSS RESERVOIR
-RECREATION RELOCATION PLAN-
DENVER WATER DEPARTMENT



PENNINSULA RECREATION FACILITIES:
-DAY USE PICNIC SITE
(10 DEVELOPED SITES AND 2 GROUP SITES)
-TRAIL CONNECTIONS
-REVEGETATION
-FISHING ACCESS

DAM RECREATION ACCESS:
-DAY USE PICNIC SITE
(20 DEVELOPED SITES AND 3 GROUP SITES)
-38 CAR PARKING LOT
(WITH PARKING DROP OFF AND TURNAROUND AND ADA ACCESS)
-TRAIL CONNECTIONS
-REVEGETATION
-FISHING ACCESS
-SCENIC OVERLOOK

PROPOSED DAM WALL EXTENSION

HAUL ROAD RECREATION ACCESS FACILITIES:
-DAY USE PICNIC SITE
(10 DEVELOPED SITES AND 2 GROUP SITES)
-20 CAR PARKING LOT
(WITH PARKING DROP OFF AND TURNAROUND AND ADA ACCESS)
-TRAIL CONNECTIONS
-REVEGETATION
-FISHING ACCESS

KEY:

NEW WATER LEVEL

0 500 1000 2000

SCALE: 1"=1000'

NORTH

Revisions:

Project #:0804566
Drawn By:EP
Checked By:JS

Date: 05.06.08

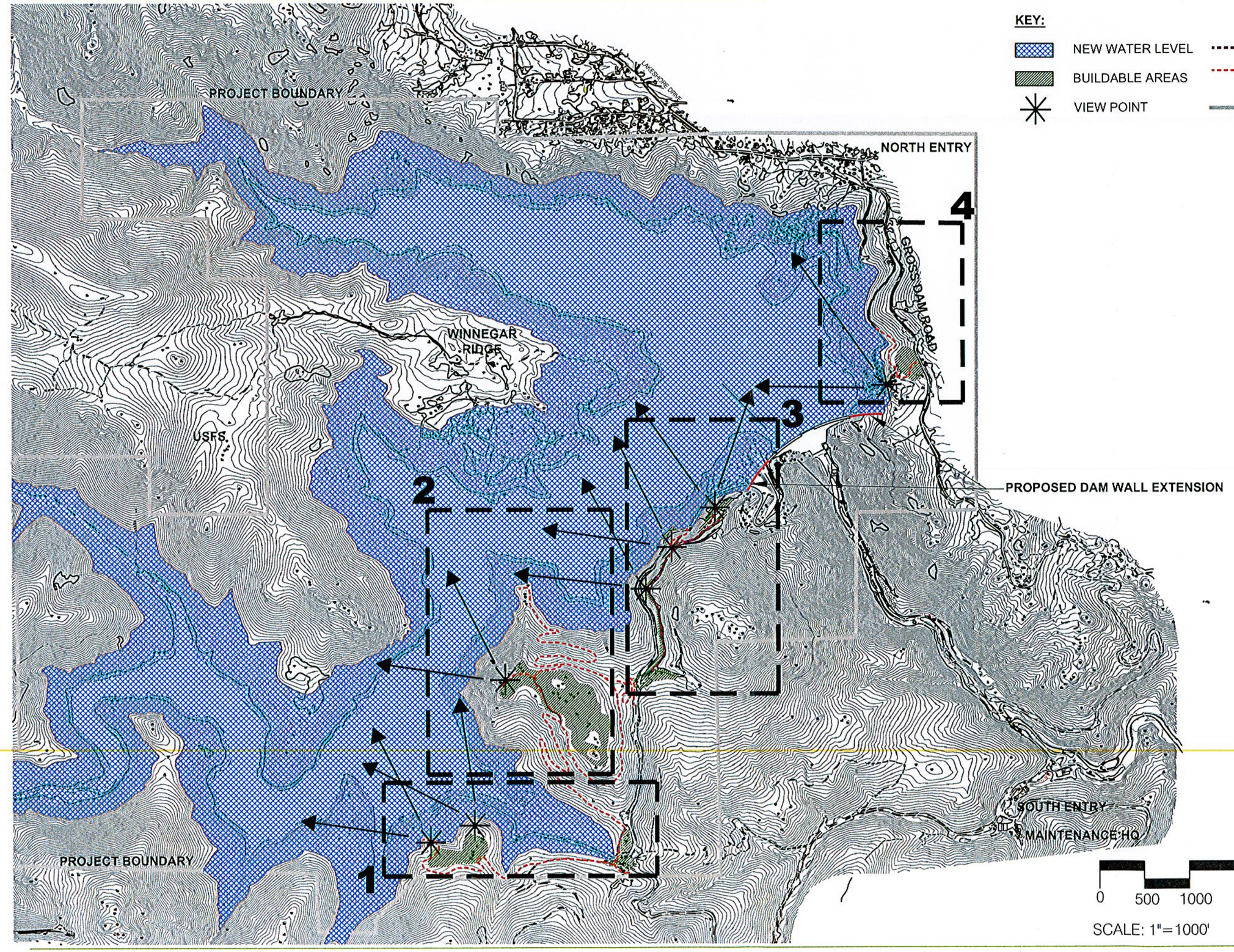
Sheet Title:

SITE ANALYSIS

AMMENITIES TO BE RELOCATED

Sheet Number:

L1



KEY:

- NEW WATER LEVEL
- BUILDABLE AREAS
- VIEW POINT
- ADA TRAIL
- HIKING TRAIL
- PROJECT BOUNDARY

0 500 1000 2000

SCALE: 1"=1000'

NORTH

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Belt Collins

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LANDSCAPE ARCHITECTURE

1818 SIXTEENTH STREET
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GROSS RESERVOIR
-RECREATION RELOCATION PLAN-
DENVER WATER DEPARTMENT

Revisions:

Project #:0604506
Drawn By:LP
Checked By:JS

Date: 05.06.06

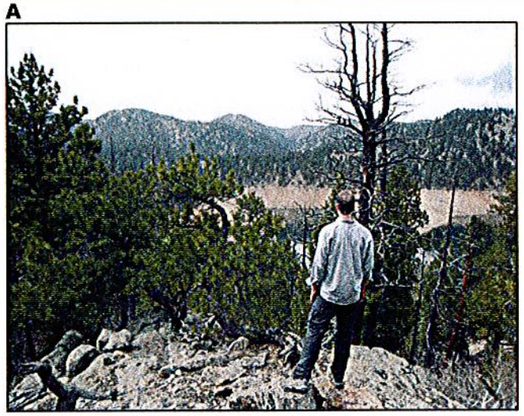
Sheet Title:

SITE SELECTION & ANALYSIS MAP

Sheet Number:

L2

A



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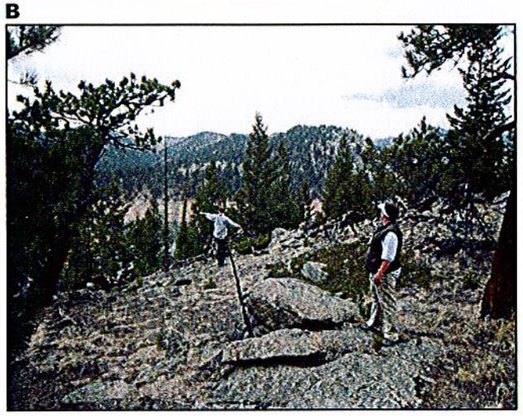

KEY:

NEW WATER LEVEL

PROPOSED SINGLE PICNIC TABLE WITH 100' BUFFER(10)

PROPOSED SINGLE PICNIC TABLE WITH 50' BUFFER(18)

EXISTING VEGETATION

EXISTING ROAD

PROPOSED SCENIC OVERLOOK (1)

PROPOSED (RELOCATED) SMALL PICNIC SHELTER (3)

PROPOSED FISHING ACCESS (4)

PROPOSED PARKING AREA (34 SPACES)

PROPOSED HIKING TRAIL

SHAPINS
Belt Collins

PLANNING
URBAN DESIGN
LANDSCAPE ARCHITECTURE

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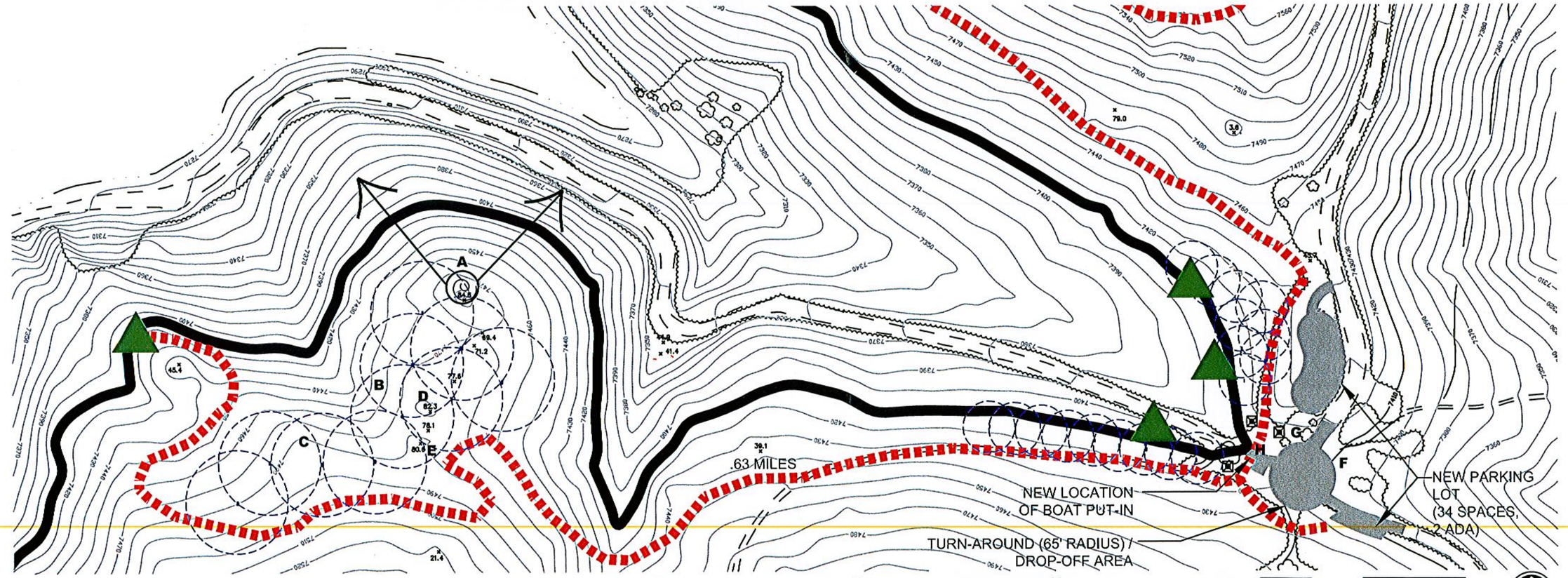
GROSS RESERVOIR
-RECREATION RELOCATION PLAN-
DENVER WATER DEPARTMENT



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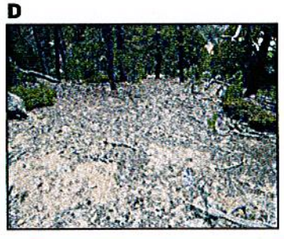

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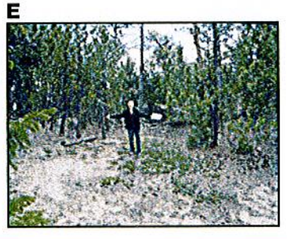

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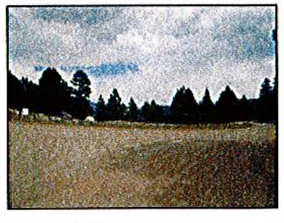

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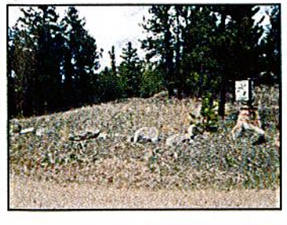

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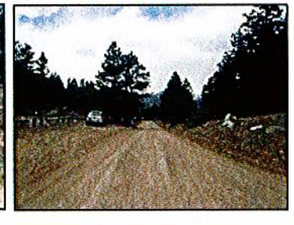


0 100 200 400

NORTH

SCALE: 1"=200'

AREA 1

Revisions:

Project #:0804598
Drawn By:EP
Checked By:JS

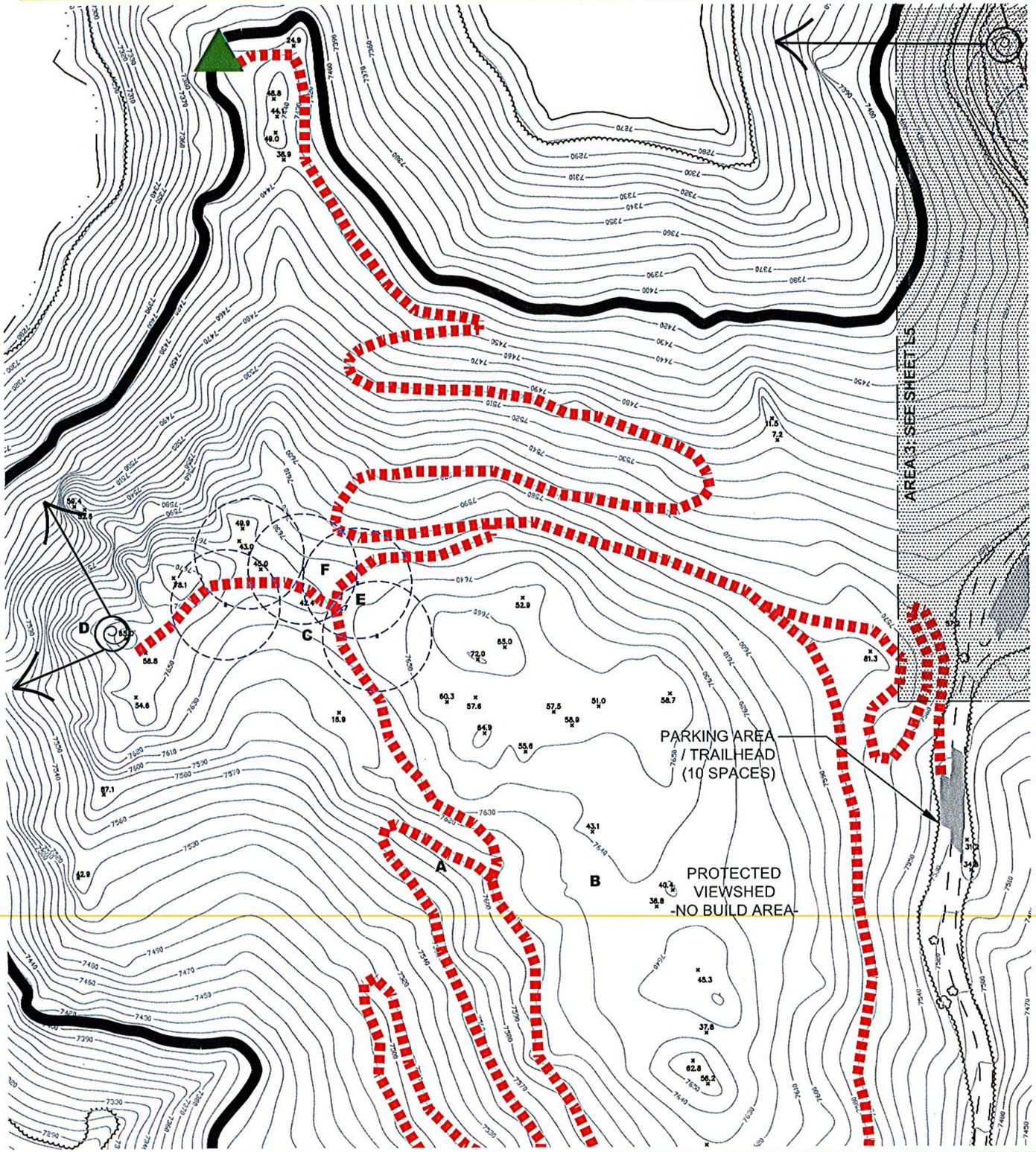
Date: 05.06.08

Sheet Title:

-AREA 1-
CONCEPT PLAN

Sheet Number:

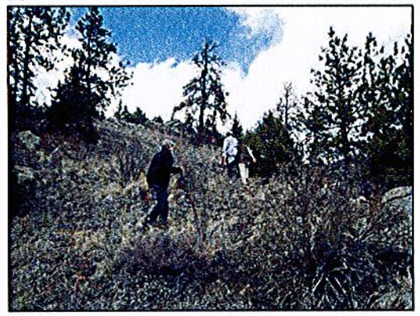
L3



KEY:

- NEW WATER LEVEL
- PROPOSED SINGLE PICNIC TABLE WITH 100' BUFFER (5)
- EXISTING VEGETATION
- PROPOSED SCENIC OVERLOOK (1)
- PROPOSED FISHING ACCESS (1)
- PROPOSED PARKING AREA (10 SPACES)
- PROPOSED HIKING TRAIL
- EXISITNG ROAD

A



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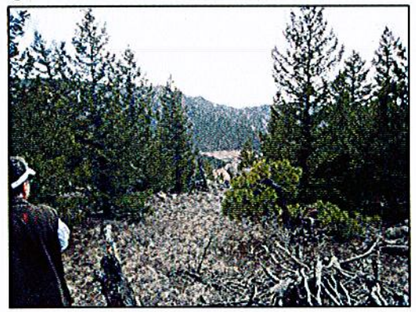

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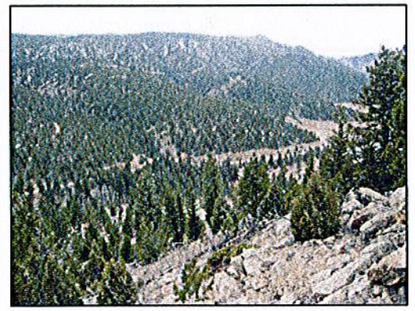

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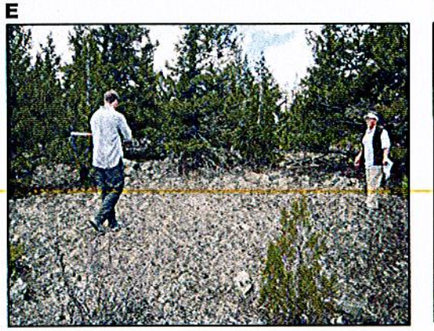

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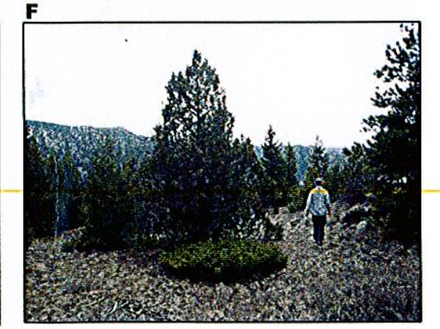

0 100 200 400

SCALE: 1"=200'

NORTH

AREA 2

SHAPINS
Belt Collins

PLANNING
URBAN DESIGN
LANDSCAPE ARCHITECTURE

1818 SIXTEENTH STREET
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GROSS RESERVOIR
-RECREATION RELOCATION PLAN-
DENVER WATER DEPARTMENT

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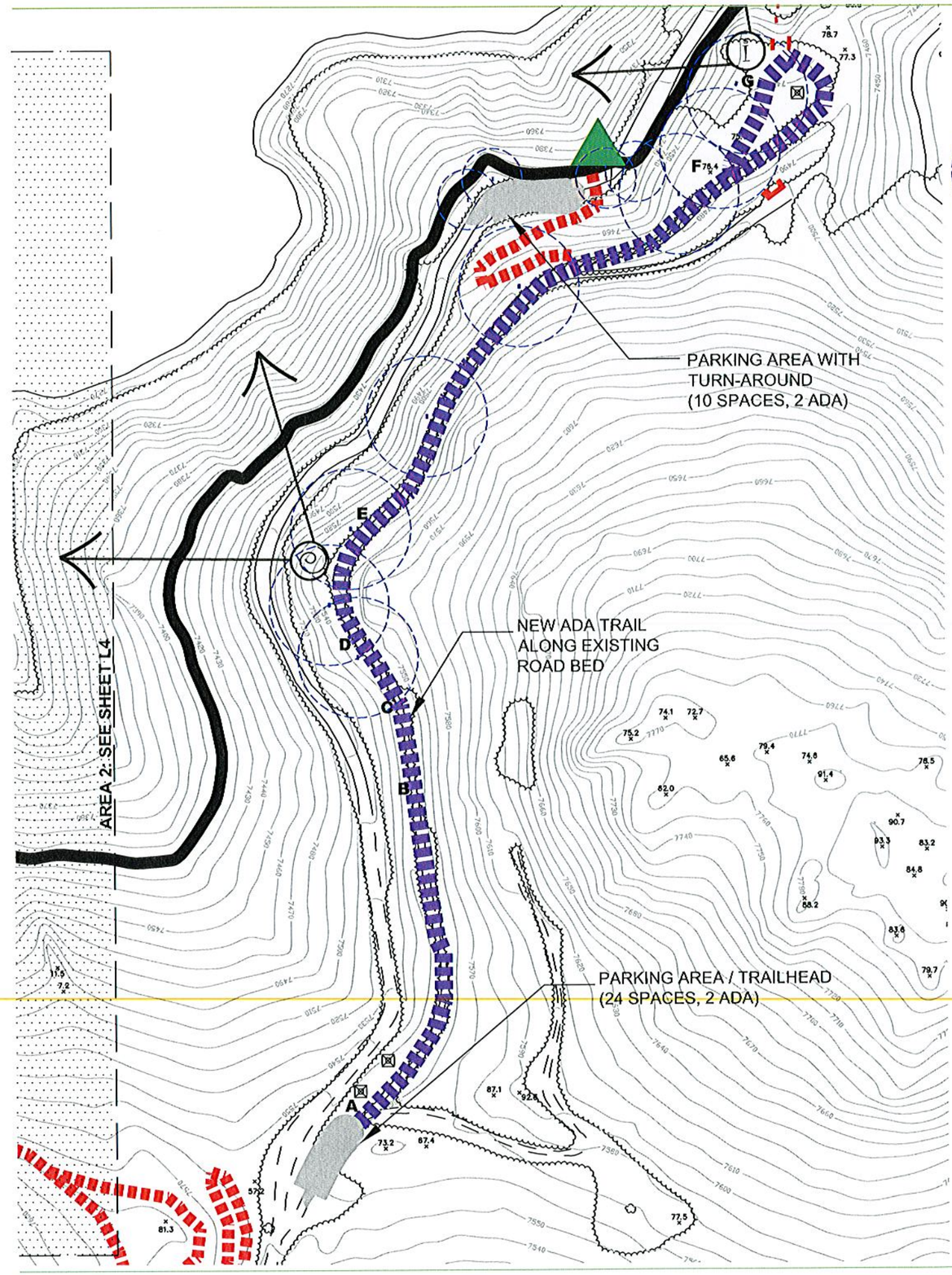
Sheet Title:

-AREA 2-
CONCEPT
PLAN

Sheet Number:

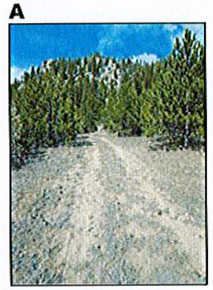
L4



KEY:

- NEW WATER LEVEL
- PROPOSED SINGLE PICNIC TABLE WITH 100' BUFFER (8)
- PROPOSED SINGLE PICNIC TABLE WITH 50' BUFFER (4)
- EXISTING VEGETATION
- PROPOSED PARKING AREA (34 SPACES)
- PROPOSED SCENIC OVERLOOK (1)
- PROPOSED INTERPRETIVE OVERLOOK (1)
- PROPOSED (RELOCATED) SMALL PICNIC SHELTER (3)
- PROPOSED FISHING ACCESS (1)
- PROPOSED HIKING TRAIL
- PROPOSED MULTI-PURPOSE TRAIL (ADA)
- EXISTING ROAD
- HISTORIC STRUCTURES

A



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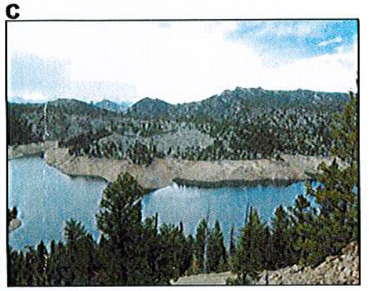

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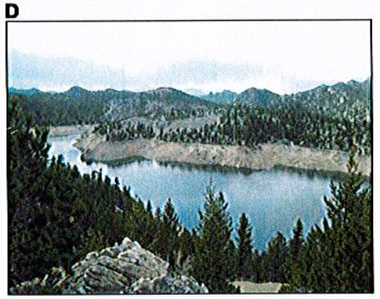

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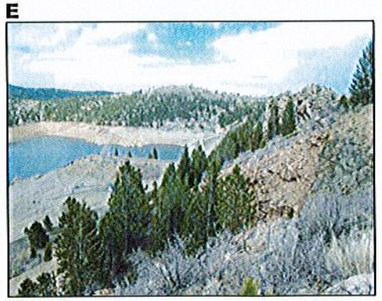

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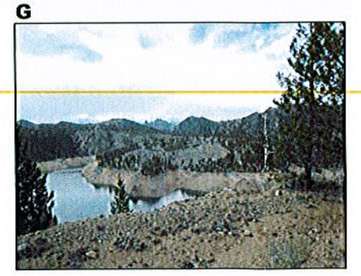


0 100 200 400

SCALE: 1"=200'

NORTH

AREA 3

L5

SHAPINS
Belt Collins

PLANNING
URBAN DESIGN
LANDSCAPE ARCHITECTURE

1818 SIXTEENTH STREET
BOULDER, COLORADO 80302
303.442.4568 FAX 303.786.8026

GROSS RESERVOIR
-RECREATION RELOCATION PLAN-
DENVER WATER DEPARTMENT

Revisions:

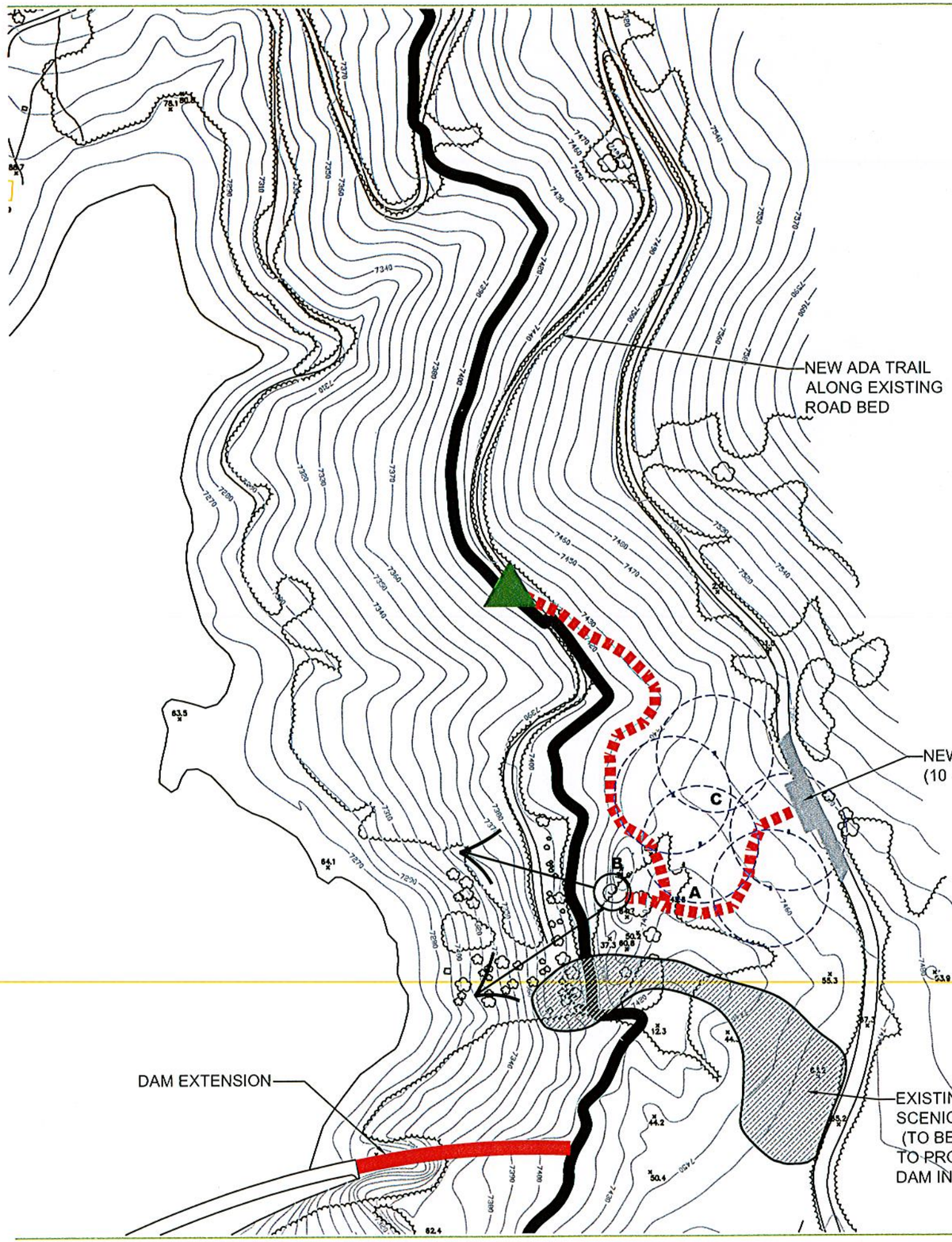
Project #:0804598
Drawn By:EP
Checked By:JS

Date: 05.06.08

Sheet Title:

-AREA 3-
CONCEPT
PLAN

Sheet Number:

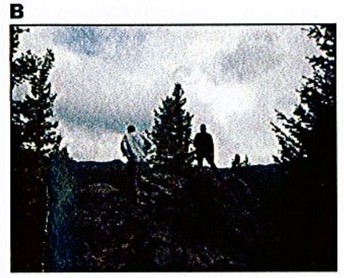


KEY:

- NEW WATER LEVEL
- SINGLE PICNIC TABLE WITH 100' BUFFER (5)
- EXISTING VEGETATION
- EXISTING ROAD
- LOCATION OF EXISTING INFRASTRUCTURE TO BE RELOCATED
- SCENIC OVERLOOK (1)
- PROPOSED FISHING ACCESS (1)
- HIKING TRAIL
- PROPOSED PARKING AREA (10 SPACES)

A

B



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0 100 200 400

SCALE: 1"=200'

NORTH

AREA 4

L6

SHAPINS
Belt Collins

PLANNING
URBAN DESIGN
LANDSCAPE ARCHITECTURE

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BOULDER, COLORADO 80302
303.442.4588 FAX 303.786.8026

GROSS RESERVOIR
-RECREATION RELOCATION PLAN-
DENVER WATER DEPARTMENT

Revisions:

Project #: 0804596
Drawn By: EP
Checked By: JS

Date: 05.06.08

Sheet Title:

-AREA 4-
CONCEPT
PLAN

Sheet Number:

Draft FERC Hydropower
License Amendment Application
Gross Reservoir Hydroelectric Project
FERC Project No. 2035

ATTACHMENT E-3

IGA AND MOU FOR MANAGEMENT OF RECREATIONAL ACTIVITIES AT GROSS RESERVOIR MAY 2005

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08380 A

INTERGOVERNMENTAL AGREEMENT BETWEEN BOULDER COUNTY AND THE CITY AND COUNTY OF DENVER AND MEMORANDUM OF UNDERSTANDING WITH THE UNITED STATES DEPARTMENT OF AGRICULTURE - FOREST SERVICE FOR MANAGEMENT OF RECREATIONAL ACTIVITIES AT GROSS RESERVOIR

This Intergovernmental Agreement and Memorandum of Understanding ("Agreement") between the City and County of Denver, acting by and through its Board of Water Commissioners ("Board"), the County of Boulder, a body corporate and politic ("Boulder County") and the United States of America, acting by and through United States Department of Agriculture, Forest Service ("USFS") (collectively "the Parties") is executed to be effective this 18th day of May, 2005.

RECITALS

WHEREAS, pursuant to Sections 29-1-203 and 30-11-410, C.R.S., the Board and Boulder County may cooperate or contract with one another to provide any function or service lawfully authorized to each of the cooperating or contracting units when such agreements are authorized by each Party to the agreement with the approval of the governing body and are encouraged to cooperate to promulgate regulations regarding the use and provision of law and regulatory enforcement for land within their respective jurisdictions; and

WHEREAS, Boulder County, the Board and the USFS each own and/or manage property in the vicinity of Gross Reservoir in Boulder County; and

WHEREAS, the Board is the owner and operator of Gross Reservoir; and

WHEREAS, the Boulder County Sheriff's Office is the responsible law enforcement agency for the unincorporated portions of Boulder County in the vicinity of Gross Reservoir and the Board, USFS and Boulder County are charged with administering recreational uses upon lands that each entity owns or administers; and

WHEREAS, the Board is licensed to operate a hydroelectric power facility at Gross Reservoir, subject to the Federal Energy Regulatory Commission ("FERC") jurisdiction; and

WHEREAS, a condition of the Board's FERC license requires the Board to develop a Recreation Management Plan and a Safety and Law Enforcement Plan (collectively "the Plan") and to provide opportunities for public recreation at the reservoir; and

WHEREAS, the primary purpose of Gross Reservoir is to supply water to the Denver Metropolitan Area. The water stored at Gross Reservoir is used for the Board's potable water supply, and therefore, the Board is concerned with the quality of the water

in the reservoir, the kinds and volumes of recreation allowable, public safety concerns, and the continuing prevention of contamination to the Board's water supply; and

WHEREAS, the Board also recognizes that some of its reservoirs and surrounding lands offer the public recreation opportunities, and the Board has historically contracted with government agencies to supervise recreation.

WHEREAS, the purpose of this Agreement is for the Parties to establish a framework of shared management of recreational activities on and around Gross Reservoir and a common set of rules and regulations for the benefit, enjoyment and safety of the visitors and residents of Boulder County, as authorized by Sections 29-1-203 and 29-7-101, C.R.S.

AGREEMENT

NOW THEREFORE, the Parties hereby execute this Agreement in accordance with, and in consideration for, the above recitals and the following mutual promises, terms and conditions:

1. The Parties recognize that unified planning and coordinated management of the Gross Reservoir Recreation Area ("GRRA") (the boundaries of the GRRA are depicted on Exhibit A, attached hereto and incorporated herein by this reference) is generally desirable and in the public interest. The parties agree to administer and manage recreational activities for the lands and water within the GRRA in a manner consistent with this Agreement.

2. This Agreement provides for the sharing of in-kind services and law or regulatory enforcement responsibilities by the Parties towards the mutual goal of providing a consistent set of rules and regulations and sufficient coverage of law enforcement services for the GRRA. This Agreement does not create an obligation of any particular level of law or regulatory enforcement presence within the GRRA by any Party or any specific level of financial commitment by any Party towards provision of law and regulatory enforcement services for the GRRA. However, this Agreement authorizes the Parties to provide law and regulatory enforcement throughout the GRRA and assures that the GRRA will be managed according to a consistent set of rules and regulations, regardless of which Party is providing law and/or regulatory enforcement.

3. Boulder County has promulgated Rules and Regulations, pursuant to Section 29-7-101(2), C.R.S., applicable to the GRRA ("Rules and Regulations") for the purposes of managing and protecting property within the GRRA. The Rules and Regulations are attached hereto and incorporated herein by this reference as Exhibit B.

4. Because it is in the Parties' interest to have a uniform set of regulations which may be enforced, regardless of property ownership and regardless of which Party is conducting the enforcement, each of the Parties is hereby authorized by this Agreement to provide law and regulatory enforcement services, including but not limited to

enforcement of the Rules and Regulations, as the Rules and Regulations may be amended from time to time, on any portion of the GRRA. Law enforcement and/or regulatory enforcement of the Rules and Regulations may be undertaken within the GRRA at the direction of any of the Parties and by any person authorized by law to enforce laws or regulations promulgated under Section 29-7-101(2), C.R.S., and pursuant to Section 16-3-110, C.R.S. and 16 U.S.C. § 559g(c). The Rules and Regulations may only be amended in a signed writing executed by each of the Parties. Any amended Rules and Regulations will supercede the original Exhibit B attached hereto.

5. Under federal law, the USFS must administer National Forest System lands within the GRRA consistent with the Arapaho National Forest Land and Resource Management Plan ("LRMP"), as that document may be amended in the future. To the extent this Agreement is inconsistent with the LRMP, the USFS will consider LRMP amendment proposals, to the extent permitted, and under any procedures required, by applicable federal law. The USFS also agrees, as appropriations and administratively budgeted resources allow, to participate in shoreline cleanup for National Forest System lands that are within the GRRA.

6. It is the intent of the Parties that they will recover their costs incurred from the provision of law and regulatory enforcement within the GRRA by collection of fees from summonses issued under Rules and Regulations. This Agreement does not require any Party to reimburse other Parties for expenditures made pursuant to the exercise of the powers granted under the Agreement.

7. The Parties enter this Agreement as separate, independent sovereign entities and shall maintain such status throughout the term of the Agreement. No Party shall be liable under this Agreement for actions of the others' employees and agents. Nothing in this Agreement shall be construed as a waiver of by any Party of its rights, immunities, defenses or privileges. By agreeing to this provision, the Board and Boulder County do not waive or intend to waive, the limitations on liability that are provided to the Parties under the Colorado Governmental Immunity Act, Sections 24-10-101 *et seq.*, C.R.S., as amended, or other applicable statutes.

8. The Parties agree that amendments to this Agreement may be proposed by any Party and shall become effective upon the unanimous written approval of all Parties. Additional Parties may be added to this Agreement by amendment.

9. Notices. Any notice sent from one Party to another pursuant to this Agreement shall be in writing address as follows:

To Boulder County: Boulder County Sheriff
P.O. Box 471
Boulder, CO 80306

With a Copy to:	Boulder County Attorney P.O. Box 471 Boulder, CO 80306
To the Board:	Denver Water Director of Engineering 1600 West 12th Avenue Denver, Colorado 80204
With a copy to:	Denver Water Chief of Distribution and Property Management 1600 West 12th Avenue Denver, Colorado 80204
To the Forest Service:	Forest Supervisor USDA Forest Service Arapaho and Roosevelt National Forests And Pawnee National Grassland 2150 Centre Ave., Building E Fort Collins, CO 80526
With a copy to:	William C. Fox Special Agent in Charge USDA Forest Service 740 Simms Golden, CO 80401

9. This Agreement shall become effective upon the authorized signatures of all Parties and shall remain in force for five years from its effective date with the following conditions:

A. The Agreement shall be automatically renewed for an additional five years if it is not terminated in writing at the end of the initial term and is subject to further renewals upon the written agreement of all Parties.

B. The Agreement may be terminated at any time upon written agreement of all Parties. The Agreement shall terminate if two or more Parties elect to withdraw from participation, provided that the Party or Parties electing to withdraw give 60 days written notice to all Parties of their intent to withdraw.

C. Any Party may withdraw from this Agreement after giving 60 day's written notice. Upon the effective date of termination, that Party's responsibilities and obligations under this Agreement will cease. Withdrawal from this Agreement shall in no way prejudice or impair

a Party's rights or entitlements arising out of future agreements between or among the parties thereto.

D. By signature below, the Parties certify that the individuals listed in this Agreement as their representatives are authorized to act in their respective areas for matters related to this Agreement.

10. Any information furnished to the USFS under this Agreement is subject to the Freedom of Information Act (5 U.S.C. 552).

11. This Agreement is not intended to, and does not, create any right, benefit or trust responsibility, substantive or procedural, enforceable at law or equity, by any person or Party, against any other person or Party, or their agencies or officers. This Agreement is not intended to, and does not, create a contract subject to the Contract Disputes Act, 41 U.S.C. § 601 *et seq*.

DATED this 18th day of May, 2005

COUNTY OF BOULDER, a body corporate and politic

By: Ben Pearlman
Ben Pearlman, Chair

By: Thomas A. Mayer
Thomas A. Mayer, Vice-Chair

By: (EXCUSED)
Will Toor, Commissioner

Attest: Marianne Reichert
Clerk of the Board

CITY AND COUNTY OF DENVER,
acting by and through its
BOARD OF WATER COMMISSIONERS

ATTESTED:

H.J. Barry, Secretary

William R. Roberts, President

APPROVED:

Jon L. Diebel, Director of Engineering

APPROVED AS TO FORM:

Legal Division

REGISTERED AND COUNTERSIGNED:
, Auditor
CITY AND COUNTY OF DENVER
By
Deputy Auditor

USDA FOREST SERVICE

Agreement # 05-MU-11021001-013

for Jacqueline L. Parks
James S. Bedwell, Forest Supervisor
Arapaho and Roosevelt National Forests
and Pawnee National Grassland

5/18/05
DATE

William C. Fox
Special Agent in Charge
USDA Forest Service
740 Simms
Golden, CO 80401

5-10-05
DATE

The authority and format of this instrument
has been reviewed and approved for signature.

Debra L. Jensen 4/27/05
DEBRA L. JENSEN DATE
FS Agreements Coordinator

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Exhibit A

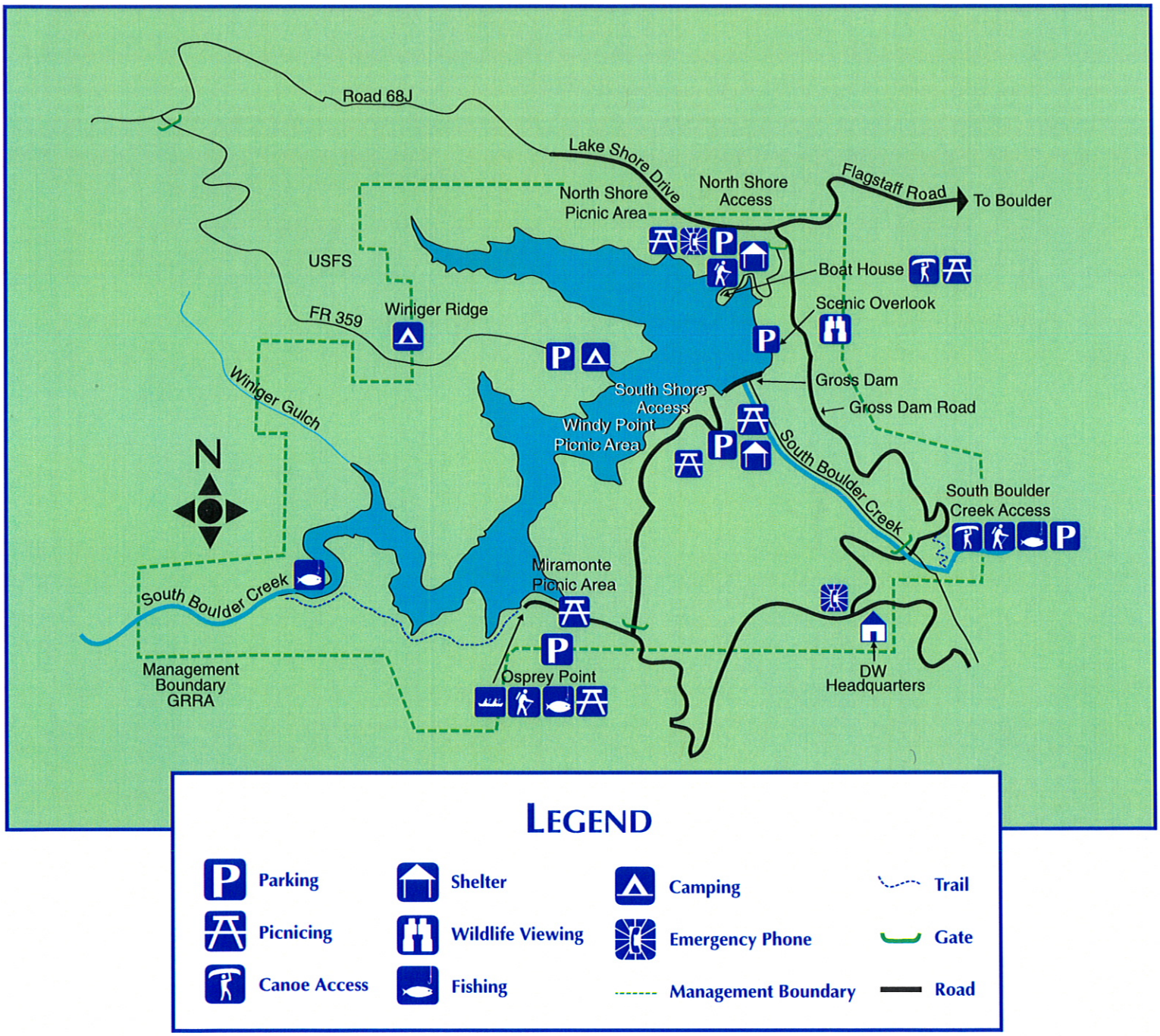
Road 68J
Lake Shore Drive
North Shore Access
Flagstaff Road
To Boulder
North Shore Picnic Area
USFS
Boat House
Scenic Overlook
FR 359
Winiger Ridge
Gross Dam
Gross Dam Road
South Shore Access
Windy Point Picnic Area
Winiger Gulch
South Boulder Creek
South Boulder Creek Access
N
Miramonte Picnic Area
South Boulder Creek
Management Boundary GRRA
Osprey Point
DW Headquarters
LEGEND
Parking
Shelter
Camping
Trail
Picnicing
Wildlife Viewing
Emergency Phone
Gate
Canoe Access
Fishing
Management Boundary
Road

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Exhibit B
Gross Reservoir Recreation Area Rules and Regulations

RESOLUTION NO. 2005-49

A RESOLUTION CONCERNING RULES AND REGULATIONS FOR THE GROSS RESERVOIR RECREATION AREA.

