RECLAMATION

Managing Water in the West

EA No. EC-1300-09-02

2009 Upper Arkansas Water Conservancy District Temporary Excess Capacity Contract, Fryingpan-Arkansas Project

Environmental Assessment

U.S. Department of the Interior
Bureau of Reclamation
Great Plains Region
Eastern Colorado Area Office

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CHAPTER ONE – PURPOSE OF AND NEED FOR ACTION

INTRODUCTION

The Bureau of Reclamation (Reclamation) is proposing to enter into a one year excess storage capacity contract with Upper Arkansas Water Conservancy District (Upper Arkansas) for contract year 2009. The contract would allow storage of non-project water in Pueblo Reservoir if and when space is available.

This Environmental Assessment (EA) was prepared by Reclamation in accordance with the National Environmental Policy Act (NEPA), the Council on Environmental Quality Regulations for Implementing the Procedural Provisions of NEPA (40 CFR 1500-1508), and Reclamation's NEPA Handbook (Bureau of Reclamation 2000). The EA is not a decision document, but rather it is a disclosure of the environmental consequences of the No Action and Proposed Action Alternatives.

PURPOSE AND NEED

In general, the purpose of the issuance of excess storage capacity contracts is to maximize the use of existing infrastructure to support entities with temporary needs to store non-project water from municipal, industrial, irrigation, fishery, and recreation needs. These contracts enable contractors to more efficiently use their non-project water, by providing temporary storage for water that will be used at a later date. Temporary excess capacity contracts provide valuable water storage and increase water management flexibility.

Upper Arkansas has a need to store up to 1,000 ac-ft of their non-project water in Pueblo Reservoir to provide more reliable timing for domestic and irrigation augmentation (Upper Arkansas 2007a). The 2009 request is similar to the 2008 request, except for exchanges at one reservoir (North Fork).

BACKGROUND

Reclamation completed Environmental Assessment and Finding of No Significant Impact No. EC-1300-06-02 in April 2006 (2006-2010 EA). The EA analyzed the effects of making up to 80,000 ac-ft of Fryingpan-Arkansas Project excess capacity storage and 10,000 ac-ft of excess exchange capacity available annually from 2006-2010.

As a basis for the analysis, the 2006-2010 EA included hydrologic modeling which included, and in most cases doubled, the amounts requested from contracts requested from 2000-2005. The 2006-2010 EA did not prevent any contractor that was not included in the analysis from receiving a contract; however, it did stipulate that additional NEPA would be required for any potential effects of future requests that were not evaluated.

ISSUES AND IMPACT TOPICS

During the consideration of the proposed contract, Reclamation conducted internal and external agency scoping, as discussed in Chapter Four – Consultation and Coordination, to determine the issues relevant to the proposed contract. Below is a summary of the issues Reclamation identified to be included for further evaluation in Chapter Three – Affected Environment and Environmental Consequences, and those considered but excluded from further evaluation along with a brief explanation.

Issues and Impact Topics Included for Further Evaluation

Hydrology
Aquatic Resources
Threatened, endangered and special status species
Recreation
Cultural Resources

Issues and Impact Topics Considered but Excluded from Further Evaluation

Floodplains
Wetlands
Water Quality
Vegetation
Farmland
Soil
Environmental Justice

Indian Trust Resources

Indian trust assets are legal interests in property held in trust by the United States for Indian tribes or individuals. The United States has a responsibility to protect and maintain rights reserved by or granted to Indian tribes or Indian individuals by treaties, statues, and Executive Orders, which are sometimes further interpreted through court decisions and regulations. This trust responsibility requires Reclamation to take all actions reasonable and necessary to protect trust assets. No Indian-owned lands, federally-recognized Indian reservation, or ceded lands have been identified within the study area where traditional use rights are retained by a federally-recognized Indian tribe; therefore, no Indian trust assets would be affected by implementation of either alternative.

SCOPE OF ANALYSIS

During consideration of the proposed contract, Reclamation revisited the 2006-2010 EA to determine whether the expected impacts were within the scope of analysis previously conducted. Further, an evaluation was completed of whether or not the environmental commitments were being met. Table 1.1 summarizes the result of this effort.

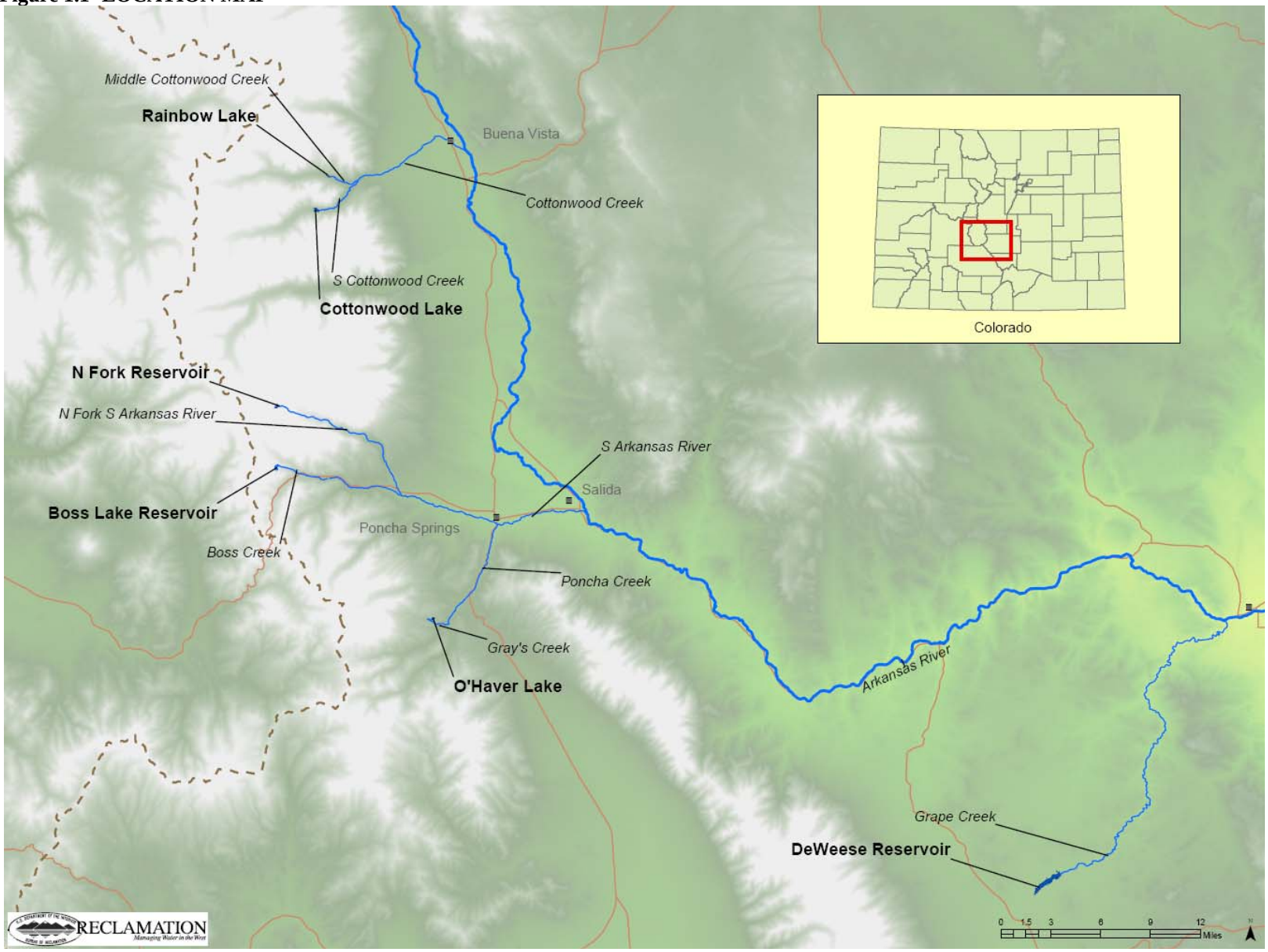
Table 1.1 – COMPLIANCE WITH ENVIRONMENTAL COMMITMENTS IN 2006-2010 EA