WHEREAS, the Board of County Commissioners ("County") is empowered by § 29-7-101(2), C.R.S. and § 30-15-401, C.R.S., as amended, to adopt rules and regulations pertaining to recreation lands and facilities owned or operated by the County; and

WHEREAS, pursuant to § 29-1-203, the County may cooperate with the City and County of Denver, acting by and through its Board of Water Commissioners ("Board") and the United States Department of Agriculture, U.S. Forest Service ("USFS") for its rules and regulations pertaining to recreation lands and facilities to apply to recreation lands owned or operated by those governmental entities; and

WHEREAS, in the Intergovernmental Agreement and Memorandum of Understanding between the County, the Board and the USFS of even date with these Rules and Regulations, to which these Rules and Regulations are attached as an exhibit ("Agreement"), the County has reached agreement with the Board and the USFS to adopt these Rules and Regulations; and

WHEREAS, these Rules and Regulations are for the sole purpose of managing and protecting property within the Gross Reservoir Recreation Area ("GRRA"), as the GRRA is defined in the IGA; and

WHEREAS, enactment of these Rules and Regulations constitutes neither a waiver of governmental immunity pursuant to § 24-10-101, et seq., C.R.S., as amended, nor the assumption of any duties of care to any person.

NOW, THEREFORE, BE IT RESOLVED that the County hereby adopts the following Rules and Regulations governing GRRA:

1. Resource Protection

(a) It shall be unlawful for any unauthorized person to remove, move, destroy, mutilate, collect or deface any natural or man-made object within the GRRA, including, but not limited to: trees, down timber or branches, shrubbery, plants, flowers, rocks, fences, signs, kiosks, restrooms, tables, benches, cultural resources and trash containers.

(b) It shall be unlawful to install or replace rock bolts, plant trees or any other type of landscape material, or establish or construct trails or other facilities for public or private use without the written authorization from the owner or manager of the property. This provision shall not apply to any federal, state or local officer, or member of an organized rescue or firefighting force in the performance of any official duty.

2. Wildlife

(a) It shall be unlawful for any person to feed, hunt, pursue, trap, molest, disturb, or kill any wildlife, or for any person to allow any domestic animal to do the same, at any time within the GRRA, except where and when such activities are permitted by the parties to the IGA. This provision shall not apply to any county, state or federal government personnel authorized by federal law or the Board to carry out a wildlife management, or other, program through law or County-approved rules and regulations, or to National Forest System ("NFS") lands within the GRRA and upon which hunting is otherwise permitted.

(b) It shall be unlawful for any unauthorized person to relocate or release any animal within the GRRA.

3. Fishing and Boating Regulations

Fishing is permitted in accordance with Colorado Wildlife Commission's land and water regulations, except as otherwise posted. Snagging kokanee is permitted September 1 to January 31 only. It shall be unlawful to violate special fishing or boating regulations posted within any portion of the GRRA. The parties to the IGA may modify these regulations or create new ones when deemed necessary for repairs, fishing and wildlife, vegetation and/or public safety concerns.

Only non-motorized car top boats are permitted. Car top boats are those single-hulled, hand-propelled recreational boats of less than 18 feet in length that can be lifted onto and taken from the top of a passenger vehicle. The only exception to the length limit are sea-touring 2-person kayaks of less than 24 feet in length. Sail boats, wind surfers and ice boards are prohibited. Inflatable car top boats must be multi-chambered. Except for kayaks entering the reservoir from South Boulder Creek and paddling along the shoreline to the Osprey (Haul Road) take-out, boating is only permitted between Memorial Day and October 1st.

4. Projectiles, Weapons and Explosives

It shall be unlawful to discharge or carry into the GRRA firearms (concealed or otherwise), projectile weapons or explosives of any kind including but not limited to fireworks, BB guns, pellet guns, rockets, air guns, paint ball guns, blow guns, crossbows, longbows and slingshots, except as expressly mandated by Article 12 of Title 18 of the Colorado Revised Statutes, as amended; Colorado peace officers and federal law enforcement officers on official duty are excepted. This provision shall not apply to NFS lands within the GRRA. Exceptions may be permitted only with written permission from the parties to the IGA.

5. Domestic Animals/ Livestock

(a) Any dog or other domestic animal within the GRRA shall be restrained by a leash, cord, rope or chain and under physical control of a person, except as otherwise provided for in this paragraph or posted with approval from the parties to the IGA. Any owner/keeper accompanying a dog in an off-leash area must have the ability to restrain his or her dog when requested by any enforcement officer.

(b) It shall be unlawful for any owner/keeper to allow his or her domestic animals within GRRA to engage in disorderly conduct or any activity which interferes with the health, safety or welfare of users, livestock, other domestic animals or neighbors in the area, or which creates a nuisance, including unwanted physical contact or threatening behavior, with any user, domestic animal or livestock.

(c) Dogs may be prohibited from specific areas of the GRRA by action of the parties to the GRRA. Dogs are not permitted to enter the reservoir.

(e) Horses must be under the physical control of a person at all times while in the GRRA.

(f) Domestic animals or livestock may be tied by a lead or rope sufficient to restrain the animals, but shall neither be left tied and unattended, nor tied in any manner which damages vegetation or structures, or which interferes with or disturbs the public's use of established trails, picnic areas or campsites.

6. Camping

No overnight camping in the GRRA is permitted except at designated campsites. This provision does not apply to NFS lands within the GRRA.

7. Fire

(a) Fires of any kind by GRRA users are only permitted in grills and fire grates provided at designated sites. Ground or open fires of any type are prohibited.

(b) Fires may be prohibited entirely by order of a Party or the Boulder County Sheriff by the posting of special notices or public notification through the press. This provision shall not apply to controlled burns by a Party upon land it owns or administers.

8. Bikes

No person shall ride a bicycle or unicycle within the GRRA except on trails where such use is designated.

9. Vehicles

(a) No person shall operate a motor vehicle, including a car, truck, motorcycle, minibike, snowmobile, four-wheel drive or other recreational vehicle, within the GRRA, unless on a road or if the area is specifically designated and posted to permit the operation of such vehicle in that area. Emergency vehicles and enforcement officials in performance of their official duty are excepted from this Rule.

(b) Exceptions to this Rule may be granted to persons with disabilities, by permission from law or regulatory enforcement staff of any of the Parties, for the use of single-rider motorized vehicles adapted for recreational use by people with disabilities.

(c) Vehicles must be parked only in designated areas.

(d) Vehicles may not be left parked and unattended at any time from sunset to sunrise, with the exception of vehicles parked by people camping at designated campsites.

(e) Only persons with a disability may park in spaces designated for persons with disabilities. A license plate or placard obtained pursuant to § 42-3-121, C.R.S, as amended, or otherwise authorized by § 42-4-1208 (4), C.R.S., as amended, shall be displayed at all times while vehicle is parked in such a space.

10. Swimming, Boating and Skating

It shall be unlawful to swim, dive, wade or otherwise have any body contact with water in the reservoir or any pond within the GRRA. Ice skating, walking on ice or ice fishing in or on within the GRRA, is permitted at the risk of the user unless the area is specifically posted to prohibit such activity. By

engaging in any of these activities, a member of the public assumes all risk of injury or damages arising from the activity.

11. Littering/Dumping

(a)It shall be unlawful to deposit or dispose of trash, garbage, rubbish, litter, debris, or other objects within the GRRA, except that which is generated by legal activities conducted within the GRRA. Trash and debris legally generated within the GRRA must be removed or deposited in a designated trash receptacle.

(b) It shall be unlawful to clean vehicles / livestock trailers out onto the GRRA.

(c) Under no circumstance may hazardous materials be deposited within the GRRA.

12. Glass Containers

It shall be unlawful for any person to carry or possess, outside of an enclosed vehicle, any glass bottle or other glass container within the GRRA, except as might be required for prescribed medical treatment.

13. Alcoholic Beverages

It shall be unlawful to consume, possess or serve alcoholic beverages, except for fermented malt beverages containing not more than 3.2% alcohol by weight, within the GRRA, except on NFS lands within the GRRA.

14. Hours

Except for overnight camping at designated campsites, the GRRA shall be open for daytime use only, between the hours of sunrise and sunset. Exceptions are permitted only by obtaining written permission from the parties to the IGA. Although the GRRA is open between the hours of sunrise and sunset, the gate to the Gross Reservoir dam may be open a lesser subset of these hours. This provision shall not apply to NFS lands within the GRRA.

15. Research Projects

All research projects to be conducted within the GRRA must be reviewed and written authorization granted in advance from the owner or manager of the land upon which the research project will be conducted.

16. Commercial Activity

It shall be unlawful for any person, acting individually or on behalf of a business or organization, to use the GRRA for any competitive or commercial purpose (such as races or events; filming movies or commercials; guiding service; equipment demonstrations; riding activities of a commercial horse stable, riding school, or livery). Individuals engaging in still camera photography are exempt.

17. Disorderly Conduct

It shall be unlawful for any person to engage in disorderly conduct or any activity within the GRRA which interferes with the health, safety and welfare of users or neighbors in the area, or which creates a nuisance (including amplified sound).

18. Trail Use

It shall be unlawful for any trail user to fail to yield to other trail users in the manner defined herein or as otherwise posted at trailheads. The appropriate order for yielding the trail right-of-way is as follows: All users yield to equestrians, bicyclists yield to pedestrians, and bicyclists headed downhill yield to bicyclists headed uphill. Yielding the right-of way requires slowing down to a safe speed, being prepared to stop, establishing communication, and passing safely.

19. Closures

Portions or all of the GRRA may be closed to the public due to wildlife, vegetation, management review, contractual agreement, public safety concerns and/or other resource protection needs. Such closures may be temporary, permanent or indefinite. The parties to the IGA may designate an area as closed temporarily, permanently, or for an indefinite period of time.

20. Other Prohibited Activities

(a) Other prohibited activities include: polluting land, water or air, golfing, hangliding, paragliding, parapenting, parachuting, parasailing, the use of remote-controlled land, water or air-borne devices, mountain skateboards, mountain ski-bikes, off-road roller blades, and similar devices.

(b) Except for emergency landings, it shall be unlawful to take off or land with any motorized or non-motorized aircraft within the GRRA; aircraft includes but is not limited to: airplanes, helicopters, ultralights, gliders/sailplanes, and hot-air balloons.

21. Regulatory Signs

It shall be unlawful to violate any rule or regulation posted on a sign or in any brochure.

22. Exceptions to the Rules and Regulations

Exceptions to these Rules and Regulations as amended, re-enacted, or re-adopted, may be granted by written permission by the parties to the IGA. Federal, state and local emergency and enforcement officers in performance of their official duties are exempt from these Rules and Regulations.

23. Enforcement

Pursuant to §§ 29-7-101(2) and (3) and § 30-15-401, C.R.S. et seq., as amended, it is the duty of the law and regulatory enforcement staff of the Parties to the Intergovernmental Agreement Between Boulder County and the City and County of Denver and Memorandum of Agreement With the United States Forest Service for Management of Recreational Activities at Gross Reservoir and the Boulder County Sheriff to enforce any and all of the Rules and Regulations adopted for the GRRA. Any person who violates any of these Rules and Regulations may be expelled from the GRRA.

24. Interpretation of Rules and Regulations

(a). It is hereby declared to be the legislative intent that the provisions of this Resolution shall be separable, in accordance with the provisions set forth as follows: If any provision of this Resolution is ruled to be invalid by any court of competent jurisdiction:

(i) The effect of such judgment shall be limited to that specific provision or provisions which are expressly stated in the judgment to be invalid; and
(ii) Such judgment shall not affect, impair or nullify the validity of application of this Resolution as a whole or any other part thereof, but the rest of this Resolution shall continue in full force and effect.

(b) The enactment of this Resolution or any amendment thereto shall not be construed as abating any action now pending under or by virtue of prior provisions, or discontinuing, abating, modifying or altering any penalty accruing or about to accrue, or as affecting the liability of any person, or as waiving any right of the parties to the IGA under any provision existing prior to the adoption of this Resolution, or as vacating or annulling any rights obtained by any person by lawful action of the parties to the IGA except as shall be expressly provided for in this Resolution.

25. Penalties

Violation of any Rule or Regulation above shall be a Class 2 Petty Offense as provided for in § 29-7-101(2) and § 30-15-402, C.R.S., as amended, and punishable by fine or as otherwise provided by law.

(a) Any person having the authority and responsibility to enforce these Rules and Regulations and having knowledge of any violation of the Rules and Regulations stated herein may issue a Citation or Summons and Complaint to the violator or, as set forth in Rule 26(b) herein, to a vehicle, stating the nature of the violation with sufficient particularity to give notice of said charge to the violator.

(b) Any person having the authority and responsibility to enforce the Rules and Regulations and having knowledge of any violation of the Rules and Regulations stated herein may use the Penalty Assessment Procedure defined under § 16-2-201 C.R.S., as amended, by issuing the violator a penalty assessment notice and releasing the violator upon its terms or, as the law allows, by taking the violator before a county court judge. The penalty assessment notice shall be a Summons and Complaint and shall contain the identification of the offender, the specification of the offense, and the applicable fine. As provided in § 16-2-201(1.5), C.R.S., as amended, a penalty assessment notice may be placed on an unattended vehicle that is parked in apparent violation of any rule or regulation. A penalty assessment notice placed on a vehicle shall contain the license plate number and state of registration of the vehicle in lieu of the identification of the offender.

(c) When the Penalty Assessment Procedure is used, the following schedule of fines shall be used with exception for parking and weapons, hunting and fire related violations as noted below:

Regulations assessments:
- First Offense $50
- Second Offense $100
- Third Offense $200
- Subsequent Offenses $300 or maximum allowable by law

Weapons, hunting and fire related assessments:
- First offense $300
- Subsequent Offenses $300 or the maximum allowable by law

Parking assessments for violation of 9 (a):
- First Offense $25
- Second Offense $50
- Third Offense $75
- Fourth Offense $100

Subsequent Offenses $300 or maximum allowable by law
Parking assessments for violation of 9 (c): $100

The parties to the IGA shall make available for inspection to the public, a current copy of the existing rules and regulations relating to the GRRA.

BE IT further RESOLVED that any prior resolutions setting forth Rules and Regulations for the GRRA, which are inconsistent herewith, are hereby expressly repealed.

A motion to adopt this Resolution was made by Commissioner Mayer, seconded by Commissioner Pearlman and adopted by a 2-0 vote.

ADOPTED this 28 day of April, 2005

COUNTY OF BOULDER, a body corporate and politic

By: Ben Pearlman
Ben Pearlman, Chair

By: Thomas A. Mayer
Thomas A. Mayer, Vice-Chair

By: (EXCUSED)
Will Toor, Commissioner

Attest: Marianne Reichert
Clerk of the Board

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Draft FERC Hydropower License Amendment Application Gross Reservoir Hydroelectric Project FERC Project No. 2035

ATTACHMENT E-4

BORROW HAUL STUDY JANUARY 2009

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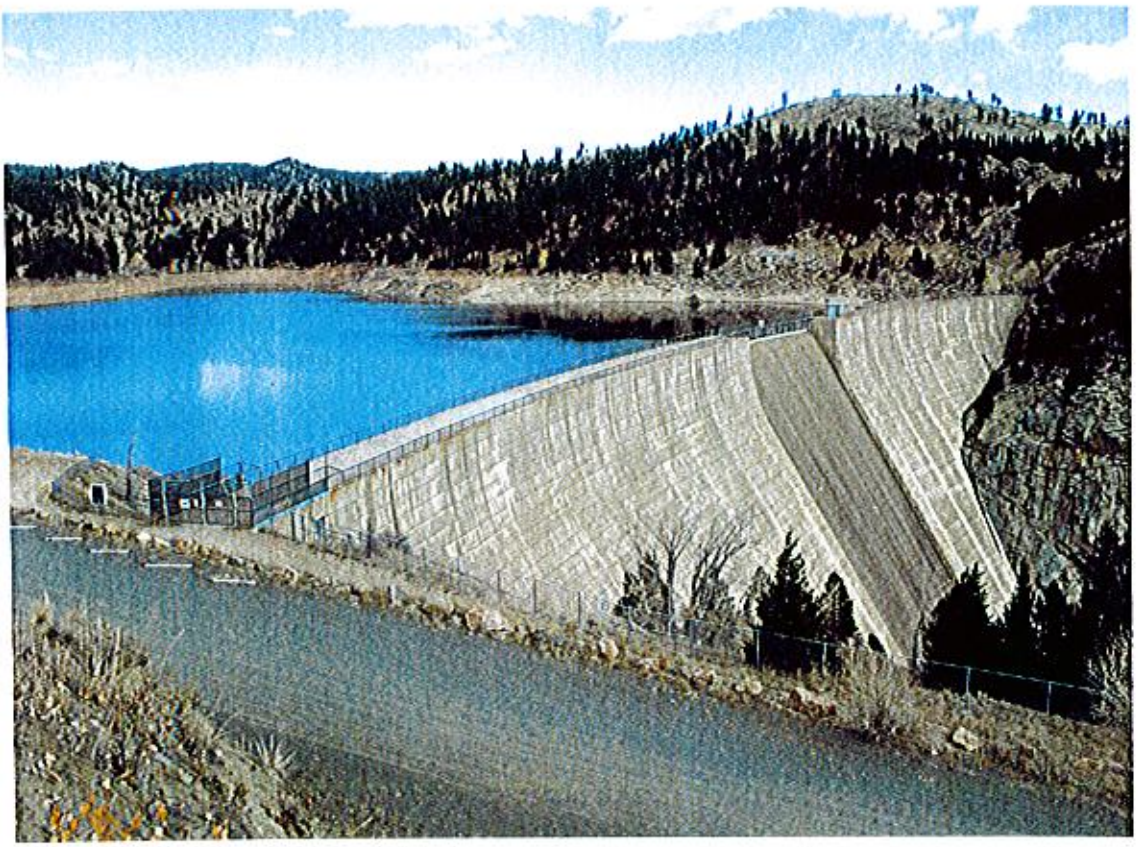
Borrow Haul Study

Task Order #11118D



FINAL

Prepared for:
Denver Water

Prepared by:
HDR

January 22, 2009

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Overview

Denver Water is actively pursuing methods to increase the capacity at Gross Reservoir. Part of the proposed solution involves raising the dam, requiring a large quantity of material to be transported to the site. Construction is anticipated to last four years and during peak times an additional 88 truck trips a day is anticipated on State Highway 72. Due to public concern of increased traffic on SH 72 during construction, Denver Water wishes to evaluate the possibility of using the existing Union Pacific Railroad (UPRR) line to haul material or to add climbing lanes to SH 72 in critical areas to help alleviate the impacts to private vehicle traffic. The general area is shown in Figure 1.

Existing highway conditions

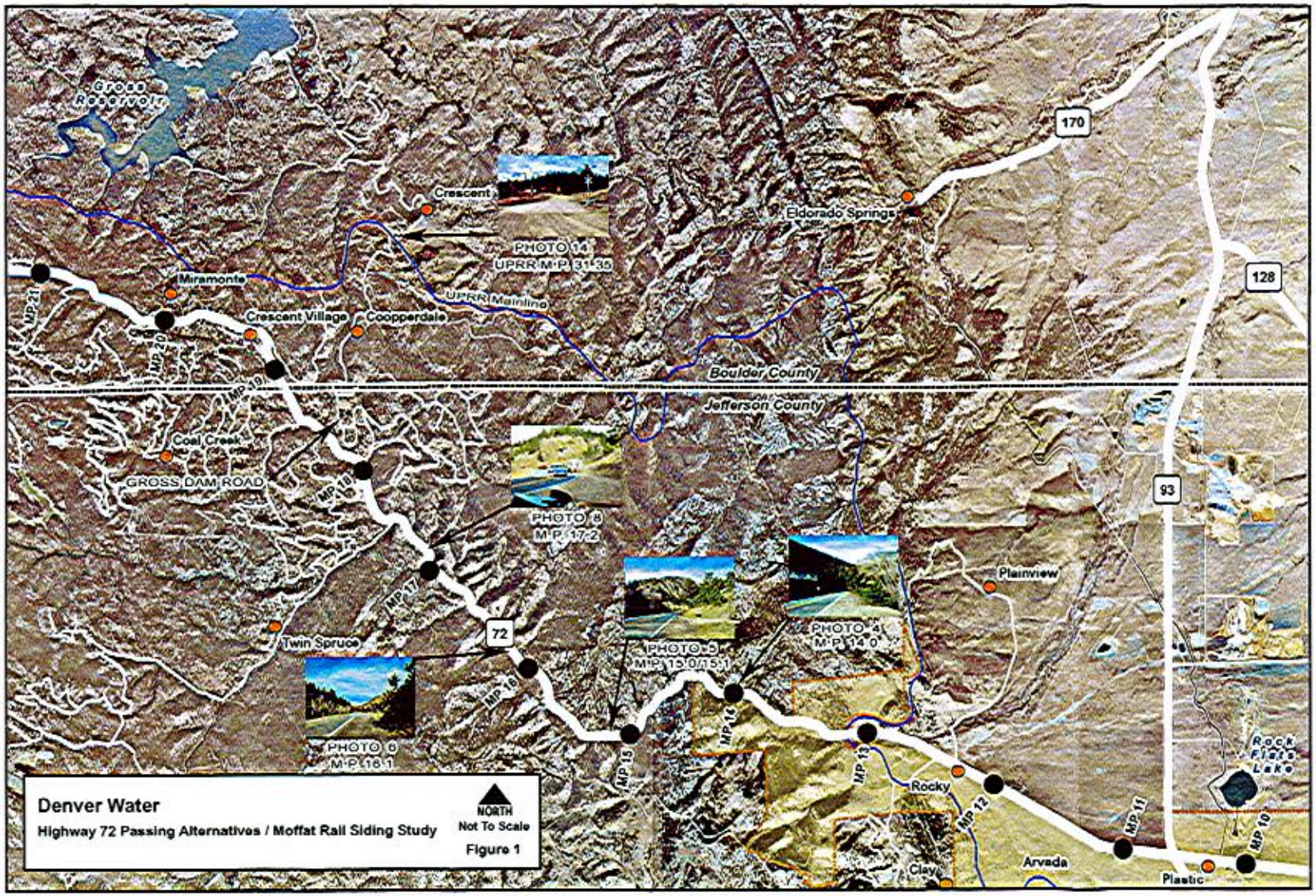
State Highway 72 (SH 72) is a paved two lane road that serves as the primary access to many residents, small communities and Gross Reservoir. West of the intersection with State Highway 93 (SH 93), the highway is a narrow rolling/mountainous road with variable paved and gravel shoulders. The portion of the highway evaluated during this study is between mile post (MP) 10.5, located at the intersection of SH 93 and MP 19, the intersection with Gross Dam Road. This 8.5 mile portion of the highway provides access to an annual average daily traffic (AADT) volume of 4900 vehicles. This actual AADT information was obtained from the Colorado Department of Transportation (CDOT) website and is based on 2007 traffic volumes (see Appendix C). The existing road between MP 10.5 and MP 12 is a level road crossing the flats between SH 93 and the foothills to the west. Beyond MP 12, the road begins to gain elevation while being routed through Coal Creek Canyon, paralleling and crossing Coal Creek at four locations.

The posted speed limit varies between 35 mile per hour in the mountainous terrain to a posted speed of 45 mile per hour along the flats just west of SH 93. Through the mountainous stretch of SH 72, there are several intersecting roads with multiple residential and private driveways. There are also several existing paved and gravel shoulder widenings and turnouts within the study corridor, some of which are currently used by slow moving vehicles traveling west.

Existing highway criteria and standards

The American Association of State Highway and Transportation Officials (AASHTO), A Policy on Geometric Design of Highways and Streets has established three climbing lane criteria which all need to be satisfied to justify implementation of a climbing lane along a two lane highway. The criteria are as follows:

1. Upgrade traffic flow rate in excess of 200 vehicles per hour.
2. Upgrade truck flow rate in excess of 20 vehicles per hour.
3. One of the following conditions exists:
    - A 10 mph or greater speed reduction is expected for a typical heavy truck
    - Level of service E or F exists on the grade.
    - A reduction of two or more levels of service is experienced when moving from the approach segment to the grade.


Gross Reservoir
Crescent
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UPRR M.P. 31.35
Eldorado Springs
170
128
Miramonte
UPRR Mainline
Crescent Village
Coopperdale
MP 21
MP 20
MP 19
Boulder County
Jefferson County
Coal Creek
GROSS DAM ROAD
MP 18
PHOTO 8
M.P. 17.2
93
Plainview
MP 17
72
Twin Spruce
PHOTO 5
M.P. 15.0/15.1
PHOTO 4
M.P. 14.0
MP 16
PHOTO 6
M.P. 16.1
MP 15
MP 14
MP 13
Rocky
MP 12
MP 11
MP 10
Rock Flats Lake
Clay
Arvada
Plastic
Denver Water
Highway 72 Passing Alternatives / Moffat Rail Siding Study
NORTH
Not To Scale
Figure 1

Using the industry standard 10% of the AADT, the design hour volume is 490 vehicles, or 245 vehicles traveling westbound considering an equal spilt in directional traffic. This value is the traffic volume traveling upgrade during the peak hour. Without taking into account the projected increase of 88 truck trips per day for construction, (or an increase in 44 trucks traveling upgrade) the existing conditions already satisfy the first criteria listed above. For the second condition to be met, the upgrade truck flow rate would need to be in excess of 20 trucks per hour. Based on the actual traffic data obtained from CDOT, truck traffic on SH 72 makes up 3% of the design hour volume, which calculates out to 7.4 trucks per hour traveling upgrade (3% of the 245 westbound vehicles). With an additional 44 trucks traveling upgrade a day, or a design hour volume of an additional 4.4 trucks per hour (assuming a 10 hour day), the projected truck flow rate would be 11.8 trucks per hour. This falls below the required 20 trucks per hour to satisfy the second criteria listed above.

When evaluating the third criteria, it is not currently known what the existing or projected level of service will be but it is anticipated the criteria of 10 mph or greater speed reduction for typical heavy trucks could be met. Based upon the AASHTO criteria, SH 72 only satisfies two of the three criteria required to justify the implementation of a climbing lane. Based on this evaluation of the available information, implementing climbing lanes is not justified at this time given the current and projected impacts of construction traffic.

Although implementing climbing lanes may not be warranted, AASHTO does provide alternatives for increased passing opportunities such as turnouts and shoulder use sections. Turnouts are more frequently used on low volume roads in difficult terrain with steep grades. The recommended lengths of turnouts range from 200 to 600 feet, based upon the approach speeds. Shoulder use sections function primarily as an extended turnout. They generally range in length from 0.2 to 0.3 miles and require at a minimum 10 feet of adequate structural strength to support anticipated vehicle weights. Following the reconnaissance trip, these alternatives appear more likely given the existing conditions along the specific stretch of SH 72.

Highway reconnaissance observations

HDR conducted a reconnaissance trip on Tuesday, October 4th, 2008. One of the primary objectives was to drive the 8.5 mile corridor and identify potential locations for climbing lanes to be incorporated on SH 72 to facilitate anticipated construction traffic. The first 2 miles of SH 72 west of SH 93 traverses flat low lying areas at the base of the foothills. The grade is relatively flat and although there are potential auxiliary/passing lane opportunities, they are not necessarily warranted as truck speeds are not significantly inhibited along this section of the corridor. As SH 72 begins to meander up Coal Creek Canyon, the topography, right of way and creek constraints begin to become more apparent off the edges of the highway shoulder. Steep terrain lines the majority of the east side of the highway and Coal Creek run adjacent to the highway primarily on the west side of the road. In several locations along this study corridor, sight distance appears to become adequate for short distances as the existing highway is striped to allow passing.

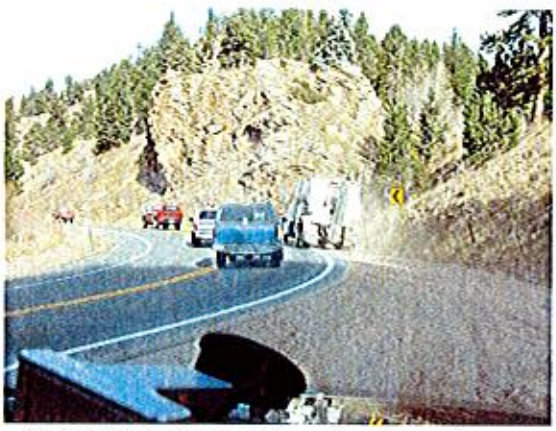
At MP 10.5, SH-72 traverses the base of the foothills west of the SH-93 intersection.

While driving the corridor, HDR was able to identify several existing gravel shoulder widenings and turnout opportunities between SH 93 and Gross Dam Road at MP 19. At MP 14.0, there is an existing pull off approximately 200 feet in length that could be upgraded as a turnout. Based on the AASHTO design

The existing shoulder at MP 16.1 presents an opportunity for a shoulder use section.

criteria, turnouts generally require 200 to 600 feet and 12 feet of width. The pull off varies in width but with little earthwork and minimal grading and paving, a turnout is feasible at this location. Near MP 15.1, there are a couple of opportunities for turnouts along the stretch east of Brumm Trail Road. A discontinuous 8 to 10 foot shoulder currently exists and there are opportunities to implement turnouts. A portion of this shoulder is already used for a Coal Creek bus stop for the local community. Another opportunity for a turnout is located at Cattle Trail Drive, MP 16.1. There is approximately 850 feet of widened gravel shoulder that could serve as a future turnout or shoulder use section with minimal effort. This would also be an ideal location as it is approximately half way between the start of the mountainous grades at MP 12 and the turnoff on Gross Dam Road at MP 19. By upgrading this existing shoulder with minimal grading and paving, a constructed turnout or shoulder use section is possible.

Prior to arriving at the community of Crescent Village, one truck was observed using an existing pull off at MP 17.2 to allow traffic to pass safely. A portion of the shoulder in this location had been previously paved and it appeared to be a known turnout, as existing traffic appeared to anticipate the truck pulling off. With minor grading and paving at this location, the existing pull off presents an opportunity for the development of a standard sized turnoff.



At MP 17.2, a truck takes advantage of an existing pulloff to allow traffic to pass.

While traveling the 8.5 mile corridor, traffic volumes were observed to be relatively low. There was no obvious location for climbing lanes of any significant length due to the steep rocky terrain along the eastern side of the highway. As an alternative to implementing climbing lanes, enhancing the existing infrastructure to accommodate turnouts and shoulder use sections and signing accordingly is reasonable to provide passing opportunities for the general public.

Highway haul recommendations

Based on the reconnaissance trip, there were very few if any opportunities for an economical implementation of climbing lanes between MP 10.5 and MP 19. The steep terrain lining the eastern side of the highway would require extensive and expensive rock excavation to provide the required widths and lengths for climbing lanes. In addition to the existing traffic volumes obtained by CDOT and projected volumes, implementing climbing lanes between MP 10.5 and 19 due to traffic demand is not justified per the established AASHTO criteria.

The viable economical alternatives to providing passing opportunities is enhancing the existing pullouts and widened shoulders along the corridor to develop standard turnouts and shoulder use sections. By enhancing the existing opportunities, the costs for improvements will remain at a minimum and the goal of providing passing opportunities along SH 72 can be attained. Although there are several opportunities for turnouts along this study corridor, the following alternatives with conceptual levels costs are recommended for further development and consideration.

Alternative	Description	Proposed Size (L x W)	Estimated cost
MP 14.0 Turnout	Existing pull off	200' x 12'	$28,100
MP 15.0 Turnout	East of existing bus stop	250' x 12'	$32,200
MP 15.1 Turnout	Existing pull off	300' x 12'	$36,300
MP 16.1 Turnout	Existing shoulder widening	850' x 12'	$83,700
MP 17.2 Turnout	Existing pull off	350' x 12'	$39,300

Estimated costs of alternatives were developed using a typical roadway section of 12" of aggregate base course and 6" of asphalt. Estimates also include a cost for mobilization and traffic control for each alternative. If multiple alternatives are carried forward for construction simultaneously, the overall costs will reduce as the cost to mobilize and traffic control will be shared. Conceptual cost estimates are appended to this report for reference (Appendix A, Tables 1-5).

Another alternative to accommodating construction traffic along SH 72 is to enforce haul time requirements with the selected contractor. SH 72 experiences the highest volume of traffic traveling westbound during the p.m. peak of 3:00 p.m. to 5:00 p.m. By restricting allowable haul times around the observed peak hours, the impacts to traffic traveling westbound would be minimized and no roadway improvements would be required.

Existing rail conditions

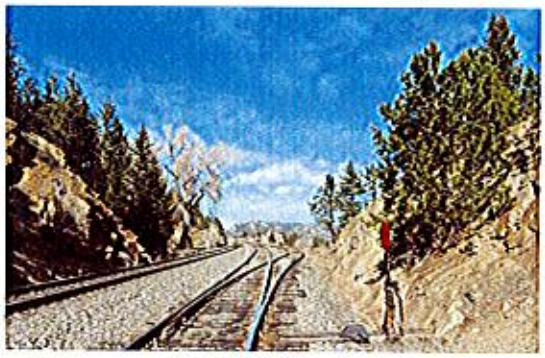
UPRR owns a mainline track that operates from Denver to Grand Junction, CO. The mainline track, within the area of interest, is located on the Denver Division, Moffat Tunnel Subdivision, starting at Milepost (MP) 30.58 Control Point Crescent and extending west to MP 31.80. The purpose of the mainline and controlled siding track 117 is to allow trains to meet and pass each other traveling in opposite directions. Both the mainline track and Crescent siding track 117 typical section consist of 136lb. welded rail, 9'-0" timber cross ties, 12" of ballast on the mainline, and 15' track centers. Approximately 35 unit trains with approximately 100 cars each or more pass through this area per day.

A house track 118 exists at approximately MP 31.04 and extends to MP 31.31. This tracks typical section consists of 115lb. jointed rail, 8'-6" wooden crossties, 8" of ballast, and 15' track centers from the Crescent Siding. It appears track 118 is used for storage of track maintenance machinery. An access road parallels this siding for most of its length.

Existing rail criteria and standards

The Union Pacific Mainline Track Engineering and Specifications, The Union Pacific Standards for Industrial Trackage, and The American Railway Engineering and Maintenance-of-Way Association (AREMA) recommended practices were taken into consideration and used for the proposed recommendations and site reconnaissance observations. UPRR track standards state "track grade shall be designed for the least grade practical, but shall not exceed 2.00%. Grades on track at locations used for spotting and unloading rail cars are not to exceed 0.4%. Exceptions to this general rule can usually be approved by the Chief Engineer by demonstrating means of safely securing rail cars by means of wheel chocks and locations of derails.

Rail reconnaissance observations



Looking west, MP 31.04 at the point of switch for the existing house track 118. From Left to Right the mainline and mainline siding track continues west.

HDR conducted a reconnaissance trip on Tuesday, October 4th, 2008. The objective was to investigate the siding at Crescent and identify the possibility of constructing an additional industrial track. The additional track would be used for unloading materials necessary to increase the capacity at Gross Reservoir. The point of switch for the mainline Crescent siding track 117 begins at MP 30.58 and is controlled by a power switch and signals. This siding is essential in providing train traffic the ability to pass one another while traversing the steep grades. The Crescent siding begins heading west at a +1.87% grade (per existing track charts) with steep rock formations on both sides of the corridor. The mainline and siding continue on a +1.87% grade, increasing to +1.98%, maintaining approximately 15' track centers. This steep grade continues until approximately MP 31.04, to a No. 10 turnout where house track 118 begins and the vertical grade decreases to +1.75%. The beginning of this existing siding is located at an optimum location allowing it to maneuver past the rock outcropping while maintaining 15' track centers with the house track. This switch is equipped with an electric lock and an operational hi-rise switch stand. Once the house track 118 starts to parallel the Crescent siding, a switch point derail located at MP 31.08 exists to prevent cars or maintenance machinery from unintentionally rolling out onto the mainline siding.

The maintenance road and embankment that parallels the house track.

Continuing west of the derail, the industrial siding parallels the mainline and the Crescent siding on a +1.75% grade with 15'-0" tracks centers and an access road, 10'-0" from center of siding to center of road. An embankment, approximately 30' in elevation with 2:1 slopes, exists to the north of the maintenance road for the remaining length of the industrial siding. This area would take a considerable amount of fill material to construct an additional industry track, with an access road. The house track continues to parallel the Crescent siding on tangent track and ties into the mainline siding with a No. 10 turnout at MP 31.31. The point of curve starts approximately 50'-0" beyond the point of switch which allows the siding to take advantage of as much length as possible.

Looking west from MP 31.35 at the Gross Dam Road grade crossing.

At MP 31.35, Gross Dam Road intersects the mainline and Crescent siding creating an at-grade crossing protected by warning flashers and bells. This grade crossing is constructed of concrete panels and is 40'-0" in length. Traveling west of Gross Dam Road the mainline and Crescent siding continue on a slight curve to the left and enter a corridor of rock outcroppings and a steep embankment onto private property. This terrain and track grade of +1.19% extends until the west switch of the Crescent siding ties into the mainline at MP 31.80.

Rail recommendations

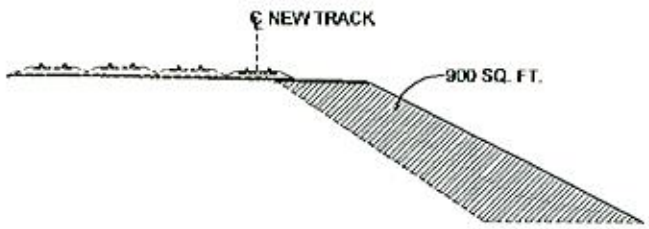
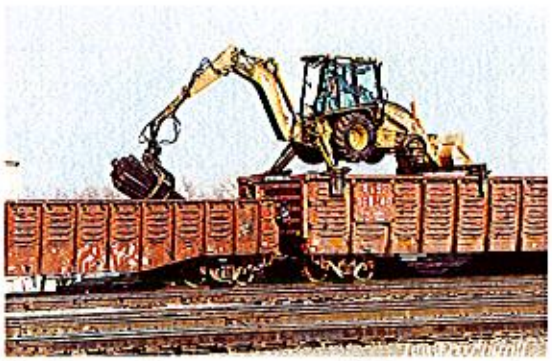


Figure 2

Based on observations in the field and UPRR standards, there appears to be very limited options for construction of an additional industry track. Based on the typical section shown in Figure 2 the volume of earthwork alone required to build up the embankment to accommodate a new siding would be in excess of 50,000 CY, slightly less than a quarter of what is required for the dam. If fill material was accessible and an embankment scenario was desired, Gross Dam Road would need to be realigned where it follows the toe of the embankment for a short distance, and additional right of way will need to be acquired. The additional length of track would only hold 11 cars at capacity on approximately 658 ft of usable track. Once constructed and ready for use, the anticipated cost for the project including construction, and shipping of material at this location would exceed 20 million dollars, (see Appendix A, Table 6) not including material for the Gross Dam expansion. This option is not recommended.

An alternative solution that takes advantage of this existing mainline is to use the existing house track 118. With a usable track length of approximately 1070' this existing siding track could hold 19 cars, containing 100 tons of material per car. This option presents one feasible way to unload material without spending an ample amount of money on structures and track upgrades.



The Herzog Cartopper can easily be equipped with a bucket to unload material directly into trucks

The use of a Herzog Cartopper that self-mounts from the ground to an operational position in less than 10 minutes, and can dismount without assistance, should be considered as an option for this location. After mounting, the Cartopper rides along the top of railcars, unloading material onto the ground or directly into trucks. Once a car is unloaded, the operator quickly and efficiently moves to the next car regardless of any variance in car height. Equipped with a bucket the Cartopper can unload 200 tons of aggregate per hour from either gondola or open top hopper cars. Once the material is off loaded from the rail cars, additional trucks would be required to haul the material approximately 3 miles from the siding to the dam. Conceptual cost estimates for this alternative are located in Appendix A, Table 7.

In lieu of a cartopper, an unloading pit could be constructed to off load material from rail cars. However this would require additional fill at this location and a total realignment of the hairpin turn of Gross Dam road located directly below the existing siding (see photo 15) resulting in additional costs for the structure, conveyor equipment, road realignment, right-of-way acquisition.

The UPRR expressed little interest in the business plan at this location. Cheryl Schow, UPRR Regional Manager for Colorado, Nebraska, and Wyoming stated the mainline in this area is already beyond capacity, and changing existing operations is not desirable. Also, as there is no local service in this area, crews and equipment from the Denver Service Unit would be required. With travel time included into operations, UPRR's standard haul fee would exceed desirable limits making it an undesirable business plan. However, Cheryl Schow did express interest in finding an alternative location closer to Denver off the mainline for this operation. Finding an alternative location to off load material for the Gross Dam could be possible but a location further from the site would be less desirable as it would not eliminate the required haul up Highway 72.

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Appendix A – Cost estimates

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Table 1
Conceptual Estimate
MP 14.0 Turnout (200' x 12')

CREATED BY: JASON WENGER
CHECKED BY: DOUG EMMONS

ITEM NO.	DESCRIPTION	UNIT	QUANTITY	UNIT PRICE	COST
304-06000	Aggregate Base Course (Class 6)	TON	160	$ 30.00	$ 4,800
403-34701	Hot Mix Asphalt (Grading SX) (75)	TON	88	$ 90.00	$ 7,920
626-00000	Mobilization	L S	1	$ 6,000.00	$ 6,000
630-10005	Traffic Control	L S	1	$ 1,500.00	$ 1,500
630-00000	Flagging	HOUR	60	$ 23.00	$ 1,380
	TOTAL OF BID ITEMS				**$ 21,600**
				SUBTOTAL	**$ 21,600**
	Contingency		30%		$6,480
				PROJECT TOTAL	**$ 28,100**

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Table 2
Conceptual Estimate
MP 15.0 Turnout (250' x 12')

CREATED BY: JASON WENGER
CHECKED BY: DOUG EMMONS

ITEM NO.	DESCRIPTION	UNIT	QUANTITY	UNIT PRICE	COST
304-06000	Aggregate Base Course (Class 6)	TON	200	$ 30.00	$ 6,000
403-34701	Hot Mix Asphalt (Grading SX) (75)	TON	110	$ 90.00	$ 9,900
626-00000	Mobilization	L S	1	$ 6,000.00	$ 6,000
630-10005	Traffic Control	L S	1	$ 1,500.00	$ 1,500
630-00000	Flagging	HOUR	60	$ 23.00	$ 1,380
	TOTAL OF BID ITEMS				**$ 24,780**
				SUBTOTAL	**$ 24,780**
	Contingency		30%		$7,434
				PROJECT TOTAL	**$ 32,200**

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Table 3
Conceptual Estimate
MP 15.1 Turnout (300' x 12')

CREATED BY: JASON WENGER
CHECKED BY: DOUG EMMONS

ITEM NO.	DESCRIPTION	UNIT	QUANTITY	UNIT PRICE	COST
304-06000	Aggregate Base Course (Class 6)	TON	240	$ 30.00	$ 7,200
403-34701	Hot Mix Asphalt (Grading SX) (75)	TON	132	$ 90.00	$ 11,880
626-00000	Mobilization	L S	1	$ 6,000.00	$ 6,000
630-10005	Traffic Control	L S	1	$ 1,500.00	$ 1,500
630-00000	Flagging	HOUR	60	$ 23.00	$ 1,380
	TOTAL OF BID ITEMS				**$ 27,960**
				SUBTOTAL	**$ 27,960**
	Contingency		30%		$8,388
				PROJECT TOTAL	**$ 36,300**

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Table 4
Conceptual Estimate
MP 16.1 Turnout (850' x 12')

CREATED BY: JASON WENGER
CHECKED BY: DOUG EMMONS

ITEM NO.	DESCRIPTION	UNIT	QUANTITY	UNIT PRICE	COST
304-06000	Aggregate Base Course (Class 6)	TON	680	$ 30.00	$ 20,400
403-34701	Hot Mix Asphalt (Grading SX) (75)	TON	374	$ 90.00	$ 33,660
626-00000	Mobilization	L S	1	$ 6,000.00	$ 6,000
630-10005	Traffic Control	L S	1	$ 2,000.00	$ 2,000
630-00000	Flagging	HOUR	100	$ 23.00	$ 2,300
	TOTAL OF BID ITEMS				**$ 64,360**
				SUBTOTAL	**$ 64,360**
	Contingency		30%		$19,308
				PROJECT TOTAL	**$ 83,700**

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Table 5
Conceptual Estimate
MP 17.2 Turnout (350' x 12')

CREATED BY: JASON WENGER
CHECKED BY: DOUG EMMONS

ITEM NO.	DESCRIPTION	UNIT	QUANTITY	UNIT PRICE	COST
304-06000	Aggregate Base Course (Class 6)	TON	280	$ 30.00	$ 8,400
403-34701	Hot Mix Asphalt (Grading SX) (75)	TON	144	$ 90.00	$ 12,960
626-00000	Mobilization	L S	1	$ 6,000.00	$ 6,000
630-10005	Traffic Control	L S	1	$ 1,500.00	$ 1,500
630-00000	Flagging	HOUR	60	$ 23.00	$ 1,380
	TOTAL OF BID ITEMS				**$ 30,240**
				SUBTOTAL	**$ 30,240**
	Contingency		30%		$9,072
				PROJECT TOTAL	**$ 39,300**

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Table 6
Conceptual Estimate
MP 31.35 Cost to construct new siding

CREATED BY: LARRY STOCKTON
CHECKED BY: JANE DONOVAN

ITEM NO.	DESCRIPTION	UNIT	QUANTITY	UNIT PRICE	COST
626-00000	Mobilization	L S	1	$ 273,300.00	$ 273,300
203-00060	Embankment Material (Complete In Place)	CY	50,000	$ 8.00	$ 400,000
	Track (Complete in place)	FT	1,000	$ 375.00	$ 375,000
	Railroad Signals		1	$ 1,000,000.00	$ 1,000,000
	Railroad Flagging	DAY	200	$ 800.00	$ 160,000
	ROW (@ $2 / SF +40% Contingency)	LS	1	$ 336,000.00	$ 336,000
	UPRR Haul cost (Embankment For Siding)	LS	1	$ 1,560,000.00	$ 1,560,000
	UPRR Haul cost (Material For Dam Construction)	LS	1	$ 9,240,000.00	$ 9,240,000
	3 mile truck haul from siding to Gross Dam	LS	1	$ 3,000,000.00	$ 3,000,000
	TOTAL OF BID ITEMS				**$ 16,344,300**
				SUBTOTAL	$ 16,344,300
	Contingency		30%		$4,903,290
				PROJECT TOTAL	**$ 21,247,600**

Assumptions:

UPRR Haul Cost (Siding) - Assume 100 ton cars = 65 cy capacity per car
Assume 20 car train = 1300 cy per day per train
Assume 50,000 cy total embankment for siding
Total number of train haul/days - 50,000 / 1300 = 39 days
39 days x $2,000 /car/day* x 20 cars = $1,560,000
***The cost shown of $2000/car/day is a typical cost for this length of haul for this material within Colorado (source: UPRR website). However, considering the special circumstances in this situation, namely the lack of available crews and equipment, the short haul route and the capacity of the railroad line, making even a ballpark estimate of the UP's actual rate for this project is very difficult.**