Environmental Commitment in 2006-2010 EA	2009 Compliance Determination
All water must be transported, stored, and released in accordance with the laws of the State of Colorado.	To be included in contract.
By entering into a temporary excess capacity contract with Reclamation, for the use and distribution of United States waters, the Contractor shall comply will all sections of the Clean Water Act.	To be included in contract. Confirmed requests include no construction to transport and/or deliver the water.
If Reclamation enters into any long-term contracts during the term of the proposed action, the amount of storage and exchange covered by this EA will be reduced by the amount of the long-term contract.	The City of Aurora long-term excess capacity contract was signed on September 12, 2007. The 57,389 ac-ft total being requested for 2009 is still well under the now 70,000 ac-ft available for temporary contracts.
Reclamation will monitor temporary excess capacity operations including daily storage and release data for Contractors' accounts, to better understand real-time use of contracted storage. This will aid in understanding how temporary excess capacity is used and present the opportunity to adaptively manage future temporary excess	Monitoring is ongoing. Year-end analysis is planned. Modifications to operations will be made accordingly, if necessary.

capacity contract operations.	
Reclamation will work with the State's Water Quality Control Division (WQCD) and other interested parties to compare their water quality data with Reclamation's operational data described above to determine if there is a correlation between selenium concentrations on the Arkansas River from Pueblo Reservoir to the Rocky Ford head gate, and changing hydrology as a result of temporary excess capacity contract operations for the years 2006 through 2010.	WQCD confirmed that the collection of selenium data is ongoing. Reclamation will initiate a study toward the end of the 2006-2010 term to determine any correlations.
Temporary excess capacity contract operations shall not cause flows on the Arkansas River as measured at the Avondale gage to fall below 86 cfs.	Ongoing communication with signatories of the IGA (Intergovernmental Agreement between the City of Aurora, Colorado Springs Utilities, City of Fountain, Pueblo Board of Water Works, the District and the City of Pueblo to maintain certain flows downstream from Pueblo Reservoir to Fountain Creek), St. Charles Mesa Water District, and State Engineer to ensure compliance.
In support of the Upper Arkansas River Flow Program (Flow Program), Contractors may not exchange water from Pueblo Reservoir to upstream locations against releases made by Reclamation in support of the Flow Program, or make any exchanges from Pueblo Reservoir which would require Reclamation to release additional water to meet the objectives of the Flow Program.	To be included in contract. If a contractor requests to exchange water from Pueblo Reservoir against releases made in support of the Flow Program, the request will be denied. This would prevent entities from exercising a physical exchange against the outflow of Twin Lakes Reservoir from Pueblo Reservoir.
Reclamation will not execute contract exchanges until the Natural Resource Conservation Service (NRCS) makes its annual May 1st water supply forecast, and Reclamation determines whether or not contract exchanges will affect its ability to operate in accordance with the Flow Program recommendations, or impair the ability of Fremont Sanitation District Wastewater Treatment Plan or the Salida Treatment Plant to meet their CDPES permit requirements.	The Aurora long-term excess capacity contract allows up to 10,000 ac-ft of exchange. However, no temporary exchange contracts have been requested for 2009, including Upper Arkansas's request. Therefore, this commitment is not applicable.
Reclamation will limit temporary excess capacity contract operations that have the potential to affect the Arkansas River below Pueblo Reservoir when flows are ≤ 500 cfs and > 50 cfs to a decrease of no more than 50% of the average daily flow as measured by adding the flow at the Arkansas Above Pueblo gage to fish hatchery return flows.	Reclamation will use the previous day's flows, as measured by adding flows at the Arkansas Above Pueblo gage to fish hatchery return flows, to determine whether this mitigation measure would be triggered. This commitment is included as a standard clause in all the contracts. Reclamation would not allow Upper Arkansas to exercise an exchange from a lower reservoir into Pueblo if flows fell below 50 cfs.
Reclamation will limit temporary excess capacity contract operations that have the potential to affect the Arkansas River below Pueblo Reservoir when flows are ≤ 50 cfs, as measured by adding the flow at the above Pueblo gage to fish hatchery return flows.	To be included in contract. See above.
Contractors that propose to store water that originates in the Upper Colorado River basin must either (1) sign a Recovery Agreement with the U.S. Fish and Wildlife Service (Service), or (2) if the water originates in the Gunnison River basin, individual consultation with the Service may be required.	Confirmed completed.
Contracts will be conditioned to limit storage of west slope water to the volume modeled for this analysis, or 14,200 ac-ft	Confirmed to be under the 14,200 ac-ft per year analyzed in the 2006-2010 EA.

per year, as discussed in the 2006-2010 EA, Chapter 3, Section IV. If a request is outside of this condition, additional environmental compliance will be required.	
If the potential effects of future requests were not evaluated in EA No. EC-1300-06-02, as discussed in Appendix C, Hydrologic Model Documentation, additional environmental compliance will be required.	The portion of Upper Arkansas's request that involves exchanging reservoirs was found to be outside the scope of analysis of the 2006-2010 EA. Additional analysis of impacts to the hydrology of the exchanging reservoirs and streams out of the reservoirs, and to the aquatic resources, threatened, endangered and special status species, and recreation in those waters will be completed for the contract requests with this EA. Based upon the magnitude of the changes in flows expected with the Proposed Action Alternative, the scope of analysis will be limited to the reservoirs and streams to the mainstem of the Arkansas River as impacts beyond that point are believed to be indiscernible. See Figure 1.1 for a location map. The analysis only discusses those streams directly below the reservoirs. However, it should be assumed that the level of impacts will gradually reduce with further distance from the reservoirs. See the 2006-2010 EA for the complete analysis for all other aspects of the 2009 requests.