Right of Way- Assume 40' x 1000' = 40,000 sq ft for siding
Assume 40' x 1500' = 60,000 sq ft for Gross Dam Road relocation
Assume 100,000 sq ft + 20% margin = 120,000 sq ft

Truck Haul- Assume 300,000 cy material to be hauled from siding to dam
Assume $10 haul charge per cy

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Table 7
Conceptual Estimate
MP 31.35 Cost to use existing siding

CREATED BY: LARRY STOCKTON
CHECKED BY: JANE DONOVAN

ITEM NO.	DESCRIPTION	UNIT	QUANTITY	UNIT PRICE	COST
	UPRR Haul cost (Material For Dam Construction)	LS	1	$ 9,240,000.00	$ 9,240,000
	3 mile truck haul from siding to Gross Dam	LS	1	$ 3,000,000.00	$ 3,000,000
	Railroad Flagging	DAY	200	$ 800.00	$ 160,000
	TOTAL OF BID ITEMS				**$ 12,400,000**
				SUBTOTAL	$ 12,400,000
	Contingency		30%		$3,720,000
				PROJECT TOTAL	**$ 16,120,000**

Assumptions:

UPRR Haul Cost (Dam) - Assume 100 ton cars = 65 cy capacity per car
Assume 20 car train = 1300 cy per day per train
Assume 300,000 cy total material for dam
Total number of train haul/days - 300,000 / 1300 = 231 days
231 days x $2,000 /car/day* x 20 cars = $9,240,000
***The cost shown of $2000/car/day is a typical cost for this length of haul for this material within Colorado (source: UPRR website). However, considering the special circumstances in this situation, namely the lack of available crews and equipment, the short haul route and the capacity of the railroad line, making even a ballpark estimate of the UP's actual rate for this project is very difficult.**

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Appendix B - Photos

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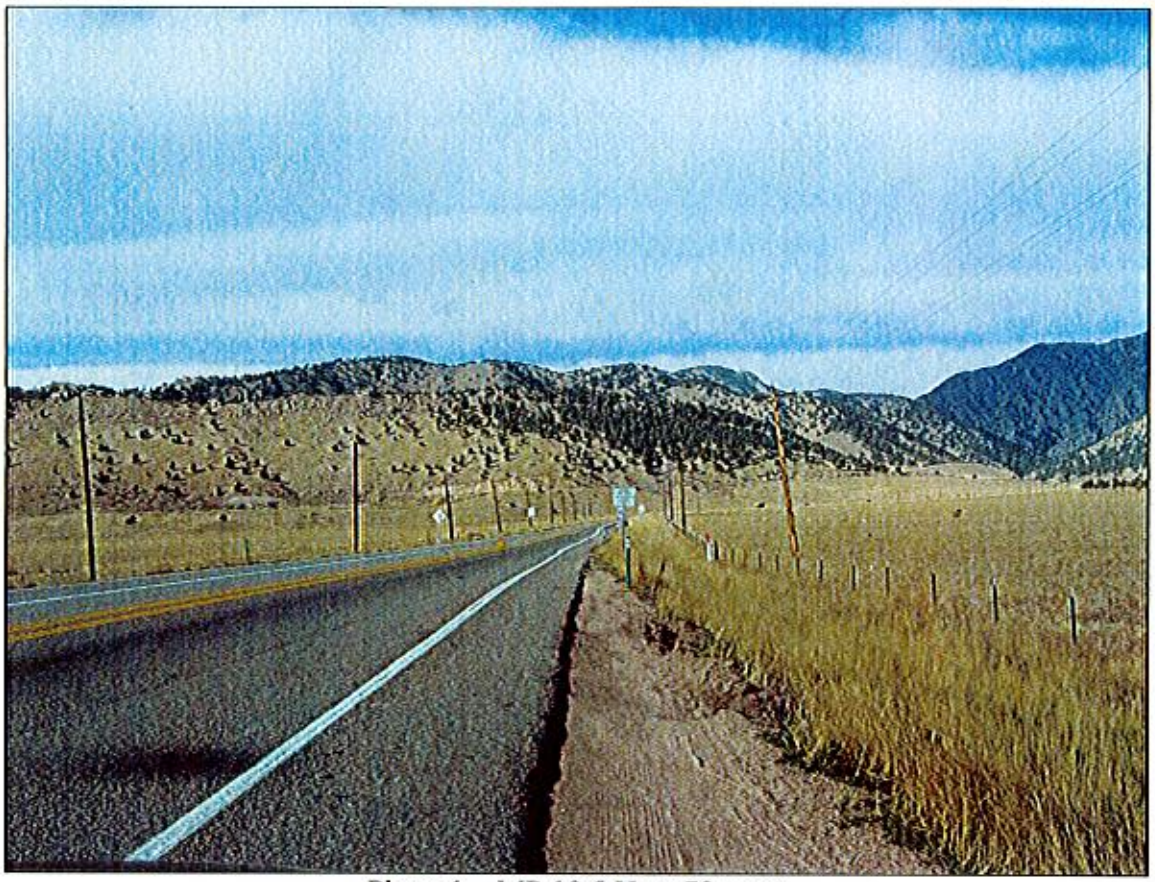

Photo 1 – MP 10.5 Hwy 72 west

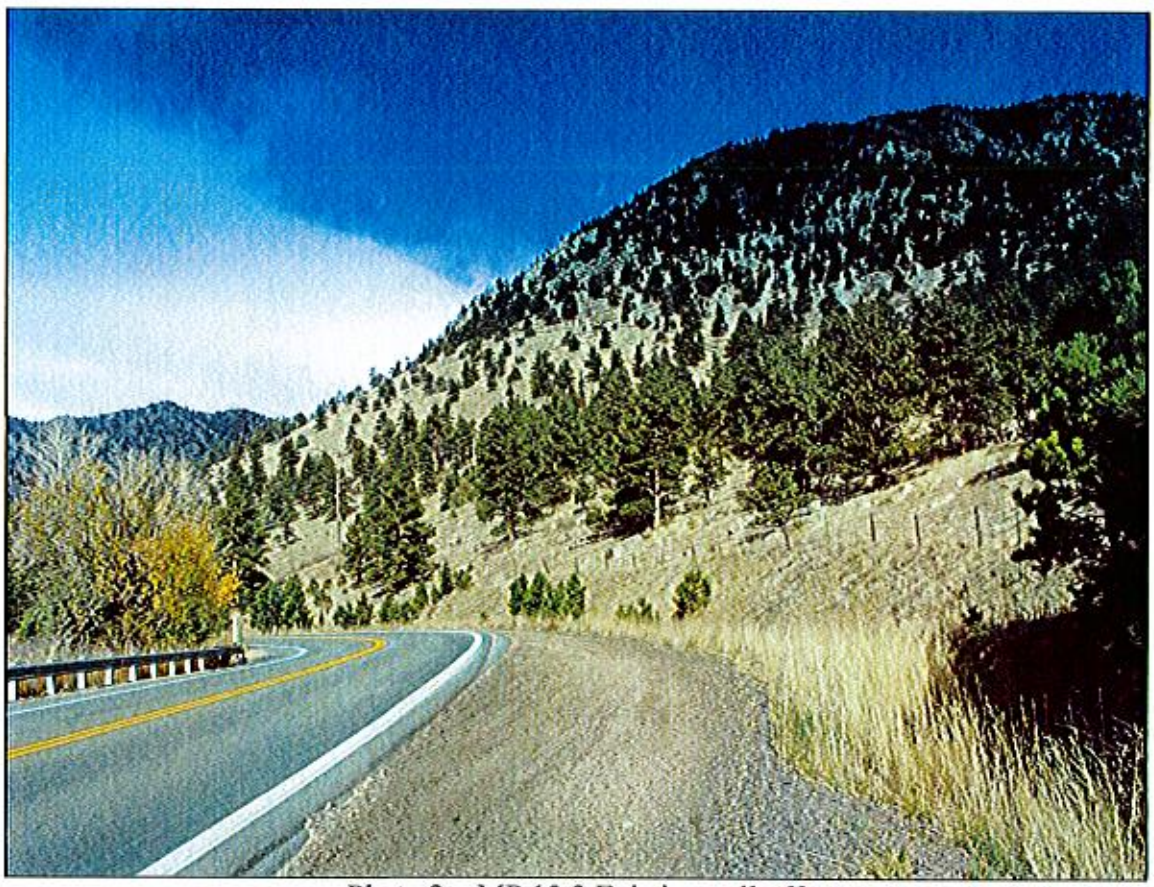

Photo 2 – MP 13.2 Existing pull off

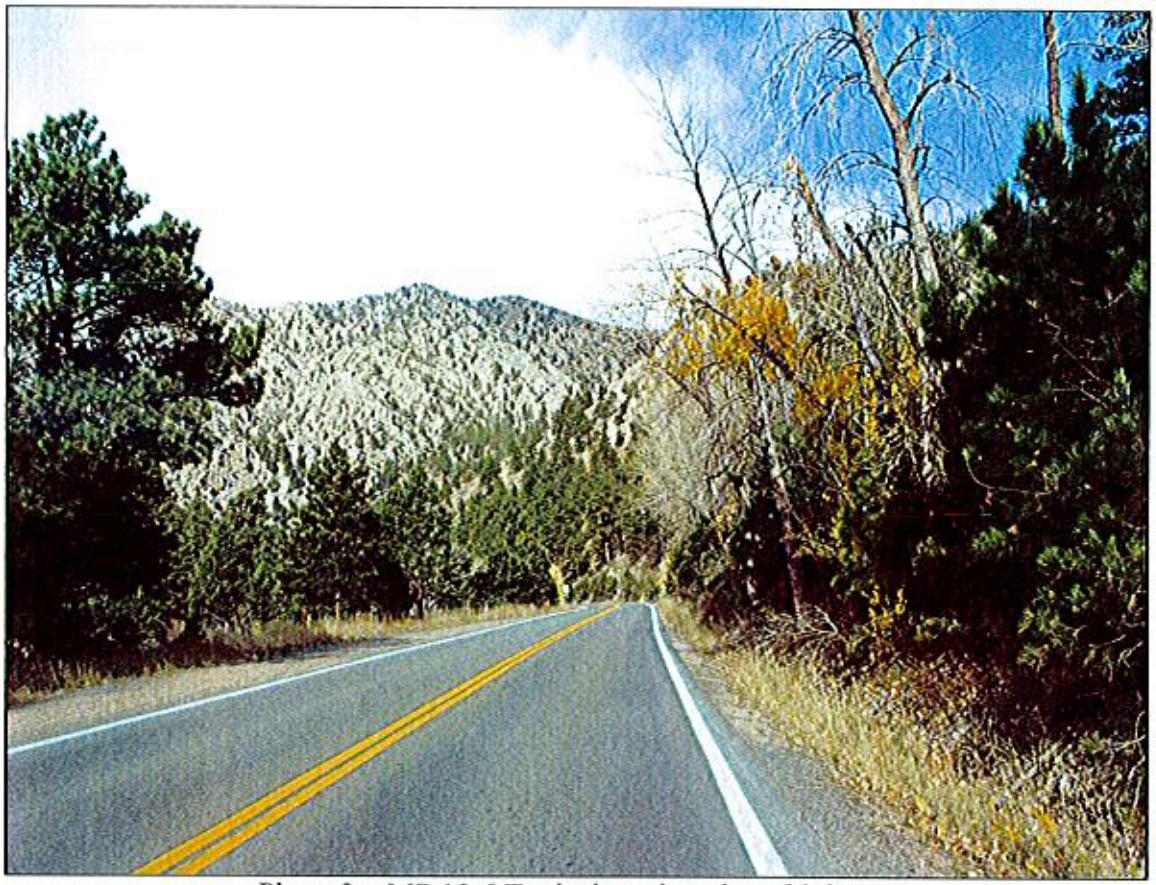

Photo 3 – MP 13.6 Typical section along highway

Photo 4 – MP 14.0 Existing pull off approximately 200 feet in length

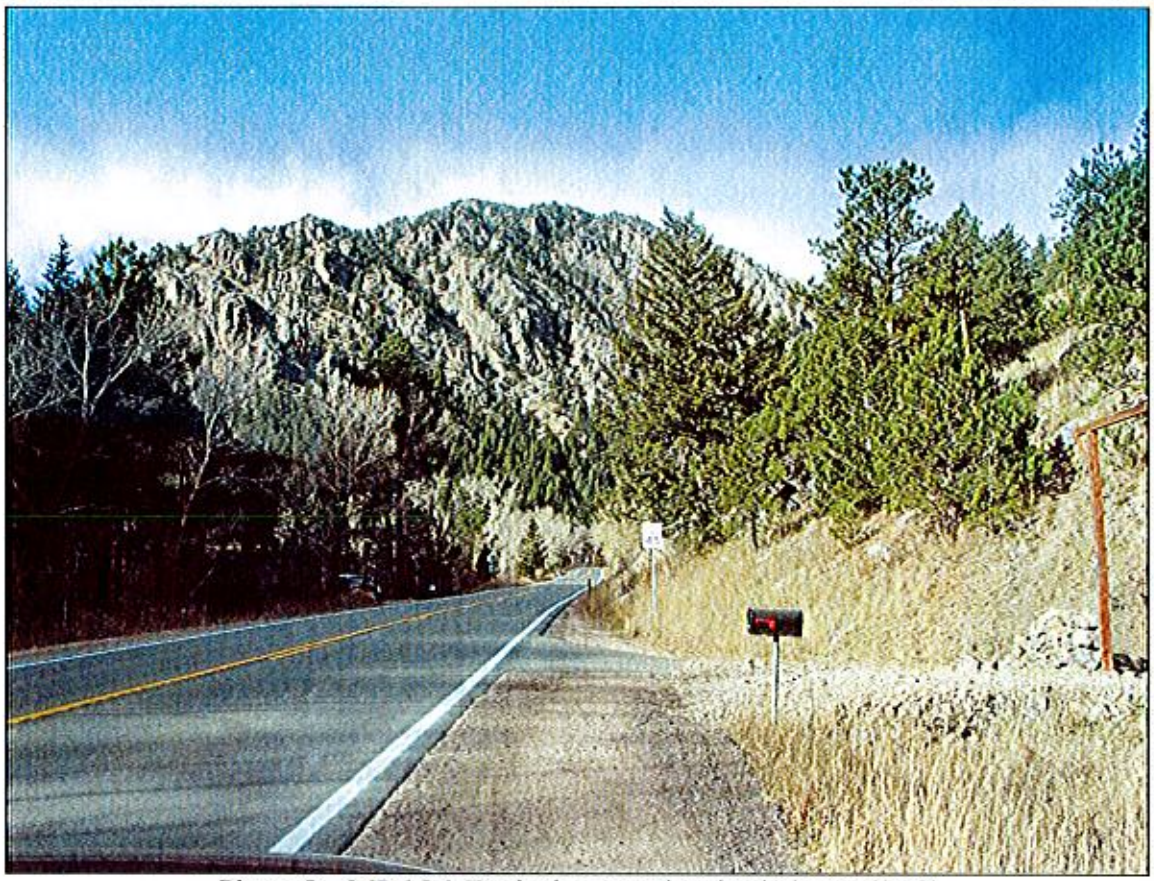

Photo 5 – MP 15.1 Typical cut section / existing pull off

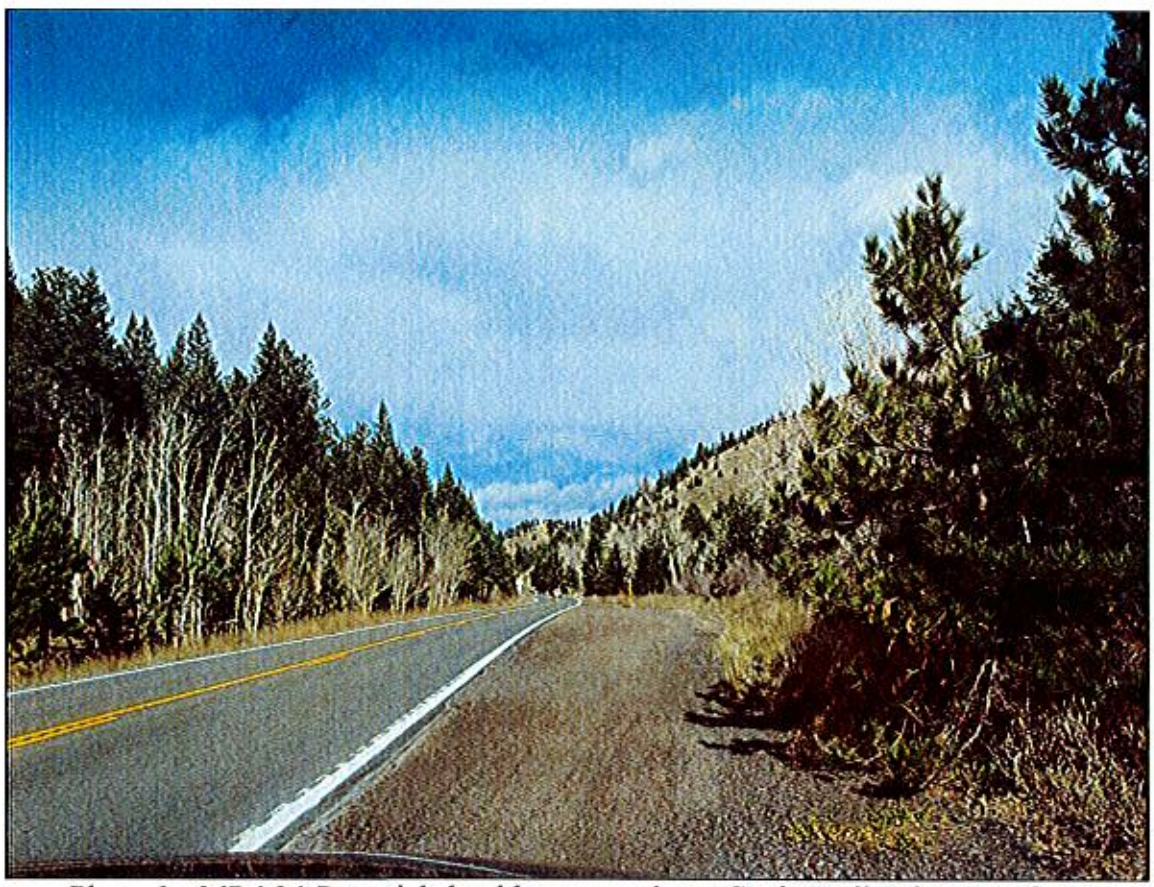

Photo 6 – MP 16.1 Potential shoulder use section – Cattle Trail Drive (850 feet)

Photo 7 – MP 16.9 Typical rock outcropping

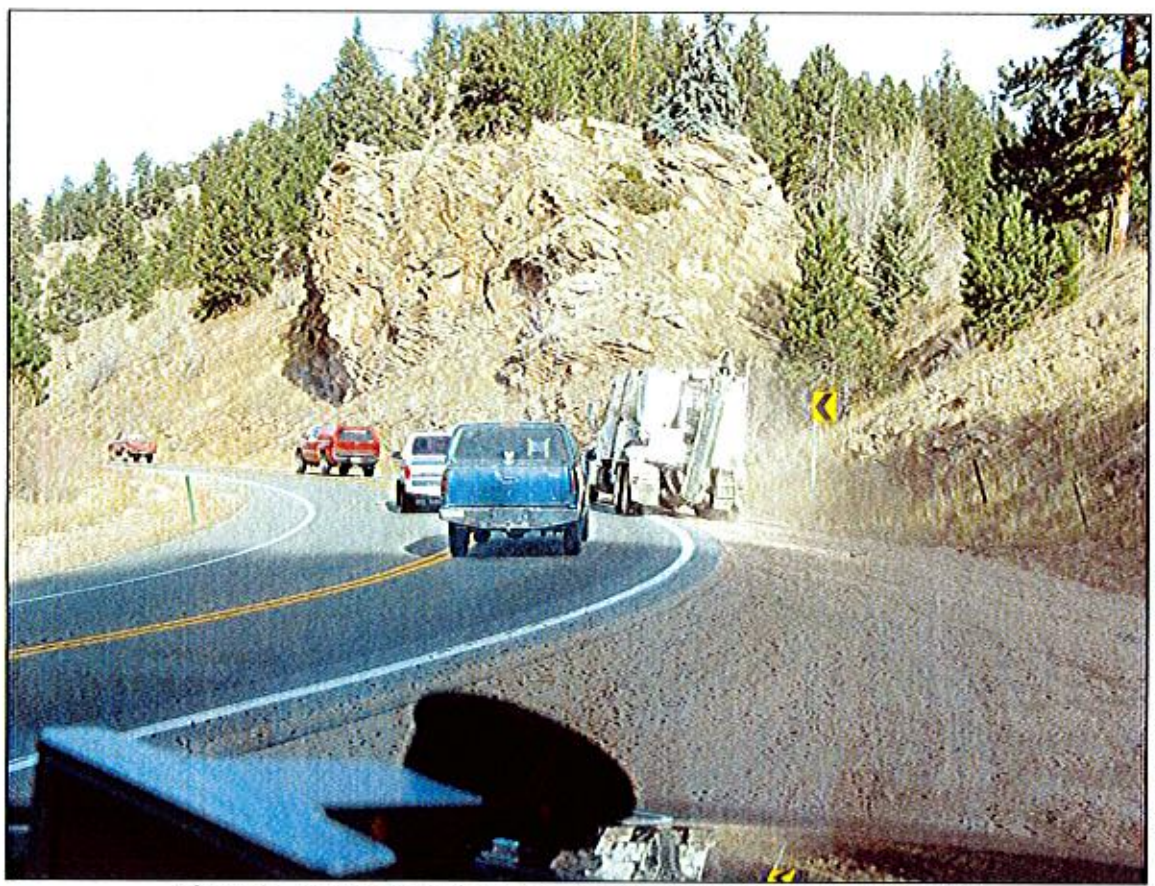

Photo 8 – MP 17.2 Existing pull off being used during site visit

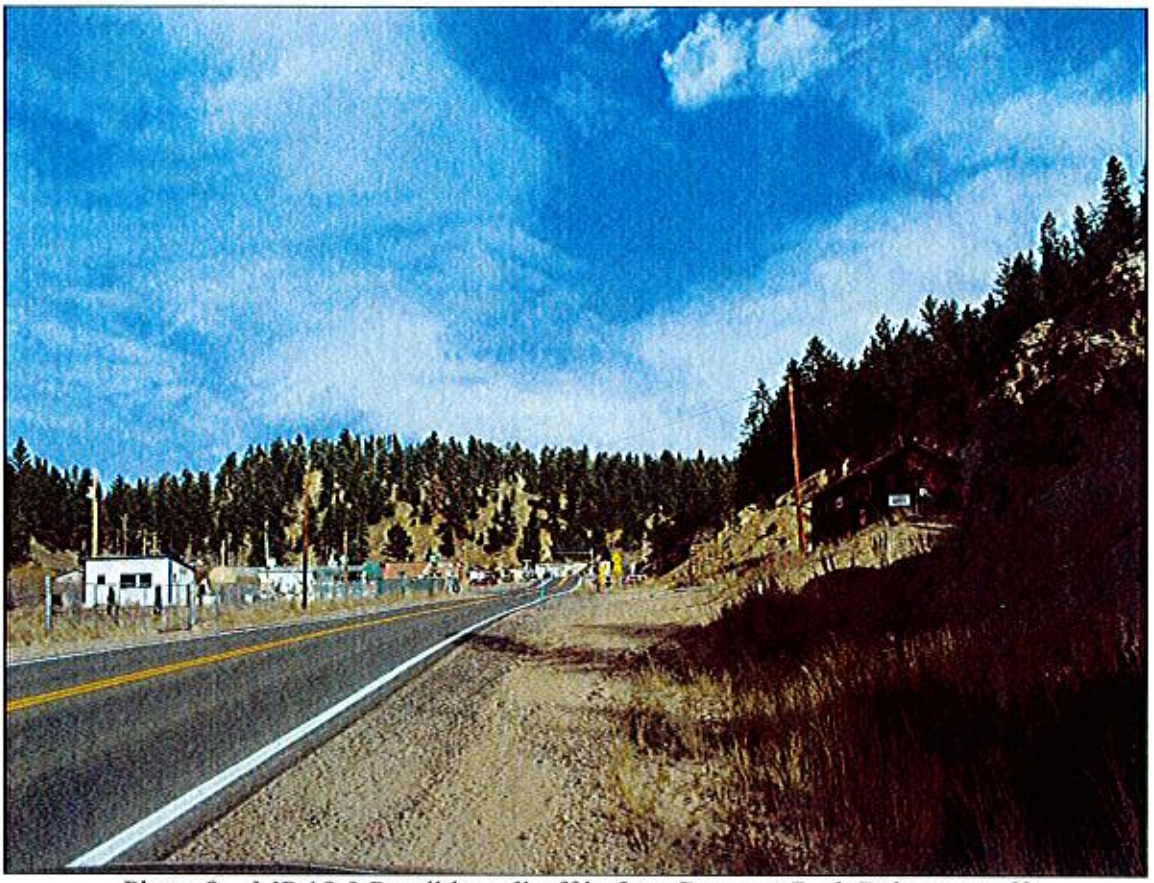

Photo 9 – MP 18.0 Possible pull off before Crescent Park Drive turnoff

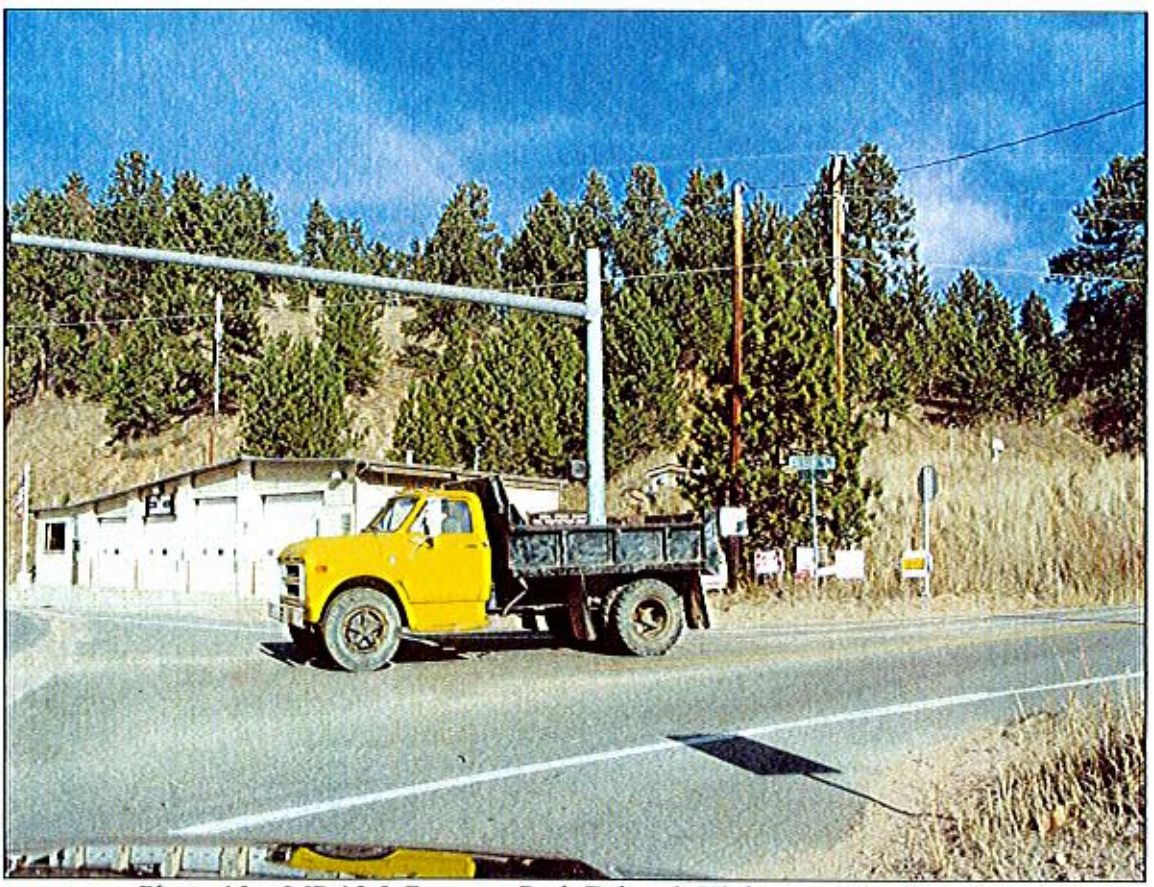

Photo 10 – MP 18.0 Crescent Park Drive & Highway 72 intersection

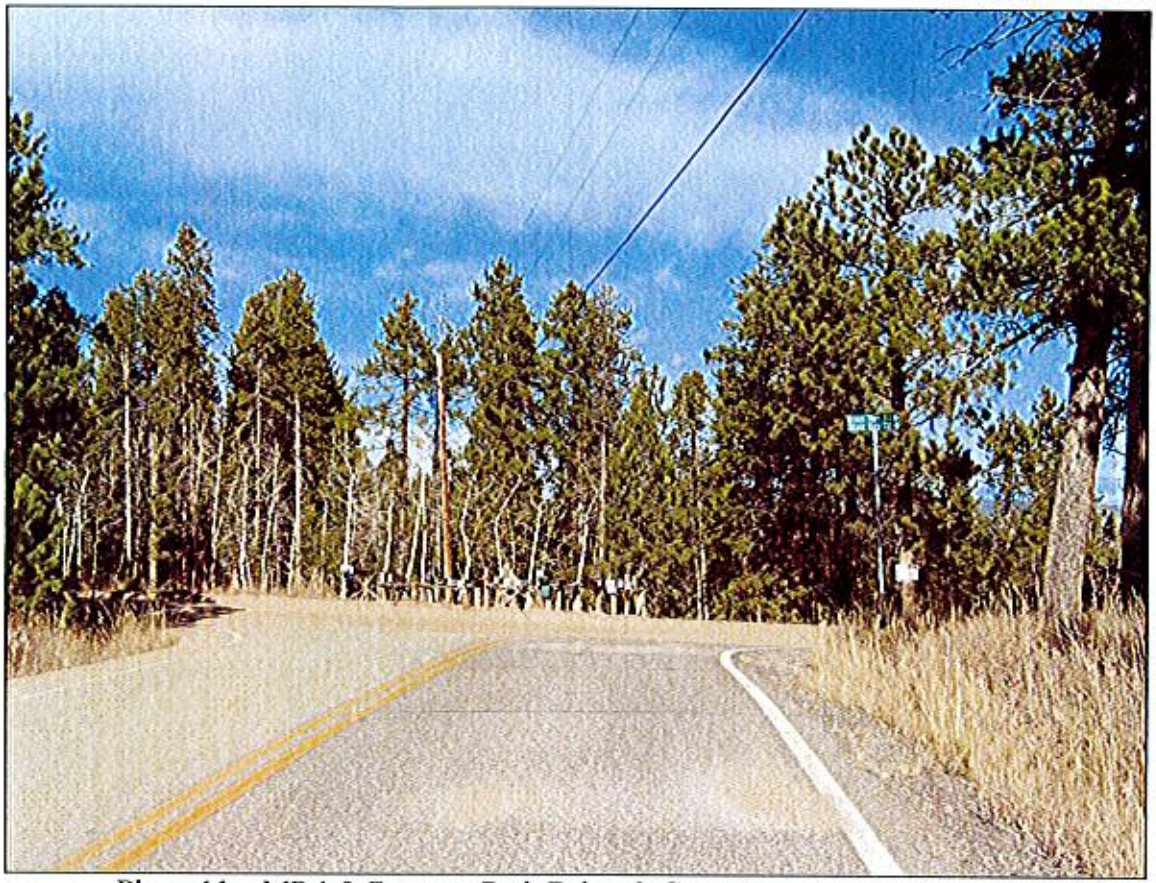

Photo 11 – MP 1.0 Crescent Park Drive & Gross Dam Road intersection

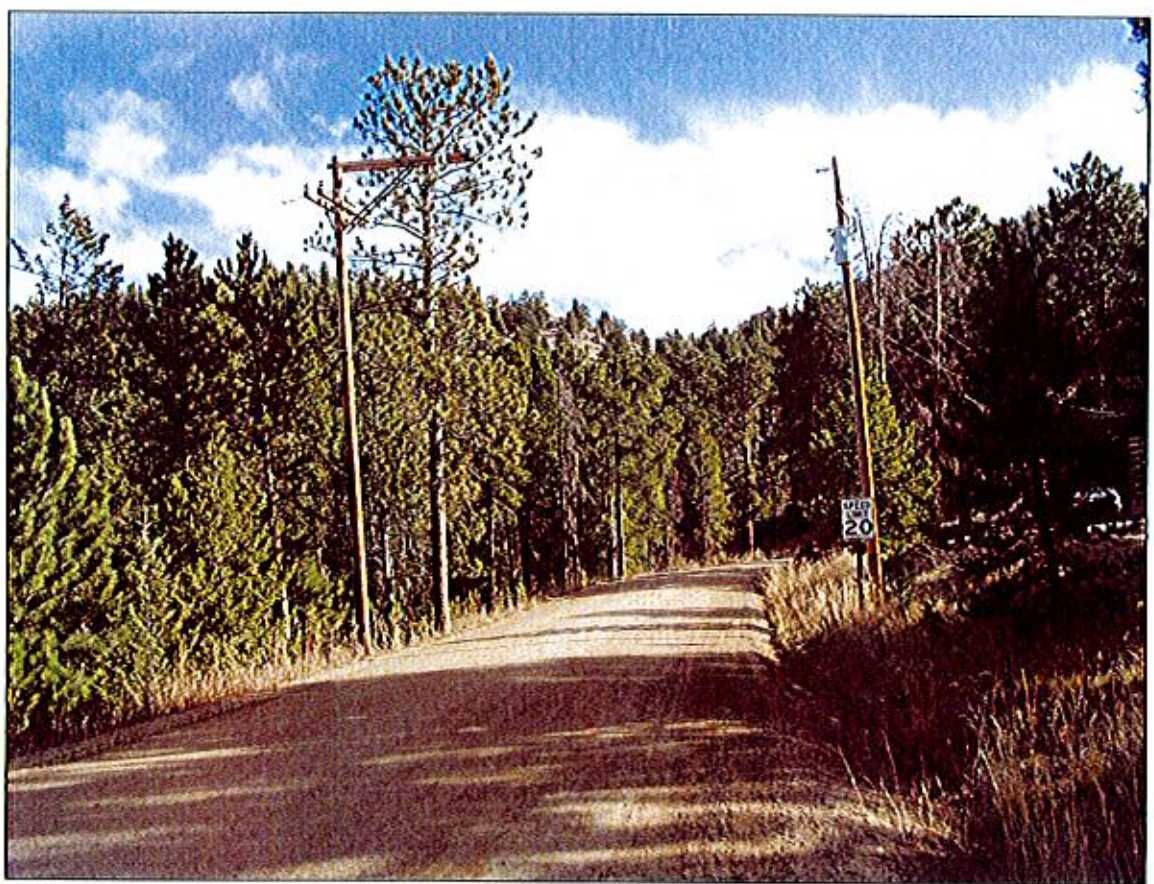

Photo 12 – MP 0.0 Gross Dam Road

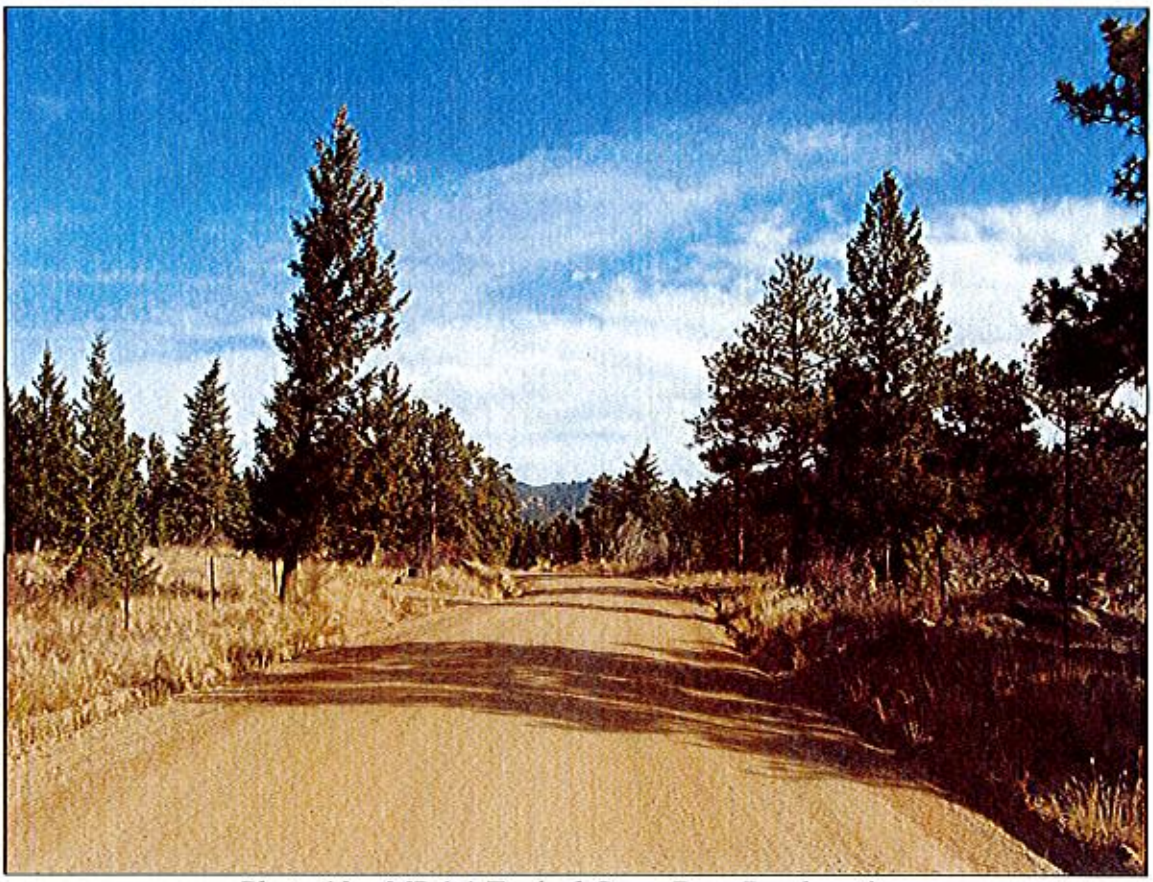

Photo 13 – MP 1.1 Typical Gross Dam Road section

Photo 14 – MP 1.5 Gross Dam Road crossing UPRR (Crescent Siding MP 31.35)

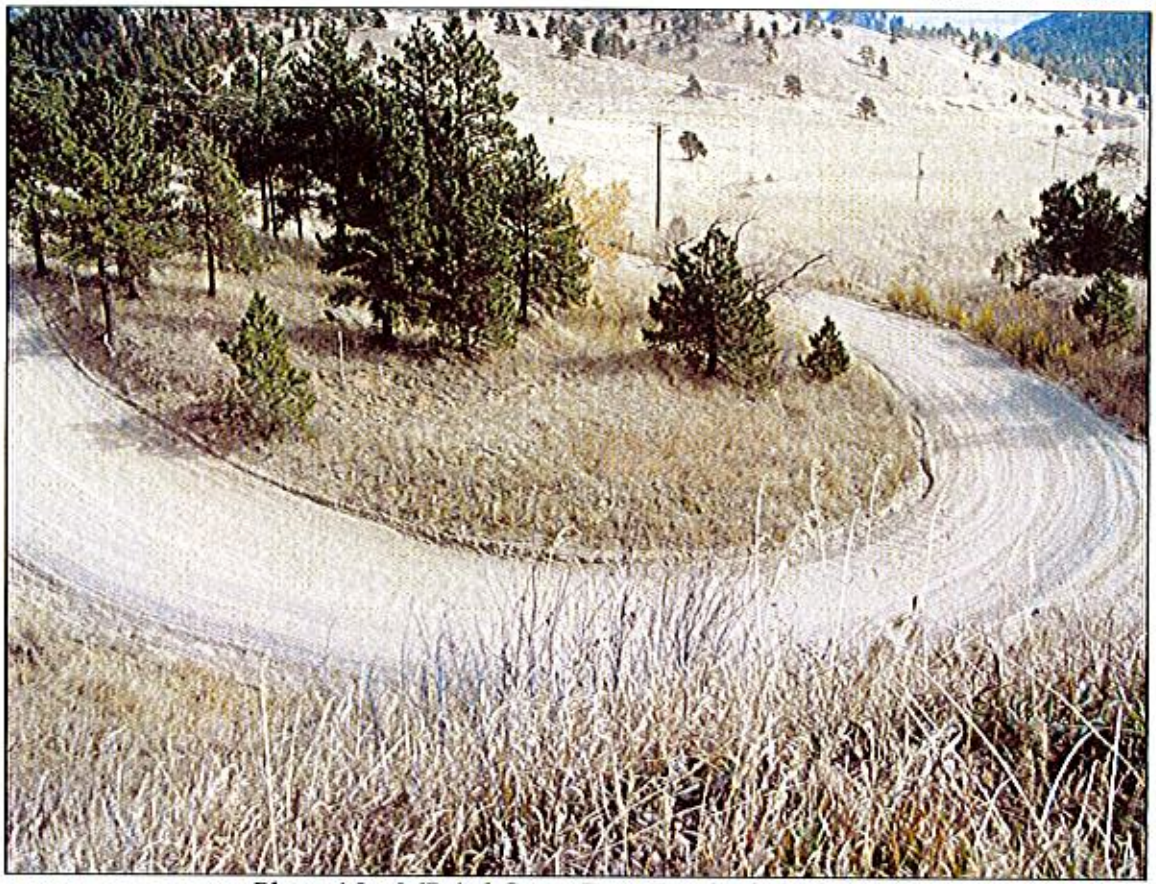

Photo 15 – MP 1.6 Gross Dam Road – hairpin turn

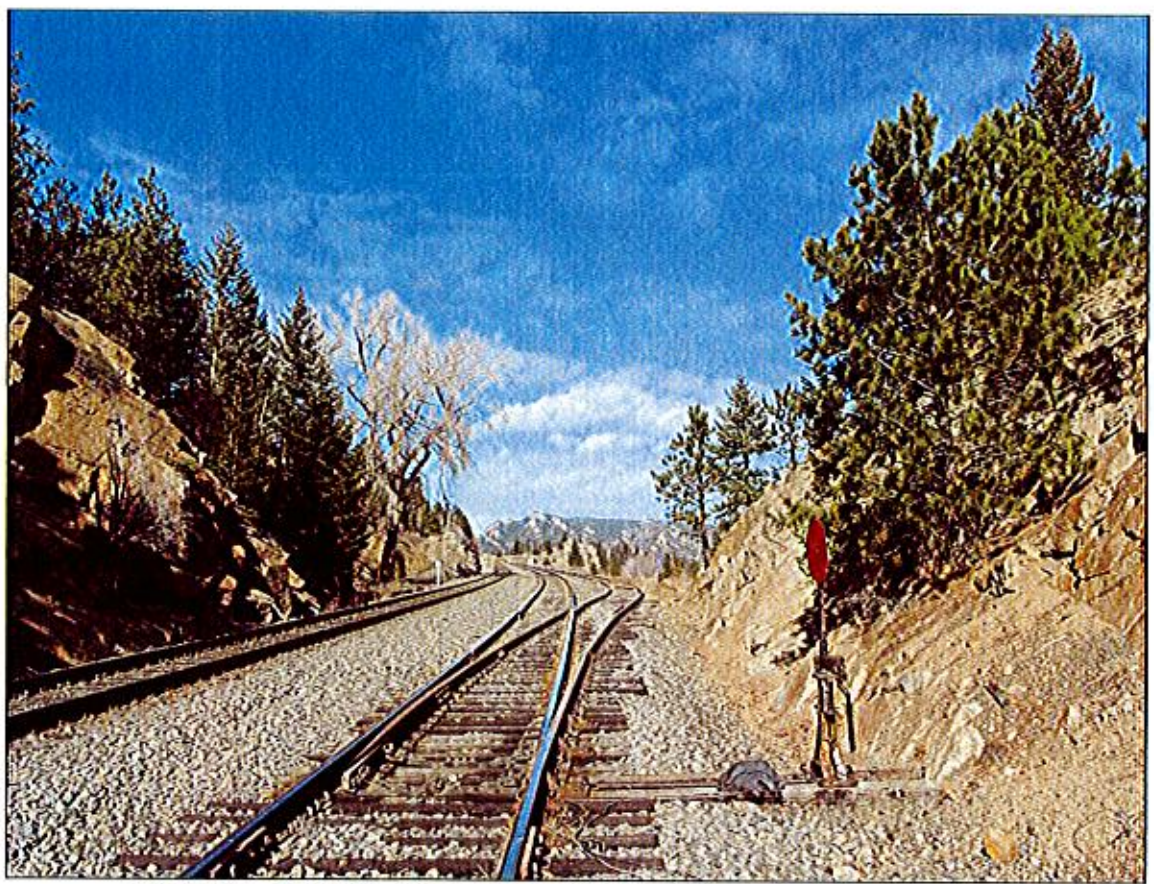

Photo 16 – East P.S. House Track 136# RE No. 10 TO (looking West)