Figure 1.1- LOCATION MAP



CHAPTER TWO – ALTERNATIVES

NO ACTION ALTERNATIVE

Under the No Action Alternative, Reclamation would not enter into an excess capacity storage contract with Upper Arkansas Water Conservancy District. Without this contract Upper Arkansas would be unable to make necessary exchanges, and the releases to meet needs downstream of the exchanging reservoirs would not be met.

PROPOSED ACTION ALTERNATIVE

Reclamation would enter into a one year temporary excess storage capacity contract with Upper Arkansas Water Conservancy District for storage of up to 1,000 ac-ft of non-project water in Pueblo Reservoir. See Table 2.1 for contract request details (Upper Arkansas 2009a).

Table 2.1–CONTRACT REQUEST MAXIMUM EXPECTED INFLOW AND OUTFLOW FROM PUEBLO RESERVOIR (AC-FT)

Jan		Feb		Mar		Apr		May		Jun	
In	Out	In	Out	In	Out	In	Out	In	Out	In	Out
0	16	0	16	50	16	100	20	100	205	100	380
Jul		**Aug**		**Sept**		**Oct**		**Nov**		**Dec**	
In	Out	In	Out	In	Out	In	Out	In	Out	In	Out
100	230	50	60	50	25	50	40	50	16	50	16

Upper Arkansas is requesting storage of up to 1,000 ac-ft of non-project water in Pueblo Reservoir to provide more reliable timing for domestic and irrigation augmentation. This EA analyzes only the 37.2 ac-ft of expected outflow that would be exchanged to Rainbow Lake (Rainbow), Cottonwood Lake (Cottonwood), O'Haver Lake (O'Haver), North Fork Reservoir (North Fork), Boss Lake Reservoir (Boss Lake), and DeWeese Reservoir (DeWeese), and the 400 ac-ft that would be exchanged to North Fork. The remainder of Upper Arkansas's request, which involves the Arkansas River below Pueblo Reservoir, is within the scope of the 2006-2010 EA.

Upper Arkansas would abide by Colorado water law and any requirements of The Colorado Division of Water Resources - The Office of the State Engineer (State Engineer), which have jurisdiction over the administration of state waters. All of Upper Arkansas's exchange rights are junior to Colorado Water Conservation Board (CWCB) in-stream flow (ISF), except at Middle Fork of South Arkansas (Middle Fork). However, for this year's contract request Upper Arkansas has committed to not decreasing flows below the CWCB ISF for Middle Fork. All of the streams have CWCB ISF except for the Lake Fork of the Middle Fork of the South Arkansas River (Boss Lake Creek). However, Boss Lake Creek is directly affected and indirectly protected by a 1983 Breach Order on Boss Lake Reservoir from the State Engineer that proclaimed the Boss Lake Reservoir structurally unsound and in essence created a "water-in water -out" system in the reservoir where native flows are passed without storage (Welker 2009).

Upper Arkansas would have to comply with any agreements and/or permits that allow them to operate the reservoirs. For example, the San Isabel National Forest has issued Upper Arkansas a Special Use Permit to operate Cottonwood. Upper Arkansas and the Rainbow Lake Resort, Inc. have an agreement regarding Rainbow. Upper Arkansas and the DeWeese Dye Ditch and Reservoir Company have an agreement regarding DeWeese.

North Fork, Boss, and O'Haver are on the Pike and San Isabel National Forest. Upper Arkansas must comply with any Operating Plans and conditions of any Special Use Permits that are or may be issued from the USFS. Currently, the three reservoirs each have separate Temporary Special Use Permits regarding operations and maintenance.

The current Temporary Special Use Permit for North Fork Reservoir stipulates that when filling the reservoir, Upper Arkansas must pass 2.5 cfs, or native inflows (whichever is less). When filling out of priority by exchange Upper Arkansas must bypass native inflows and or the CWCB ISF of 8 cfs (whichever is less). Once full, the releases below the reservoir will follow the watershed's natural hydrograph (Gaines 2008, Gaines 2009).

Since the USFS conditions are still being developed and are not expected to be finalized before this EA is complete, or may change throughout the life of the proposed contract, possible scenarios with the potential to cause the most impacts are presented in Chapter 3.

Operational flexibility allows the South Arkansas River Basin reservoirs (North Fork, Boss Lake, and O'Haver) and Cottonwood Creek Basin reservoirs (Cottonwood and Rainbow) to share the exchange/capture of water and burden of releasing for augmentation on a sliding scale from none to all. Upper Arkansas has a policy of maintaining a 3 year supply for augmentation. Under the worst case scenario they would need to exchange 3 year's worth of augmentation water to these reservoirs. Therefore, Upper Arkansas could exchange up to 15 ac-ft of contract water into North Fork, Boss Lake or O'Haver; and up to 13.2 ac-ft into Rainbow or Cottonwood; and up to 9 ac-ft into DeWeese. In addition, Upper Arkansas drained the North Fork reservoir in 2005 to facilitate structure repairs on the dam. In order to complete the filling operation, 400 ac-ft of contract water could be exchanged into North Fork.

But exchanges of the water in all reservoirs involved in this contract could occur only as long as the conditions of the USFS permits and the CWCB ISF are met (including Middle Fork).

CHAPTER THREE – AFFECTED ENVIRONMENT AND ENVIRONMENTAL CONSEQUENCES

INTRODUCTION AND METHODOLOGY

This chapter describes the affected environment and discloses the environmental consequences associated with implementing the No Action and Proposed Action Alternatives that are beyond those analyzed in the 2006-2010 EA. This includes the utilization of exchanging reservoirs in Upper Arkansas's request. Resources evaluated in this chapter include the hydrology of the exchanging reservoirs and streams out of the reservoirs, and the aquatic resources, threatened, endangered, and special status species, and recreation in those waters.

Based upon the magnitude of the changes in flows expected with the Proposed Action Alternative, the scope of analysis will include the reservoirs and streams to the mainstem of the Arkansas River, as impacts beyond that point are believed to be indiscernible. See the 2006-2010 EA for the complete analysis for all other aspects of the 2009 request.

Impact Thresholds

Direct, indirect, and cumulative effects were analyzed for each impact topic and are described in terms of type, duration, and intensity with general definitions of each provided below.

Type - describes the classification of the impact as beneficial or adverse, and direct, indirect or cumulative.

Beneficial: positive change in the condition or appearance of the resource, or a change that moves the resource toward the desired condition.

Adverse: negative change that detracts from the resource's appearance or condition, or a change that moves the resource away from the desired condition.

Direct: effect caused by alternative and occurs in the same time and place.

Indirect: effect caused by alternative but is later in time or farther removed in distance, but is still reasonably foreseeable.