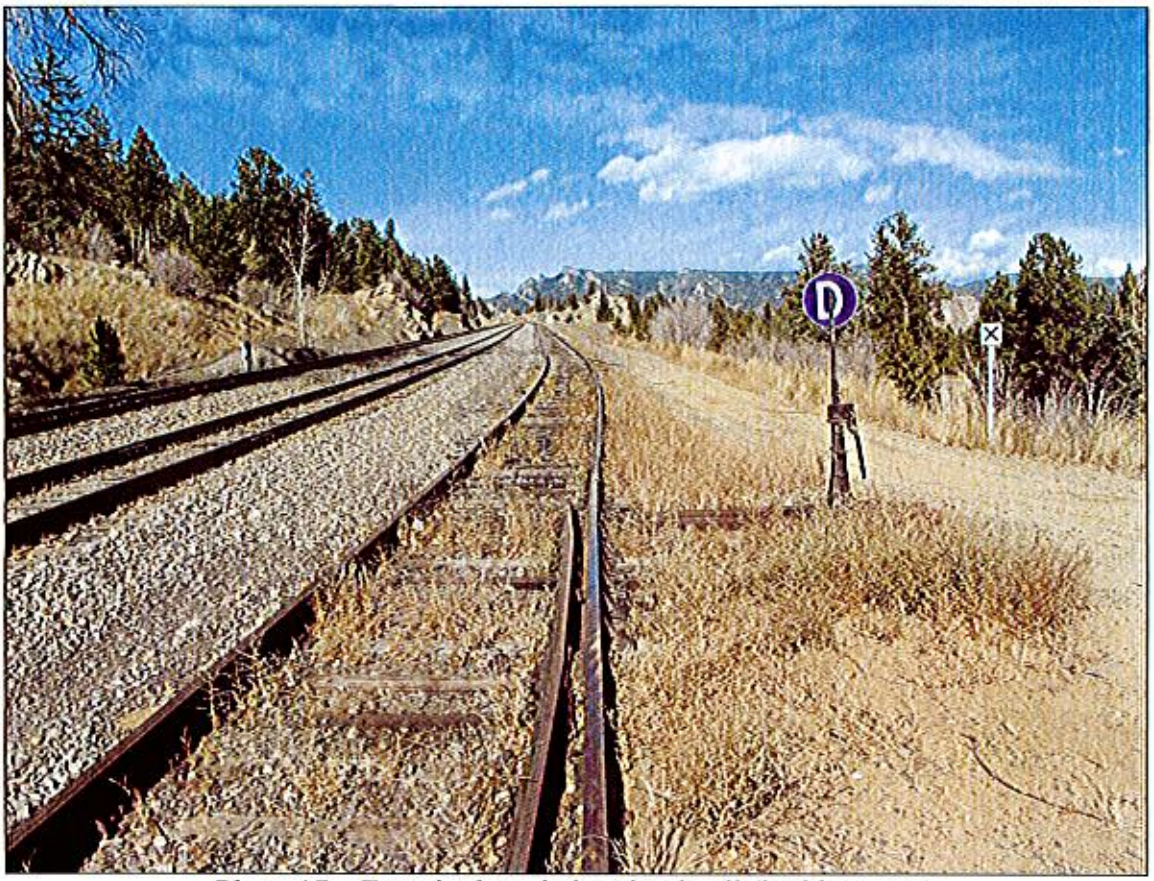

Photo 17 – East single switch point derail (looking west)

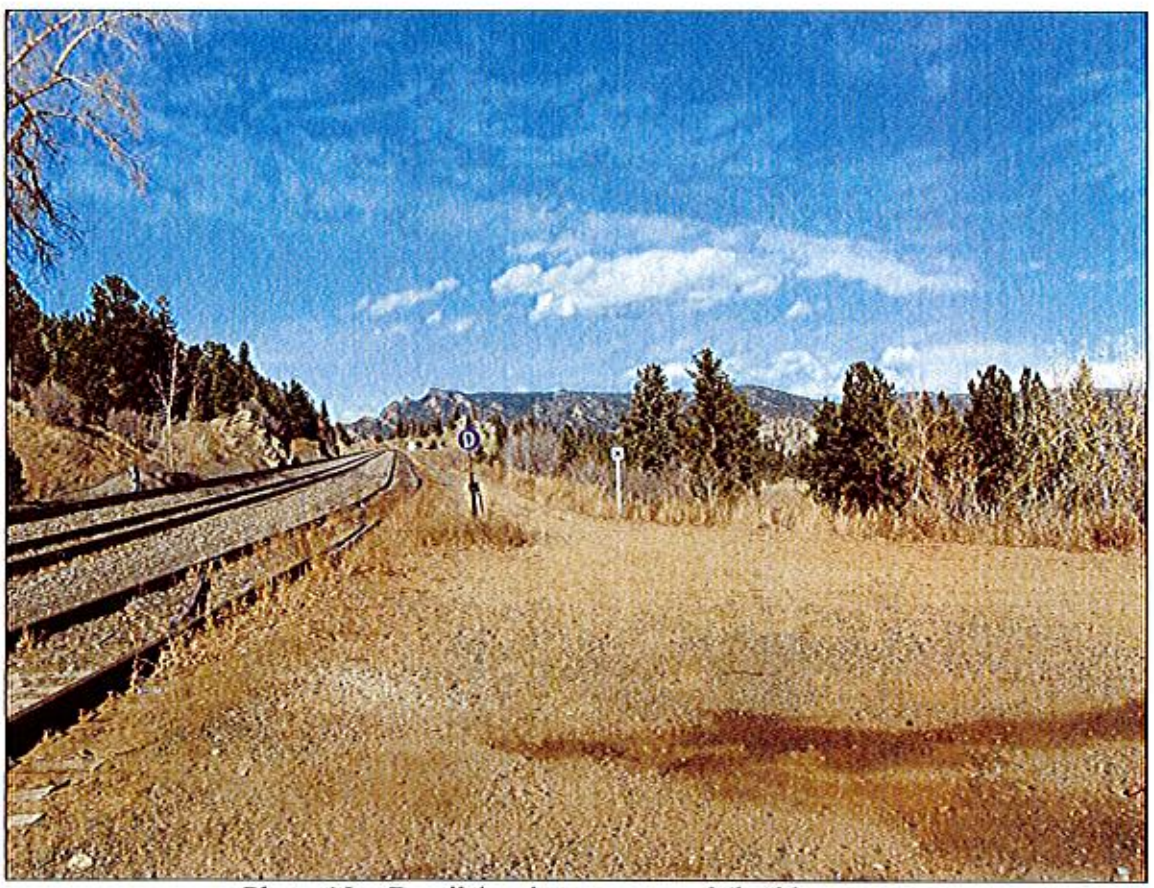

Photo 18 – Derail / maintenance road (looking west)

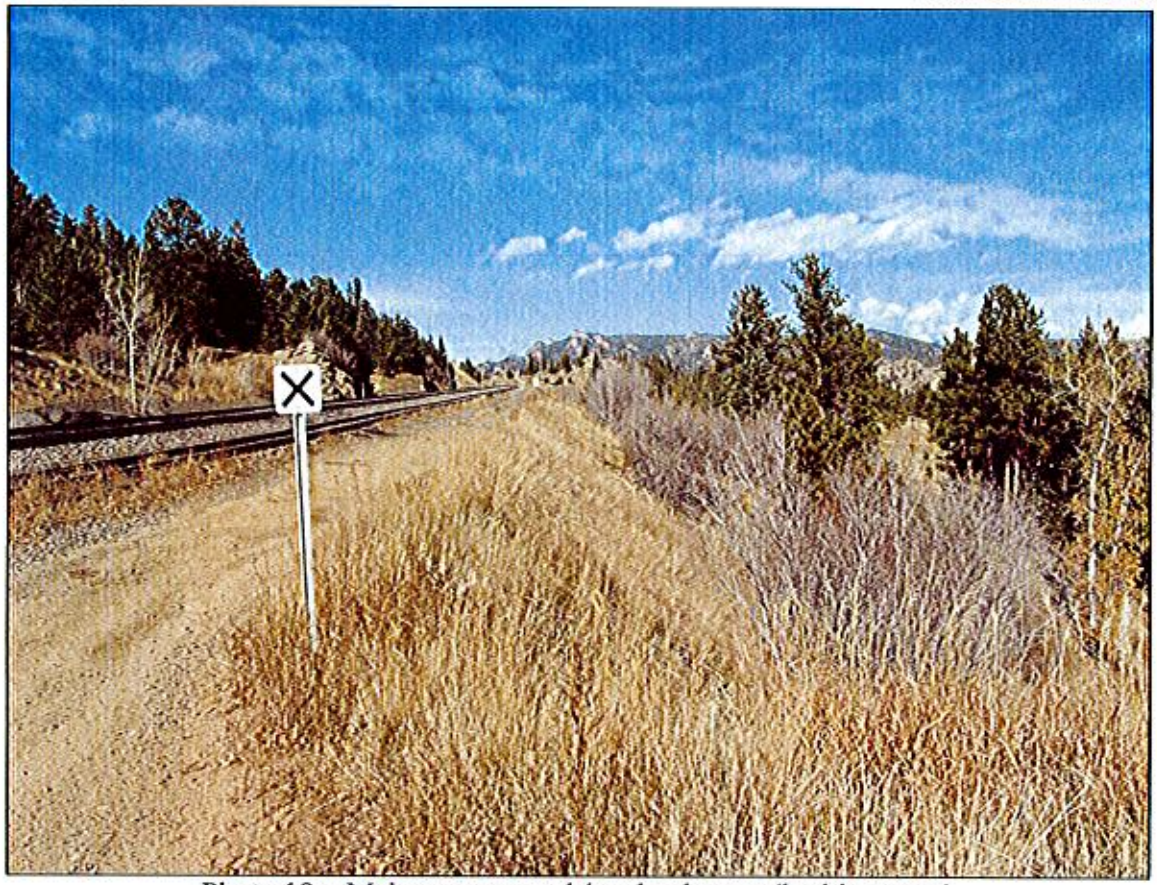

Photo 19 – Maintenance road / embankment (looking west)

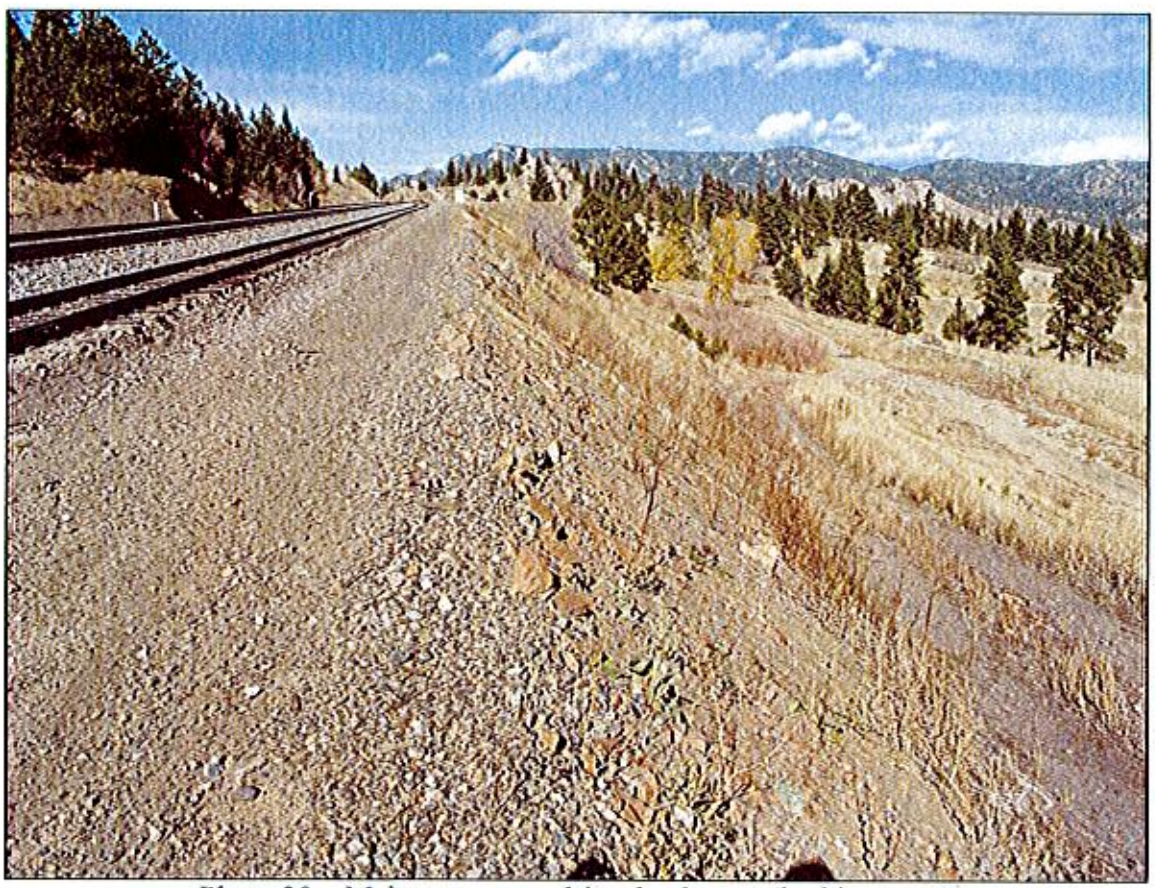

Photo 20 – Maintenance road / embankment (looking west)

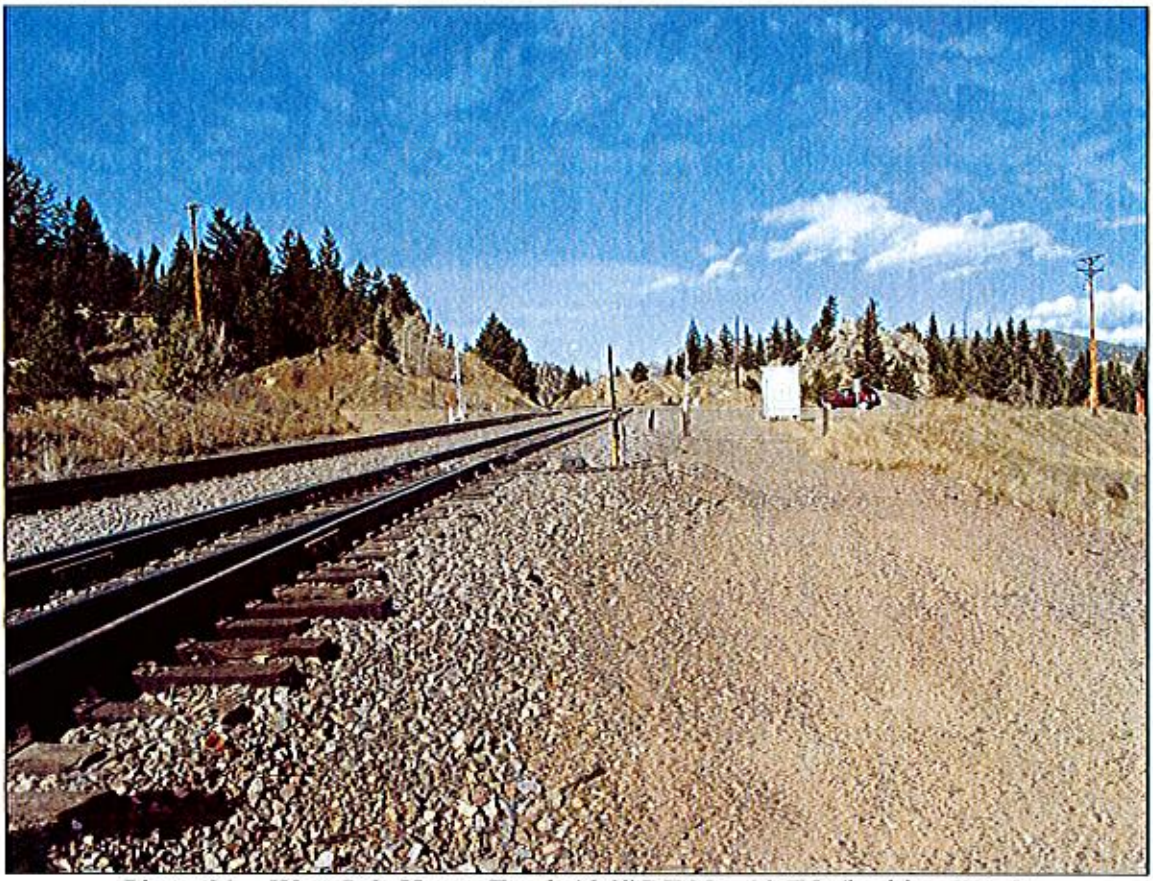

Photo 21 – West P.S. House Track 136# RE No. 10 TO (looking West)

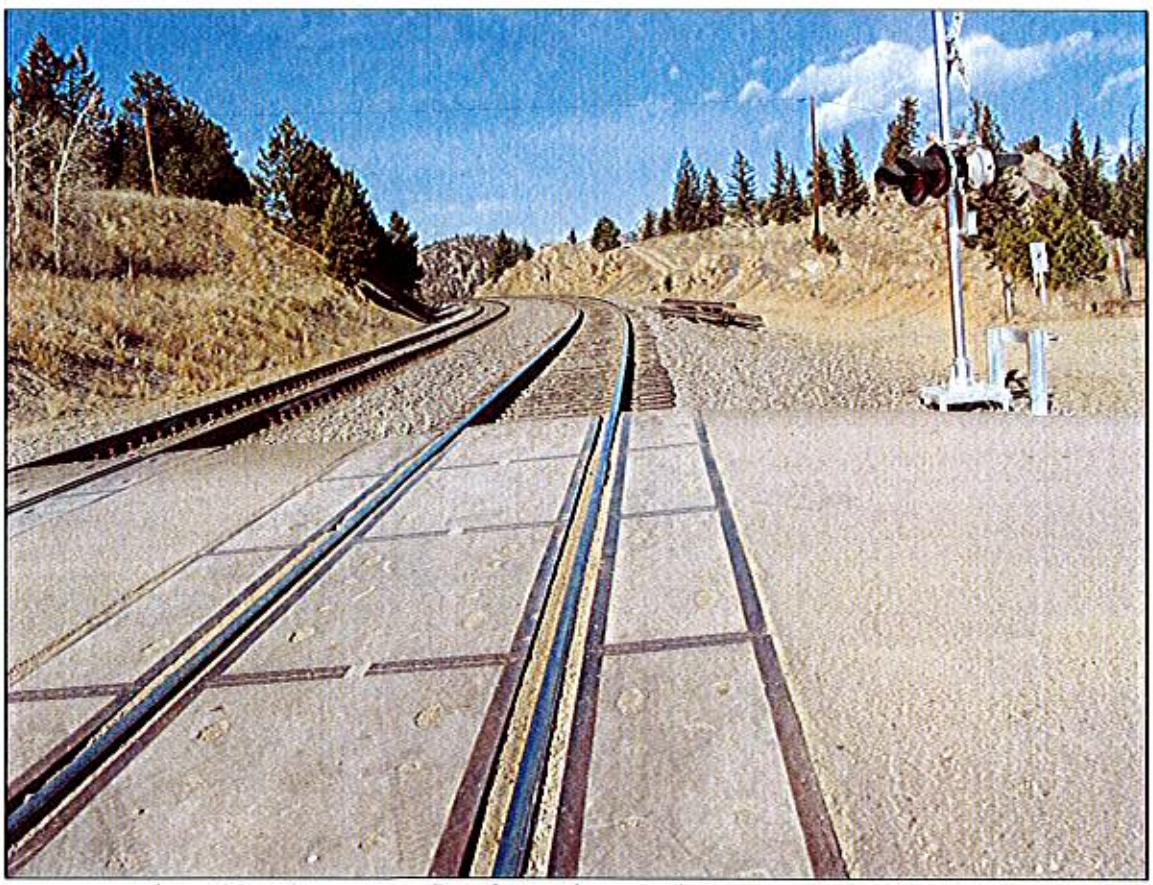

Photo 22 – Gross Dam Road crossing – point of curve (looking west)

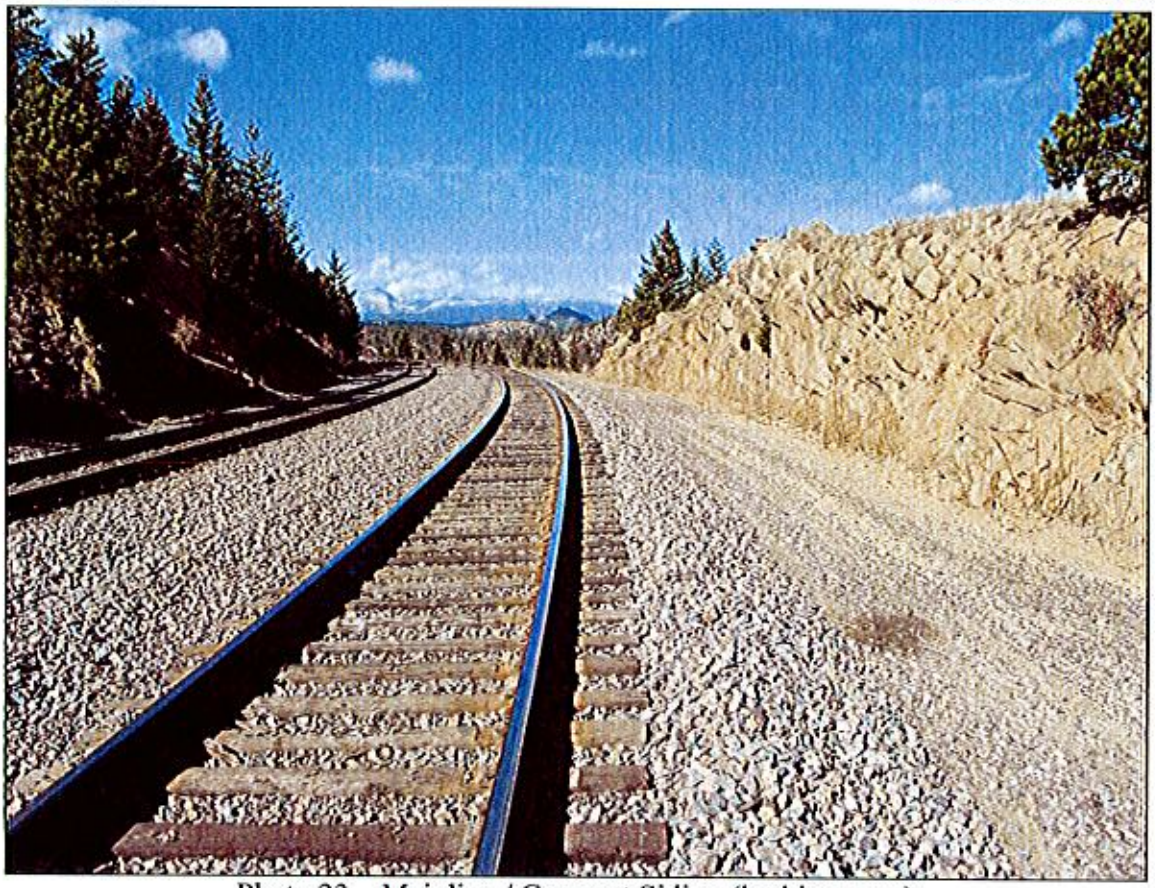

Photo 23 – Mainline / Crescent Siding (looking west)

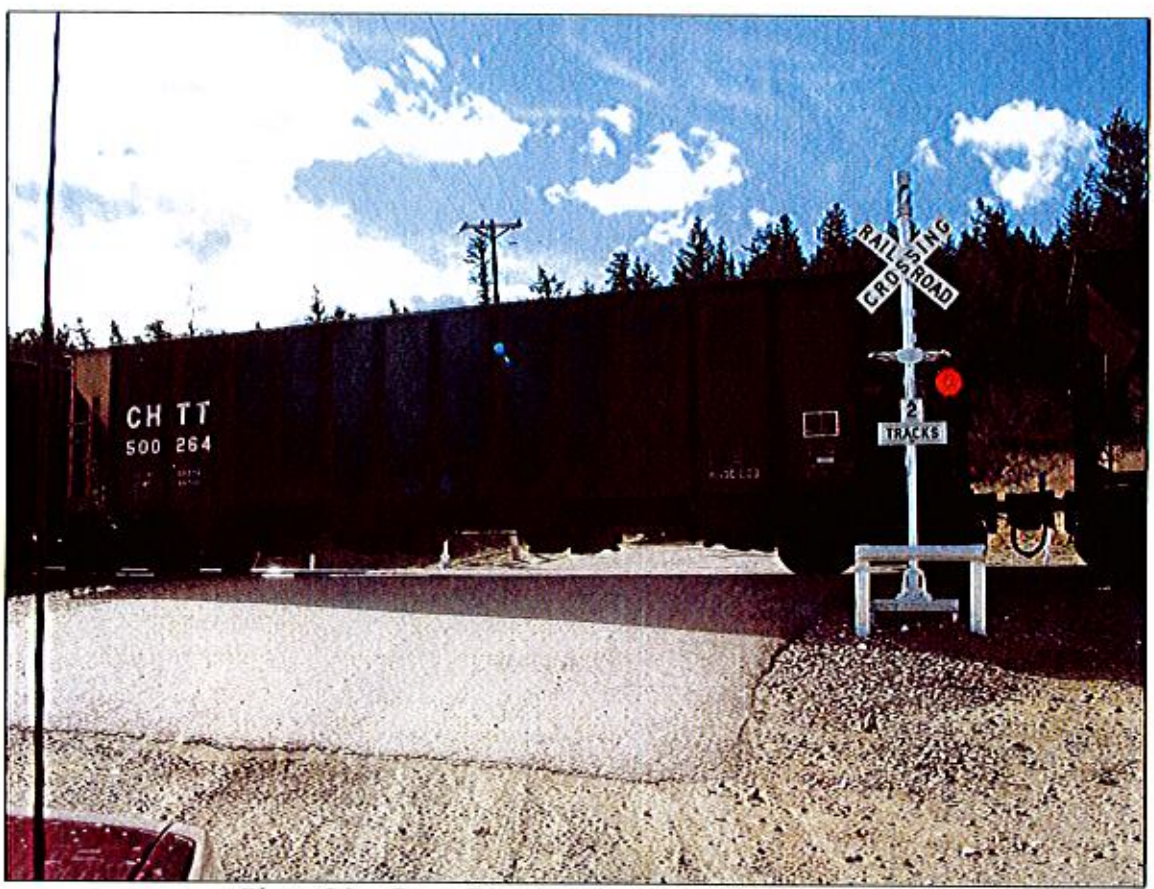

Photo 24 – Gross Dam Road Crossing (looking east)

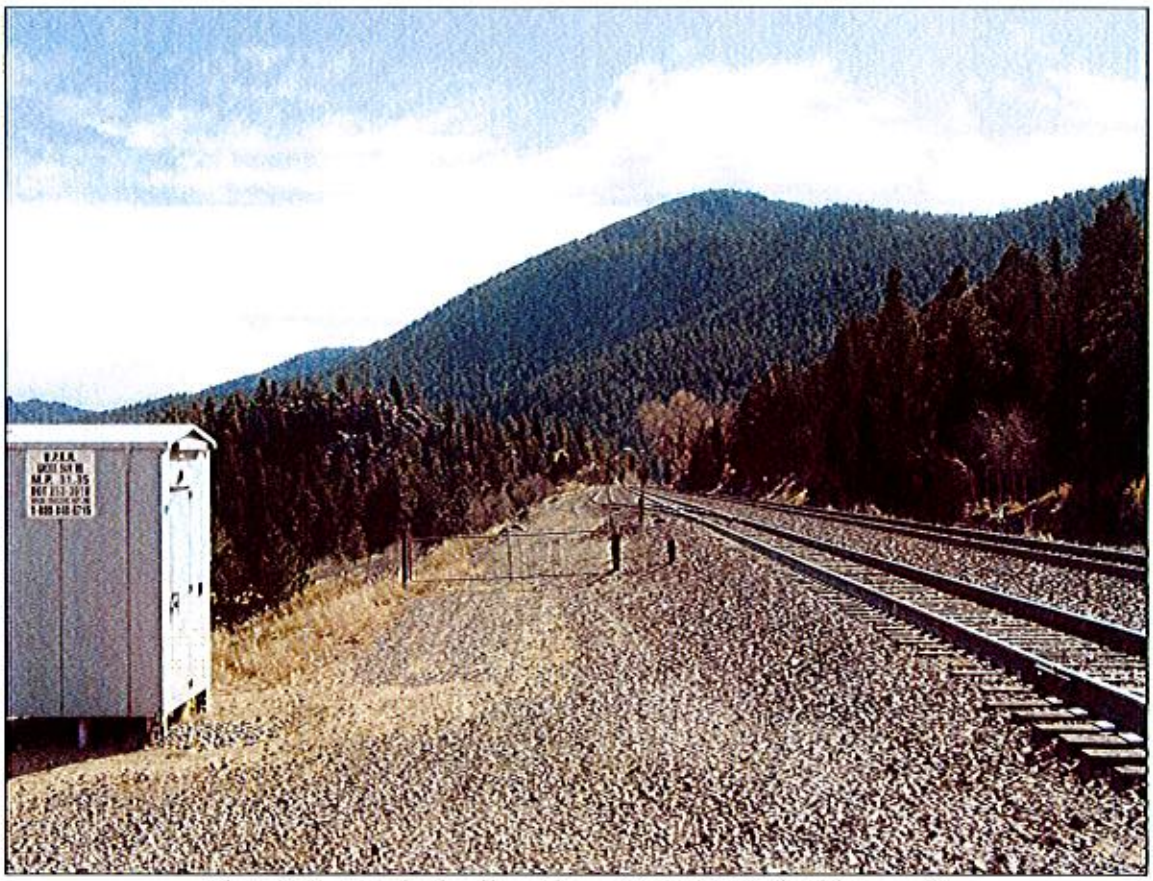

Photo 25 – Typical rail section at MP 31.35 (looking east)

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Appendix C – Traffic information

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Traffic Information for Highway 072

From RefPoint 10.5 To RefPoint 19

Route	Ref Point	End Ref Point	Start Point Description	Annual Average Daily Traffic	AADT Year	AADT Derivation	AADT Single Trucks	AADT Comb. Trucks	Percent Trucks	20 Year Factor	Design Hour Vol (% of AADT)	Daily Vehicle Miles Traveled
072A	10.659	17.516	ON SH 72, COAL CREEK CANYON RD W/O SH 93, ARVADA	4,900	2007	Actual	120	30	3.00%	2.34	10	34,325
072A	17.516	18.611	ON SH 72, COAL CREEK CANYON RD W/O TWIN SPRUCE RD	4,000	2007	Factor	80	20	2.70%	2.33	10	4,380

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Draft FERC Hydropower License Amendment Application Gross Reservoir Hydroelectric Project FERC Project No. 2035

ATTACHMENT E-5

SUMMARY OF CONSULTATION

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Draft FERC Hydropower
License Amendment Application
Gross Reservoir Hydroelectric Project
FERC Project No. 2035

ATTACHMENT E-5
SUMMARY OF CONSULTATION

Federal Energy Regulatory Commission (FERC) regulations at 18 CFR § 4.38 require that Denver Water consult with state and federal resource agencies and with the public before filing a license application. The FERC application requirements include documentation of consultation, including a summary of consultation. This Summary of Consultation documents Denver Water's consultation with resource agencies and stakeholders through the end of the First Stage of Consultation and describes the major events comprising the Second Stage of Consultation (release of a draft license amendment application for agency and stakeholder review) and the Third Stage of Consultation (filing of the license amendment application with the FERC). All correspondence and other documents underlying this Summary of Consultation will be provided to the FERC as part of the license amendment application.

I. First Stage of Consultation

A. Consultation Timeline

Table 1 lists the tasks completed by Denver Water during the First Stage of Consultation.

Table 1
First Stage of Consultation
Gross Reservoir Hydroelectric Project License Amendment Application

Date	Type of Correspondence	Subject of Correspondence
May 1, 2008	Stakeholder Letter	Request for stakeholder participation in the Initial Consultation Process for Denver Water's license amendment application.
June 18, 2008	Stakeholder Letter	Notice indicating that Denver Water Initial Consultation document is available for review.
July 2008	Public Notice	Announcement for a site visit and three public meetings to

Date	Type of Correspondence	Subject of Correspondence
		be held in Coal Creek Canyon, Boulder, and Denver
July 21, 2008	Stakeholder Letter	Denver Water provided a revised "Tree Removal Plan for Pool Enlargement," FERC process timeline, and correction of the deadline for public comment.
July 29, 2008	Public Meeting	Coal Creek Canyon Community Center from 1:00 to 3:00 pm.
July 29, 2008	Public Meeting	Spice of Life Event Center in Boulder from 6:00 to 9:00 pm.
July 30, 2009	Public Meeting	Trinity United Methodist Church Hall in Denver from 6:00 to 9:00 pm.
Sept. 29, 2008	-	Initial Consultation Process comment period deadline.
Sept. 29, 2008	Letter	U.S. Forest Service and U.S. Fish & Wildlife Service request extension.
Nov. 7, 2008	Stakeholder Letter	Denver Water provides a 60-day extension of the comment period and provided information on hydrology.
March 6, 2009	Letter	Denver Water letter to the U.S. Forest Service responding to the request for additional studies.

B. Request for Studies and Information

1. Residents of the area around Gross Reservoir, Boulder County, and the U.S. Forest Service requested that Denver Water explore options for reducing construction-related traffic. Denver Water has conducted a study of construction traffic, which is included as Attachment E-4 *Borrow Haul Study – January 2009* of the draft license amendment application.
2. Boulder County requested that Denver Water contact all owners within 1,500 feet of travel routes about the proposed project. Denver Water received a list of property owners from Boulder County and will notify all property owners of the release of the draft license amendment application and the U.S. Army Corps of Engineers (Corps) Draft Environmental Impact Statement (DEIS) for Denver Water's Moffat Collection System Project.
3. A number of stakeholders and agencies requested information about water rights that would be used to fill an enlarged Gross Reservoir. Denver Water has incorporated a description of its water rights used at Gross Reservoir in the draft license amendment application.
4. A number of stakeholders and agencies requested an analysis of the impacts of the project. Some entities requested an evaluation of the impacts the project will have on the West Slope. Exhibit E of Denver Water's license amendment application references pertinent sections of the Corps' DEIS that address the impacts of the proposed hydropower license amendments. While the Corp's DEIS analyzes impacts on the West Slope from operation of Denver's water supply system, Denver Water believes that impacts to the West Slope are beyond the scope of the amendments proposed for the hydroelectric project.
5. Many stakeholders suggested mitigation efforts. Denver Water is considering mitigation opportunities and will propose mitigation measures.

6. The U.S. Forest Service (USFS) has requested that, prior to Denver Water removing timber from National Forest System land, the volume of timber be determined. The USFS suggests designing a tree cruise for estimating the volume of timber proposed to be removed to accommodate construction under the Gross Reservoir enlargement. The tree cruise design should adhere to USFS estimating requirements and would need to be approved by a qualified USFS cruiser. Denver Water will coordinate with the USFS to conduct this study prior to project construction.
7. Boulder County asked Denver Water to explore opportunities to add more hydropower units under the proposed reservoir enlargement project. In the license amendment application, Denver Water discusses why adding hydropower generating capacity is not economically feasible at this time.
8. The U.S. Fish and Wildlife Service (USFWS) and the USFS requested an extension of time for comments on the Initial Consultation document. Following an additional 60-day comment period, Denver Water received study requests from the USFS. This study request and a letter responding to the studies requested will be included in the documentation of consultation provided to the FERC with the license amendment application. The USFWS provided no additional comments.

C. Comments

Table 2 provides a list of federal, state, and local agencies and public stakeholders that participated in the First Stage of Consultation for the FERC license amendment application by providing comments.

Table 2
Comments Received during the First Stage of Consultation

Letter Index Number	Comment Received From
FEDERAL AGENCIES	
FWSC-01	U.S. Fish & Wildlife Service – Susan Linner
FSC-01	U.S. Forest Service – Glenn Casamassa
STATE AGENCIES	
SHPOC-01	Colorado State Historic Preservation Office – Edward Nichols
LOCAL AGENCIES	
BC-01	City of Boulder – Robert Williams & Robert Crifasi
BCC-01	Boulder County – Peter Fogg
LAF-01	City of Lafayette – Gary Klaphake
LOU-01	City of Louisville – Thomas A. Phare
EC-01	Town of Erie – Gary Behlen
GCC-01	Grand County – Jo Lauren Seavy
CDEPC-01	Clinton Ditch & Reservoir Company/Eagle Park Reservoir Company – Glenn Porzak

Letter Index Number	Comment Received From
DN6C-01	Water Users Association of District No. 6 – Scott Holwick
ENVIRONMENTAL GROUPS	
PUMA-01	Preserve Unique Magnolia Association – Leadership Council
TEG-01	The Environmental Group – Victoria Brunner
TUC-01	Trout Unlimited – Drew Peternell
BCWIC-01	Boulder Creek Watershed Initiative – Paul Hempel
WRAC-01	Western Resource Advocates – Bart Miller
INDIVIDUALS	
PC-01	Elid Jiminez & Family
PC-02	Charles McKay
PC-03	Timothy Flanagan
PC-04	James Moss
PC-05	Sadie McKay
PC-06	Creig Veldhuizen
PC-07	Terry Ten Eyck
PC-08	Patrick Vaughn
PC-09	A.J. Beckman
PC-10	Kelly McKay
PC-11	Gregg Bradbury
PC-12	Brian Daly
PC-13	Gregg McKay
PC-14	David Kuntz
PC-15	Kristin Bowers
PC-16	Diana Ten Ecyk
PC-17	Munsey Ayers
NC-01	David & Jennie Curtis
NC-02	Jack & Kit Coddington
NC-03	Mia Pryce
NC-04	William Berg
NC-05	Nancy Gordon
NC-06	Susan Starr
NC-07	Jennifer Strode
NC-08	Curtis Framel
NC-09	David Waddington
NC-10	Brent & Pat Heaviland
NC-11	Anita Wilks
NC-12	Paul & Bambi Hansen
NC-13	Mark Gonglach
NC-14	Joe & Shelly Ceurvorst
NC-15	Orvel Ray & Denise Wilson
NC-16	Erik Gasner

Letter Index Number	Comment Received From
NC-17	Jill Billings
NC-18	Ann Sherman
NC-19	TZUBRICKY@aol.com
NC-20	Robert Cohen
NC-21	Stephen Herrington
NC-22	Judy Lehmkuhl
NC-23	Todd Salzer
NC-24	Melanie Gonglach
NC-25	John & Linda Lodenkamper
NC-26	Kathy Doyle
NC-27	G.M. Harrison
NC-28	Pastor Brian Young
NC-29	Jan & Dave Waddington
NC-30	Leon Evans
NC-31	Tyson Long
NC-32	Hans Rohner
NC-33	Paul McCarthy
NC-34	Erik Erwin
NC-35	Marielle Gerard
NC-36	Rick Cobb
NC-37	Terry Greenberg
NC-38	Jared Urchek
NC-39	Debra Biasca
NC-40	Dawn Joyce
NC-41	Mark Stangl
NC-42	Steve Terjak
NC-43	Claire Farley
NC-44	Bay Roberts
NC-45	Mary Chachere
NC-46	Bonnie Sundance
NC-47	Julia Chase
NC-48	John McClellan
NC-49	Ron Bowman
NC-50	Anne Pfeffer
NC-51	Robert Frey
NC-52	Roz McClellan
NC-53	Rebecca Bredehoeft
NC-54	Brian & Anna Campbell
NC-55	Greg Joder
NC-56	Paul DeLong
NC-57	Gretchen Spiro, Steve Homsher, Quill Homsher, Mike Hankal, Mike Hankal

Letter Index Number	Comment Received From
NC-58	Susan Simone
NC-59	Gail Matheson
NC-60	Curtis Linville
NC-61	Michelle Clopton
NC-62	Tom Klosowski
NC-63	Francois & Ursula Treves
NC-64	Lara Reinoehl
NC-65	Jerome Kress

The most frequent issues and concerns repeated during the public comment period for the First Stage of Consultation included:

Construction – Stakeholder comments and concerns pertaining to construction included the following topics:

- Erosion Prevention – What provisions are being made to prevent erosion during construction and during the time it takes for Gross Reservoir to fill once construction has been completed?
- Onsite Aggregate Production – Denver Water should utilize on-site aggregate for construction material that will be inundated with the expansion instead of transporting aggregate to the Gross Reservoir site.
- Public Notices – Local residents have requested that Denver Water provide public notices for project-related closures, construction-related transportation, and timelines for construction activities associated with the Gross Reservoir project.
- Noise – Local residents are concerned with the increased noise associated with construction activities at Gross Reservoir.
- Logistics of Enlargement – Where will the construction personnel live or park during construction?
- Cost of Project – Has Denver Water factored the recent escalation in fuel, raw material, and labor costs into the evaluation of the Gross Reservoir project?
- Blasting Impacts – Local residents are concerned with the use of explosives during construction and with the affected radius of such activities.
- Tree Thinning – Local residents have requested that, while doing tree removal for construction, Denver Water thin trees between Denver Water's property and the Lakeshore neighborhood located on the north shore of Gross Reservoir.
- Air Quality – Local residents are concerned with air quality issues related to construction activities, increased traffic along haul routes, and burning associated with tree removal activities.

Environmental – Stakeholder comments and concerns pertaining to the environment included the following topics:

- Hydro Power – Stakeholders are interested in knowing whether Denver Water is going to assess the impacts of generating additional hydropower from the Gross Reservoir expansion.
- Stream Flows – Several stakeholders are concerned with the changes that enlarging Gross Reservoir may have on stream flows, both upstream and downstream of the reservoir.
- Groundwater Impacts – Several local residents are concerned with impacts of construction-related activities and expansion of Gross Reservoir on their groundwater wells.
- Water Accounting – Stakeholders are concerned that Denver Water's historical and current operations and accounting have upset the delivery of native water to the basin's senior water rights holders.
- Wildfires – Several local residents expressed concerns regarding potential fire danger caused by the existing grills in the picnic areas and also see this project as an opportunity to mitigate for wildfires surrounding Gross Reservoir. Local residents are also concerned that firefighters responding to wildfire will be hindered by construction-related activities associated with the reservoir enlargement.
- West Slope Impacts – Local residents and stakeholders have concerns about impacts that diverting more water from the Gross Reservoir project will have on rivers and communities on the West Slope.
- Surface Water Impacts – Stakeholders are unclear whether adequate studies were completed for the proposed changes in the amount and timing of stream flows and effects on water quality, channel stability, and morphology associated with the project.
- Water Quality Impacts – Stakeholders are concerned with how water quality will be impacted during construction for the Gross Reservoir project.
- Wildlife Impacts – Several stakeholders expressed concerns about the impacts that construction activities for the Gross Reservoir project will have on local wildlife (i.e., elk, flora, and fish). What measures will Denver Water take to minimize the impacts to the local wildlife during construction at Gross Reservoir?

Tree Removal – A majority of stakeholder comments dealt with tree removal and related activities associated with the Gross Reservoir project. How long is tree removal expected to last? Is Denver Water working on a plan to lessen the local impacts associated with tree removal activities? Will Denver Water be addressing noise and air quality impacts associated with tree removal activities? Will Denver Water offset the number of trees removed by planting trees within the area of impact? Are the methods being considered for tree removal the most cost effective and safest?

Recreation – In 2002, Denver Water developed a Recreation Management Plan (RMP) for Gross Reservoir, which was approved by the FERC. The RMP followed construction and maintenance of recreation facilities prescribed pursuant to the conditions set in the current FERC license. Development of the RMP was a collaborative effort with federal, state, and

local stakeholder input. Therefore, Denver Water is proposing to continue to provide the types of facilities and level of management desired by participants under this plan. Denver Water will consult again with stakeholders and agencies to address their comments and concerns related to Gross Reservoir recreation facilities. Denver Water is analyzing the relocation of the existing recreation facilities and has developed a preliminary plan that indicates where the recreation facilities would be relocated. Denver Water will be responsible for implementation, construction, management, and maintenance of existing, proposed, or relocated recreation facilities at Gross Reservoir.

Stakeholder comments and concerns pertaining to recreational opportunities and facilities at Gross Reservoir included the following topics:

- No Net Increase – Stakeholders would like to see recreation facilities and recreational opportunities stay the same as are currently provided at Gross Reservoir.
- Construction Impacts – Stakeholders would like to know what, if any, changes to recreational opportunities will occur during the construction phase of the Gross Reservoir expansion. Stakeholders would also like to know how long temporary or permanent closures would last.
- No Motorized Boating – Several stakeholders indicated that they would like non-motorized, "car-top only" boating to continue as is currently allowed at Gross Reservoir.

Traffic – Stakeholders expressed the following comments and concerns regarding traffic during construction at Gross Reservoir. Local residents are concerned with the adverse consequences of years of construction on local community and events, deteriorated road conditions, driver safety on the curvy and steep road grades, traffic congestion, delayed response time for emergency vehicles, and noise and air quality impacts associated with construction-related traffic. What is the projected timeframe for construction of the Gross Reservoir enlargement and how long should local residents expect construction traffic to last? Has Denver Water considered other options besides the use of roadways for getting construction materials and supplies to Gross Reservoir? Did Denver Water consider use of the existing railway located near the site?

Conservation – Several stakeholders believe that, instead of enlarging Gross Reservoir, conservation should be Denver Water's major focus. It was also suggested that Denver Water enact more restrictive conservation guidelines. Why does Denver Water not do mandatory conversation like mountain residents abide by year round? The role of conservation as a component in meeting Denver Water's future water supply demands must be properly analyzed. Denver Water's use projections must include the benefit of more aggressive water conservation, water pricing structures, plumbing codes, land use restrictions (including residential, commercial, and other development that has greater density and less turf grass), rainwater harvesting, and other measures to evaluate the purported need for Gross Reservoir expansion. Denver Water should notify jurisdictions that will receive water from this project that contracts for delivery will be conditioned in part on those jurisdictions incorporating water conservation requirements for all interior and exterior uses in to their

land use and building permit approval processes. Denver Water should also require drought-tolerant landscaping plans, watering plans, and flora as part of any final plat or other development approval.

Water Rights – Denver Water received the following comments and concerns pertaining to water rights associated with Gross Reservoir. What water right will Denver Water use to fill the expanded Gross Reservoir? How does the Moffat Collection System Project comply with Denver Water's obligation to reuse water supplies from the Colorado River System? Is the contemplated service area of the Moffat Collection System Project within the Denver "metropolitan area," which is limited to such an area as is reasonably integrated with the development of Denver?

Cultural Resources – The Colorado State Historic Preservation Office (SHPO) has requested that, when there is a potential effect to historic properties located on lands managed by the USFS within the project boundary, Denver Water include the USFS in all consultation regarding compliance with Section 106 of the National Historic Preservation Act.

II. Second Stage of Consultation

Denver Water gathered additional information and now releases the draft license amendment application for agency and stakeholder review and comment. Denver Water is releasing the draft license amendment application concurrently with the Corps' release of the DEIS for the Moffat Collection System Project. Stakeholders and agencies have a 90-day comment period to provide comments to Denver Water on the draft license amendment application. Comments and responses will be described here following the 90-day comment period.

III. Third Stage of Consultation

After Denver Water finalizes its license amendment application, it will be submitted to the FERC with all stakeholders and agencies receiving a notice of its availability on Denver Water's website.