Cumulative: incremental effect caused by alternative when added to other past, present, and reasonably foreseeable future actions regardless of what agency (federal or nonfederal) or person undertakes such other actions" (40 CFR 1508.7). Cumulative impacts can result from individually minor, but collectively significant actions taking place over time.

Duration - describes the length of time an effect would occur as short- or long-term.

Short-term: lasting no longer than the contract year.

Long-term: lasting beyond the contract year.

Intensity - describes the degree, level, or strength of an impact as no impact, negligible, minor, moderate, or major.

No impact: no discernable effect.

Negligible: effect is at the lowest level of detection and causes very little or no disturbance.

Minor: effect that is slight, but detectable, with some perceptible effects of disturbance.

Moderate: effect is readily apparent and has measurable effects of disturbance.

Major: effect is readily apparent and has significant effects of disturbance.

HYDROLOGY

Affected Environment

See Table 3.1 for information regarding the exchanging reservoirs involved in Upper Arkansas's request (Upper Arkansas 2009b, Judge 2009). The current storage levels for all reservoirs except DeWeese were as of December 1, 2008 (Upper Arkansas 2009b). The DeWeese reservoir level was as of January 26, 2009 (Judge 2009). Upper Arkansas tries to maintain their reservoirs at full capacity at all times; therefore, their goal is to have the reservoirs at or near capacity by July 1. See Appendix A for the capacity tables of these reservoirs.

Table 3.1- EXCHANGING RESERVOIRS

Reservoir / Lake	Current Storage (ac-ft)	Storage Capacity (ac-ft)	Water Depth (ft)	Surface Area (ac)
DeWeese	3,926	4,100	42	352
***DeWeese UAWCD Only**	10	60		
O'Haver	173	193	25	15
Boss	252	252	22	24
N Fork	261	602	26	32
Rainbow	61.4	63	4	20
Cottonwood	96	116	3	47

*UAWCD has 10 acre-feet of firm storage and 50 acre-feet of if & when storage in DeWeese Reservoir.

The USFS has begun an Environmental Impact Statement (EIS) to analyze, among other things, the impacts of the long term operations and maintenance of North Fork, Boss Lake, and O'Haver. Upper Arkansas is working with the USFS to procure Temporary Special Use Permits to allow continued operation of those reservoirs until the completion of the EIS. The USFS has jurisdiction and regulatory authority over the operation of these reservoirs.
Upper Arkansas has been issued Special Use Permit #FS-2700-4 from the Salida District of the San Isabel National Forest with an expiration of 12/31/17. This permit authorizes Upper Arkansas to store 50 ac-ft of water in Cottonwood and release up to 1.075 cfs from the reservoir. Upper Arkansas and the Rainbow Lake Resort, Inc. entered into an agreement that is to last as long as Upper Arkansas is in legal existence. The agreement allows Upper Arkansas to store 106 ac-ft in Rainbow and to make releases according to its augmentation plan with the Division Water Engineer. DeWeese is owned by DeWeese Dye Ditch and Reservoir Company.

See Table 3.2 for flows downstream of the reservoirs for the period of record available (CWCB 2007, USGS 2007, Upper Arkansas 2007b). Note that the only stream flow gage in the South Arkansas River Basin is near the confluence of the South Arkansas and Arkansas Rivers. These data are affected by a significant amount of upstream diversions. Therefore, the average flow for each month shown for the streams was based on a correlation analysis with the Clear Creek stream gage # 17086500. The analysis assumes that the basin size ratio relative to the Clear Creek Basin is 4.72% for North Fork Basin, 2.3% for Boss Lake Basin, and 5.8% for O'Haver Lake Basin.

In addition, the data shown for the Cottonwood Creek Basin is from gage #07089000, below Hot Springs. Although the readings were discontinued in 1986, the data record lasted for 50 years and the only other alternative, the gage at the mouth, is downstream of active diversions. The analysis assumes 44.4% of the gage reading is attributable to Middle Cottonwood Creek and 40.9% is attributable to South Cottonwood Creek.

Note that this method of hydrologic modeling, although a common technique and accepted by the Division of Water Resources Dam Safety Branch during its consideration of work at the North Fork Reservoir, is not highly rigorous. It does not take into consideration slope, aspect, or several other geographical and physical variables that have significant effects on rainfall, snowfall, and snowpack. This method is also subject to significant error. However, given that there are no existing real data, the

numbers are being used to provide the reader some context.

Table 3.2 also shows CWCB ISF and Upper Arkansas exchange rights (Exch). The State Engineer has jurisdiction over the administration of the water. Upper Arkansas's exchange rights are all junior to CWCB ISF except Middle Fork. All the streams have CWCB ISF except for Boss Lake Creek as shown in Table 3.2.

Releases from the reservoirs are administered by the Colorado Division of Water Resources. Releases are generally made in measureable amounts at a rate of at least 0.5 cfs (Upper Arkansas 2007b, Upper Arkansas 2009b, Smith 2008).

Table 3.2- STREAMS BELOW RESERVOIRS

Stream	ISF Jan-Dec (cfs)	Approp Date	Exch (cfs)	Approp Date	Monthly Average Flow (cfs)											
					Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
Grape Cr	1	6/3/82	N/A	N/A	14	17	32	53	59	90	50	36	20	17	19	15
Gray's Cr	4	1/14/76	85	5/18/87	0.7	0.7	0.6	1.1	6.4	17.6	10.3	4.3	2.5	1.7	1.2	0.9
Boss Lake Cr/Middle Fork Cr	5*	1/23/08*	85	5/18/87	0.3	0.3	0.3	0.4	2.5	7.0	4.1	1.7	1.0	0.7	0.5	0.4
N Fork S Arkansas R	8**	11/15/77	85	5/18/87	0.6	0.5	0.5	0.9	5.1	14.3	8.4	3.4	2.1	1.4	0.9	1.7
M Cottonwood Cr	10***	11/15/77	25	6/30/01	10.4	8.3	8.9	9.7	30	80	49	29.0	19.2	16.1	13.9	11.3
S Cottonwood Cr	10***	11/15/77	25	6/30/01	9.6	7.7	8.2	8.9	32	87	53	26.7	17.7	14.9	12.8	10.4

*Boss Lake Creek from outlet of Boss Lake Reservoir to confluence with Middle Fork of South Arkansas has no ISF. Middle Fork of South Arkansas has ISF as shown
**CWCB ISF increases to 10 cfs below confluence of McCoy Creek
***CWCB ISF increases to 20 cfs on Cottonwood Creek below confluence of Middle and South Cottonwood Creeks

Environmental Consequences

No Action Alternative

This alternative would result in the exchanging reservoirs and downstream hydrology continuing to fluctuate as a result of any existing storage and release operations, water rights administration, and yearly precipitation variations. Therefore, there would be no impact to the exchanging reservoirs or downstream hydrology as a result of this alternative.

Proposed Alternative

Upper Arkansas must comply with any North Fork, Boss and/or O'Haver Operating Plans and conditions of any Special Use Permits that are or may be issued from the USFS. Since the USFS conditions are still being composed and are not expected to be finalized before this EA is complete or may change during the life of the proposed contract, for the purposes of the analysis when ISF's (Table 3.2) are met, the outflows of the exchanging reservoirs are assumed to have minimum flows necessary to preserve the downstream hydrology to a reasonable degree.

Table 3.3 shows the changes that could occur to the storage of the exchanging reservoirs as compared to the No Action Alternative. In order to illustrate the largest potential difference between the alternatives, the largest exchange is shown as early as possible in the year. The contract would limit the exchanges to a total of 9 ac-ft into DeWeese, 15 ac-ft into North Fork, Boss, or O'Haver, 13.2 ac-ft into Rainbow or Cottonwood, and 400 ac-ft in North Fork. In other words, the largest changes possible are shown for each month, but those changes would not be possible for all months.

By the end of July, DeWeese Reservoir is expected to have 9 ac-ft more water in storage than with the No Action Alternative. This amount would remain until by the end of November the storage level would again be the same as the No Action Alternative.

For all the other reservoirs involved in Upper Arkansas's request, the worst case scenario of 3 year's worth of augmentation water exchanged and only one year's worth released is shown, along with the worst case scenario of the fill water exchange involving North Fork only. The reservoirs would have the potential of not returning to No Action Alternative conditions until October 2011.

Table 3.3- PROPOSED ACTION ALTERNATIVE MAXIMUM MONTHLY STORAGE LEVELS CHANGES FROM NO ACTION ALTERNATIVE (ac-ft)

	Annual Maximum	Jan-Apr	May	Jun	Jul	Aug	Sept	Oct	Nov-Dec
DeWeese	9	0	0	4	9 (4 + 5 captured)	9	9	9	0
Boss Lake, O'Haver or North Fork	15	10	15	15	13.46 (15 -1.54 released)	12.03 (13.46 -1.43 released)	10.73 (12.03 -1.3 released)	10.04 (10.73 – 0.69 released)	10.04
North Fork	400	44	178.5 (150 +44 captured=194 -15.5 released)	400 (236.5+178.5 captured=415-15.0 released)	399.5 (400+15 captured=415-15.5 released)	403.3 (399.5+10 captured=409.5-6.2 released)	397.1 (403.3-6.2 released)	411.9 (397.1+17.9 captured=415-3.1 released)	415 (411.9+3.1 captured)
Rainbow or Cottonwood	13.2	7	13.2	13.2	11.73 (13.2 – 1.47 released)	10.42 (11.73 – 1.31 released)	9.28 (10.42 – 1.14 released)	8.79 (9.28 – 0.49 released)	8.79

Refer to Appendix A for a listing of elevations and surface areas at certain storage capacities. Upper Arkansas is unable to estimate what the monthly average storage capacities might be for 2009 beyond that their goal is to have their reservoirs at or near capacity by July 1. However, it is possible to determine what a 9 ac-ft (DeWeese), 15 ac-ft (Boss Lake, O'Haver, North Fork), 13.2 ac-ft (Rainbow, Cottonwood), and 400 ac-ft (North Fork) change in storage would cause to the elevation and surface area for any storage level greater than the current level until the reservoir is full. See Table 3.4; note these numbers are relative to current elevations.

Based on the changes expected, there could be a long-term increase in storage levels and surface acres of the exchanging reservoirs ranging from up to moderate for North Fork, up to negligible for Boss Lake, and Cottonwood to up to minor for Rainbow and O'Haver. DeWeese is expected to experience a negligible short-term increase in storage level from June through November.

Table 3.4- PROPOSED ACTION ALTERNATIVE POTENTIAL RESERVOIR CHANGES COMPARED TO THE NO ACTION ALTERNATIVE

Reservoir/Lake	Elevation Change (ft)	Surface Area Change (ac)
DeWeese	0**	0
O'Haver	1-1.08	1
Boss	0**	0
N Fork	16.4-25.3	27-33
Rainbow	0.7-3	0.75-1.08
Cottonwood	0.3-0.7	0.25-0.33

**Currently full; there may be a change in elevation if room is made in the reservoir to allow storage of the exchange water.

AQUATIC RESOURCES

Affected Environment

All of the exchanging reservoirs support an active fishery (Policky 2007, Policky 2009). The primary fish in these reservoirs are brown, rainbow, and cutthroat trout (Schuckert 2008). The Colorado Division of Wildlife actively stocks these high use areas with fish such as rainbow and cutthroat trout. The streams below these reservoirs support an active fishery, with self-sustaining trout populations (Policky 2007, Policky 2009). Along with the fish species mentioned above, fall spawning brook trout are present below North Fork Reservoir (Schuckert 2008, Policky 2009). Analysis relative to greenback cutthroat trout will be discussed in the Threatened, Endangered, and Special Species section of this chapter.

Macroinvertebrates represent a significant food source for trout species, and their presence is important to maintaining a productive fishery.

Environmental Consequences

No Action Alternative

This alternative would result in the exchanging reservoirs and downstream hydrology continuing to fluctuate as a result of any existing storage and release operations, water rights administration, and yearly precipitation variations. Therefore, there would be no impact to the exchanging reservoirs or downstream hydrology as a result of this alternative.

Proposed Action Alternative

See the Hydrology section of this chapter for a discussion about the expected changes in the exchange reservoir storage levels as a result of this alternative. The increased amount of water in the exchanging reservoirs involved with this alternative is sufficient to sustain fish populations to a reasonable degree and could possibly reduce stress to fish during the summer due to increased oxygen levels and cooler temperatures of the surface water.
Further, the trout species in the reservoirs do not spawn in the reservoir; rather they ascend tributary creeks and streams where adequate discharge volume and substrate particle size is available (Schuckert 2008). Therefore, this alternative is not expected to cause any adverse impacts to the aquatic resources of the reservoirs.

See the Hydrology section of this chapter for a discussion about the expected changes in the flows downstream of the exchanging reservoirs as a result of this alternative. In the Upper Arkansas Basin reservoirs, the maximum increases in flows released during the late summer through early fall spawning period are expected to be up to 2.0 cfs and 2.3 cfs respectively in Boss Lake and North Fork in August, and up to 5.0 cfs in O'Haver in October. In the Cottonwood Creek Basin reservoirs, the maximum increases in flows released during the late summer through early fall spawning period are expected to be up to 0.44 cfs. These reservoirs normally release at rates of at least 0.5 cfs (Upper Arkansas 2007b, Upper Arkansas 2009b, Smith 2008), making

the issue one of increased velocity downstream of the Arkansas River Basin reservoirs.

There is potential for adverse effects on fall fish spawning downstream of the exchanging reservoirs with increased flows. Higher flows during a portion of the spawning period could encourage trout to use redds (gravel beds) that might afterward dry up and become exposed. The rest of the spawning period would be unaffected since the flows during the later winter period would not be reduced lower than USFS permit conditions or CWCB ISF levels (including Middle Fork).

Reduced flows in the spring and early summer could limit spawning habitat for spring spawning fish. The reduced flows in summer could limit the availability of habitat and/or damage incubating eggs of spring spawning fish. But again, the flows would not be reduced lower than USFS permit conditions or CWCB ISF levels (including Middle Fork).

Of the basic physical requirements necessary to sustain macroinvertebrate populations, river depth and flow velocity are the most critical (Nelson and Roline 1996). Significant fluctuations in flow velocity and depth can have negative effects on macroinvertebrates; however, since this variation is typical for high mountain environments, where summer storm events are common, these species are adapted to fluctuations of this nature (Roline 2001). Macroinvertebrates are primarily confined to the areas of the stream that remain submerged during the lowest flows. This alternative would not cause flows to be lower than CWCB ISF levels (including Middle Fork). However, macroinvertebrates could be affected by the greater frequency of fluctuations that would occur as a result of this alternative (Schuckert 2008).

The CWCB ISF program was designed to provide minimum stream flows to preserve the natural environment to a reasonable degree (CWCB 2007). Based on this premise, and given that the proposed storage and releases would be restricted by the conditions of the USFS permit, and given the expected frequency, timing and magnitude of the hydrological changes, there could be a short-term adverse impact to the aquatic resources ranging from up to negligible at Grape, Middle and South Cottonwood Creeks to up to minor at Gray's Creek, North Fork South Arkansas River, and Boss Lake Creek.

Mitigation of Adverse Effects

To minimize the adverse effects on fall spawning, Upper Arkansas must maintain the annual flows recommended by the Colorado Department of Natural Resources. The spawning flow for the Upper Arkansas River occurs from October 15 to November 15. If Upper Arkansas chooses a 3-day release of augmentation water, it must be completed by October 15. Upper Arkansas may choose to release augmentation water after October 15 but it must be released over a minimum of 10 days.

THREATENED, ENDANGERED, AND SPECIAL STATUS SPECIES

Affected Environment

DeWeese and Grape Creek are in Custer County, whereas all the other reservoirs and affected stream segments are in Chaffee County. Table 3.5 shows the Federally-listed Threatened and Endangered Species within these counties (USFWS 2008).

Table 3.5 – USFWS Federally-Listed Species and Habitat (County)

Species	Scientific Name	Status	Custer	Chaffee
Canada Lynx	*Lynx canadensis*	Threatened	Yes	Yes
Greenback Cutthroat Trout (greenback)	*Oncorhynchus clarki stomias*	Threatened	Yes	No*
Mexican Spotted Owl	*Strix occidentalis lucida*	Threatened	Yes	Yes
Uncompahgre Fritillary Butterfly	*Boloria acrocnema*	Endangered	No	Yes

*Error; should be listed (Ellwood, 2008).

There is no critical habitat for greenbacks (Ellwood, 2008). Within the analysis area, protected populations of greenbacks are only found in Boss Lake. Interagency recovery efforts have resulted in greenbacks in the reservoir and upstream of the reservoir in Boss Lake Creek. Downstream from the reservoir there are other trout species present. The incidental greenbacks that make their way out of the reservoir readily hybridize with the other trout; therefore, the greenbacks downstream of the reservoir are not part of a protected population.
See Appendix B for additional greenback information that was considered during this analysis.

In addition to the USFWS listed species, there is a moonwort species (*Botrichium bifurcatum*) that is on the Regional Forester's Sensitive Species List. This species is not listed by the USFWS and has no special protection under the Endangered Species Act. However, the USFWS requested that this species be addressed (Ellwood 2008). The Regional Forester's Sensitive Species listing applies to species on U.S. Forest Service lands.

The moonwort is known to occur within the analysis area; however, there is no published location data for this species. A survey status report is being produced by the USFS and is expected to be available in 2009. According to studies conducted by the USFS, this moonwort is an upper sub-alpine species that prefers previously disturbed areas. It occurs in meadow openings on rocky or course-textured soils (Olson 2008, Olson 2009).

Environmental Consequences

No Action Alternative

This alternative would result in the exchanging reservoirs and downstream hydrology continuing to fluctuate as a result of any existing storage and release operations, water rights administration, and yearly precipitation variations. Therefore, there would be no impact to the exchanging reservoirs or downstream hydrology as a result of this alternative.

Proposed Action Alternative

There is no ground disturbances expected with the implementation of this alternative as a result of construction, operation, or maintenance activities. The only changes expected with the implementation of this alternative are water related. As a result, there are no impacts ("no effect") to Canada lynx, Mexican spotted owl, or Uncompahgre fritillary butterfly expected with the implementation of this alternative.

This alternative does not concern Boss Lake Creek above the reservoir since it only involves storage in the reservoir and releases downstream. Therefore, there is no potential to impact the protected population of greenbacks in Boss Lake Creek above the reservoir. The only protected population of greenbacks in the analysis area is at Boss Lake.

See the Hydrology and Aquatic Resources sections of this chapter for a discussion of the expected impacts to the Boss Lake storage levels and aquatic resources of the reservoirs. It is possible that the increased water levels in summer could reduce stress to the greenbacks due to increased oxygen levels and cooler

temperatures of the surface water. However, the amount of water involved with this alternative is small relative to the capacities of the reservoirs. Further, the greenbacks in the reservoir do not spawn in the reservoir; rather they ascend tributary creeks and streams to spawn. Therefore, the greenbacks in Boss Lake are not expected to experience any adverse impacts as a result of this alternative ("is not likely to adversely affect").

The protection of the moonwort plants within the analysis area will be a condition of the permit Upper Arkansas receives from the USFS (Schuckert 2009). As part of this alternative, Upper Arkansas must abide by all conditions of any USFS permits. As such, there is no potential to affect ("no effect") the moonwort plants with the implementation of this alternative.

Reclamation received concurrence from the USFWS on these determinations on March 3, 2008. Further consultation would be required if at any time it is determined other species are found in the project area that are Federally-listed, proposed for Federal listing, or candidates for Federal listing; if critical habitat is designated in the project area; or if new information becomes available that reveals that the action may impact such species in a manner or to an extent not previously considered.

RECREATION

Affected Environment

Fishing is a very popular activity at all of the reservoirs and streams below the reservoirs. DeWeese is a State Wildlife Area and, in addition to fishing, is a popular area for hunting. Several of the reservoirs also have campgrounds at or nearby that provide services to the visitors of the reservoirs and streams. Rainbow is privately owned and hosts a resort for access by guests only. Non-motorized boating is allowed on Cottonwood, Rainbow (private guests only), and O'Haver.

Environmental Consequences

No Action Alternative

This alternative would result in the exchanging reservoirs and downstream hydrology continuing to fluctuate as a result of any existing storage and release operations, water rights administration, and yearly precipitation variations. Therefore, there would be no impact to the exchanging reservoirs or recreation uses as a result of this alternative.

Proposed Action Alternative

There is no ground disturbances expected with the implementation of this alternative as a result of construction, operation, or maintenance activities. Further, the reservoirs would not exceed their storage capacities which are shown in Table 3.1. There could be up to a short-term negligible impact to the recreational fishing at the North Fork South Arkansas River, Boss Lake Creek, and Gray's Creek. The 0.5 cfs that would be released from Cottonwood Creek Basin reservoirs downstream is well within the normal release patterns for the reservoirs (Upper Arkansas 2007, Smith 2008). Therefore, the only changes expected with the implementation of this alternative are water related. As a result, there are no impacts to non-water related recreation expected with the implementation of this alternative.

Refer to the Aquatic Resources section of this chapter for a discussion of the expected impacts to sport fish as a result of the implementation of the Proposed Alternative. Using a conservative approach, it is estimated that up to similar levels of impact would result to fishery recreation in those water bodies.

For the magnitudes of hydrologic changes expected with this alternative, impacts to non-fishery water-related recreation can be directly correlated with whether there is an expected increase (beneficial impact) or decrease (adverse impact) in storage levels and flows. Refer to the Hydrology section of this chapter for a discussion on the expected water level and

stream flow changes of this alternative. By extension, non-fishery water-related recreation is expected to experience up to similar levels of impacts during those time periods.

CULTURAL RESOURCES

Area of Potential Effect

Reclamation and the Colorado State Historic Preservation Officer (SHPO) entered into a Programmatic Agreement (PA) for Reservoir Operations and Storage Contracts on January 23, 2007 (Reclamation 2007). The PA states that there is a theoretical possibility of effects at non-Eastern Area Colorado (EACO) reservoirs. In practice the change in elevation is accomplished by others and is not subject to Reclamation Control. Essentially, effects will occur whether or not the water contracts are implemented. Reclamation has evaluated the effects at non-EACO reservoirs during the NHPA process using available data, but the lack of control at non-EACO reservoirs dictates that they not be included in the Area of Potential Effect (APE).

The proposed operational changes in reservoir levels fall within the normal range of operations at ECAO reservoirs and therefore the APE for the proposed Upper Arkansas Temporary Excess Capacity Contract is the shoreline and land between the waterline and the maximum pool of Pueblo Reservoir.

The PA allows for implementation of temporary excess capacity storage contracts without further consultation when the expected changes will not exceed the existing high and low pool levels originally established for Pueblo Reservoir, and will require no new construction or modification of the existing reservoir structures.

Effects of Operations and Storage Contracts

ECAO operations impact the physical integrity of sites through loss of sediments, displacement of artifacts, loss of features and organics, and weathering caused by repeated drying, re-wetting and exposure to dissolved chemicals in the water. All known shoreline historic properties within Pueblo Reservoir operating elevations have and continue to undergo these types of impacts.

The types of impacts to historic properties will not change as a result of implementing the operational changes proposed by the Victor Temporary Excess Capacity Contract.

Mitigation of Effects to Historic Properties

The “Implementing Actions” identified in the PA call for ECAO to undertake as part of its National Historic Preservation Act (NHPA) Section 110 responsibilities, systematic intensive cultural resource inventories and evaluation of historic properties within the fluctuation zone of Pueblo Reservoir. These Section 110 inventories began at Pueblo Reservoir in 2007 and will be completed by the end of calendar year 2010. The PA states that these Section 110 inventories will satisfy the NHPA Section 106 requirements for reservoir operations and storage contracts. These Section 110 Inventories mitigate the continued effects to Historic Properties at Pueblo Reservoir. No additional consultation under Section 106 is required for the proposed Upper Arkansas Temporary Excess Capacity Contract.

CUMULATIVE IMPACTS

All of the reservoirs and lakes are utilized for storage of water unrelated to the temporary excess storage capacity contracts. Only a portion of the overall operation and maintenance of these reservoirs is attributable to the temporary contract request being contemplated in this EA.

Still, despite what other reservoir operations have, are, or will occur at the exchanging reservoirs related to Upper Arkansas’s contract request, the addition of the implementation of this alternative would not cause flows to be reduced lower than CWCB ISF levels ISF (including Middle Fork). Upper Arkansas must

comply with any Operating Plans and all conditions of any Special Use Permits that have or will be issued from the USFS. A cumulative impact analysis will be completed by the USFS as part of their ongoing EIS process for the issuance of the Special Use Permits (Sugaski 2007).

However, it is important to consider the cumulative impact of the issuance of multiple one-year contracts in a row. Upper Arkansas received a contract in 2007, 2008, and will likely continue to request contracts in the years to follow 2009. The resultant cumulative impact of these consecutive contracts is that all the impacts discussed earlier in this chapter would be long-term.

CHAPTER FOUR – CONSULTATION AND COORDINATION

SCOPING PROCESS

Reclamation conducted extensive consultation and coordination during the 2006-2010 EA process. When 2009 contract requests were received, internal discussions between Reclamation staff established which contract requests were outside the scope of the 2006-2010 EA and defined the scope of analysis for this EA.

In November and December 2007, issue scoping was conducted with Colorado Division of Wildlife (CDOW) and USFS staff. Communications centered on concerns related to aquatic resources and recreation. Discussion with USFS also included their EIS process related to the reservoir operations at O'Haver, Boss, and North Fork and the approval of reservoir operations on their property. In January and February 2009 brief issue scoping was conducted with CDOW and USFS staff. Since the request was similar to the previous year's request, updates and status checks on relevant issues and concerns were made and are reflected in this EA. In 2009, particular attention was paid to CWCB ISF as a basis for the assessment.

The draft EA was posted on Reclamation's NEPA Quarterly website in March 2009 at http://www.usbr.gov/gp/nepa/quarterly.cfm#ecao

PREPARERS

See Table 4.1 for a list of Reclamation staff involved in the preparation of the EA.

Table 4.1 – LIST OF RECLAMATION PREPARERS

Name	Title	Contribution
Schaaf-Gallagher, Dan	Repayment Specialist	Water contracting information and document review.
Meyer, Tim	Natural Resource Specialist	NEPA compliance and document review
Boston, Richard	Archaeologist	Cultural resources compliance
Lamb, Kara	Public Information Specialist	Scoping guidance and posting.
Ronca, Carlie	Natural Resource Specialist	NEPA compliance guidance and document review.
Thomasson, Ron	Hydraulic Engineer	Hydrologic modeling guidance.
Tully, Will	Environmental Specialist	Environmental compliance guidance and document review.
Vaughan, Roy	Facility Manager	Document review.
Wheatley, Laura	Natural Resource Specialist, SCEP	NEPA compliance and document production.

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APPENDIX A– RESERVOIR CAPACITY TABLES

Table 1a
North Fork Reservoir - Revised Capacity Table

Elevation 2007 Datum	Water Depth (feet)	Surface Area* (sq. feet)	Surface Area (Acres)	Incremental Volume (Acre-Feet)	Capacity Active Storage (Acre-Feet)	Notes
Unknown						Unknown depth on natural lake
11399	0	516,421.00	11.9		0.0	Lip of concrete box = 11398.9'
11400		538,557.00	12.4	2.1	2.1	
1402		608,552.00	14.0	6.3	8.4	
1404		728,205.00	16.7	0.7	9.1	
1406		840,494.00	19.3	6.0	05.1	
1408		922,373.00	21.2	0.5	45.6	
1410	1	1,002,426.00	23.0	4.2	89.8	
1412	3	1,066,089.00	24.5	7.5	37.3	
1414	5	1,136,303.00	26.1	0.6	87.8	
1416	7	1,190,652.00	27.3	3.4	41.3	
1418	9	1,242,315.00	28.5	5.9	97.1	
1420	1	1,291,172.00	29.6	8.2	55.3	
1422	3	1,340,276.00	30.8	0.4	15.7	
1424	5	1,390,191.00	31.9	2.7	78.4	
1426	7	1,453,278.00	33.4	5.3	43.7	
11424.5	25.5				594.7	Capacity@ spillwayelev

Table 1b
North Fork Reservoir - Depth vs. Capacity Table
Volume in acre-feet

Depth		0.1	.2	.3	.4	.5	.6	.7	.8	.9
0	0.0	1.2	2.4	3.6	4.8	6.1	7.3	8.5	9.7	10.9
1	12.1	13.4	14.7	16.1	17.4	18.7	20.0	21.3	22.6	24.0
	25.3	26.6	27.9	29.2	30.5	31.9	33.2	34.5	35.8	37.1
3	38.4	40.0	41.5	43.0	44.6	46.1	47.6	49.2	50.7	52.3
	53.8	55.3	56.9	58.4	59.9	61.5	63.0	64.5	66.1	67.6
5	69.1	70.9	72.7	74.5	76.3	78.1	79.9	81.7	83.5	85.3
	87.1	88.9	90.7	92.5	94.3	96.1	97.9	99.7	101.5	103.3
7	105.1	107.2	109.2	111.2	113.2	115.3	117.3	119.3	121.3	123.4
	125.4	127.4	129.4	131.4	133.5	135.5	137.5	139.5	141.6	143.6
9	145.6	147.8	150.0	152.2	154.5	156.7	158.9	161.1	163.3	165.5
0	167.7	169.9	172.1	174.3	176.5	178.8	181.0	183.2	185.4	187.6
11	189.8	192.2	194.5	196.9	199.3	201.7	204.0	206.4	208.8	211.2
2	213.5	215.9	218.3	220.7	223.0	225.4	227.8	230.2	232.5	234.9
13	237.3	239.8	242.3	244.9	247.4	249.9	252.5	255.0	257.5	260.0
4	262.6	265.1	267.6	270.2	272.7	275.2	277.7	280.3	282.8	285.3
15	287.8	290.5	293.2	295.9	298.5	301.2	303.9	306.5	309.2	311.9
6	314.6	317.2	319.9	322.6	325.2	327.9	330.6	333.3	335.9	338.6
17	341.3	344.1	346.9	349.6	352.4	355.2	358.0	360.8	363.6	366.4
8	369.2	372.0	374.8	377.6	380.4	383.2	385.9	388.7	391.5	394.3
19	397.1	400.0	402.9	405.8	408.8	411.7	414.6	417.5	420.4	423.3
0	426.2	429.1	432.0	434.9	437.8	440.7	443.6	446.6	449.5	452.4
21	455.3	458.3	461.3	464.3	467.4	470.4	473.4	476.4	479.4	482.5
2	485.5	488.5	491.5	494.5	497.6	500.6	503.6	506.6	509.6	512.7
23	515.7	518.8	522.0	525.1	528.2	531.4	534.5	537.6	540.8	543.9
4	547.0	550.2	553.3	556.4	559.6	562.7	565.8	569.0	572.1	575.2
25	578.4	581.6	584.9	588.2	591.4	594.7	598.0	601.2	604.5	607.7
6	611.0	614.3	617.5	620.8	624.1	627.3	630.6	633.9	637.1	640.4
27	643.7									

Spillway = 25.5 feet

Boss Lake
Area Capacity
Tables

2-Nov-99

Elevation (ft)	Survey area/ ft sq	Area (acres)	Capacity (a.f.)	Elevation Spacing (feet)	
530	1759198.1051	40.386	1612.53		
528	1724941.4695	39.599	1532.55	2	
526	1691675.4675	38.836	1454.11		
524	1658914.5304	38.083	1377.19		
522	1626157.1803	37.331	1301.78		
520	1594186.1873	36.597	1227.85		
518	1563491.9635	35.893	1155.36		
516	1533525.8388	35.205	1084.26		
514	1503427.8931	34.514	1014.54		
512	1473469.4364	33.826	946.20		
510	1443893.5892	33.147	879.23		
508	1411202.4577	32.397	813.68	~El for 796 af is 507.45	
506	1379232.4183	31.663	749.62		
504	1346736.1605	30.917	687.04	~El. for 688 af is 504.03	
502	1314746.9220	30.182	625.95		
500	1280311.8645	29.392	566.37	Existing Crest El. 500.0	
498	1244121.1764	28.561	508.42		
496	1208962.4117	27.708	452.15		
494	1171977.3595	26.905	397.54		
492	1133551.6909	26.023	344.61		
490	1094131.5922	25.118	293.47		
488	1050802.3689	24.123	244.23	Spillway @ 487 +/-	
486	1002654.8446	23.022	197.08	Restricted storage ~ 221 af	
484	938922.2330	21.555	152.50		
482	876153.3918	20.114	110.84		
480	798413.1227	18.329	72.39		
478	711981.0725	16.345	37.72		
476	212409.5078	4.876	16.50		
474	159467.3698	3.661	7.96		
472	80735.6295	1.853	2.45		
470	6460.7057	0.148	0.44		
466	0.0000	0.000	0.00	* Start El.	

Elevation	Area ft^2	Area Ac.		
476.10	423584.3624	9.724	south	Old Lake (dead Storage)
470.03	12622.0717	0.290	north	Normal Water Level
465.95				Invert of Outlet Intake
463.92				Invert Outfall of Outlet

Equation: Approximate USGS Elevation 10,860 feet = 476.1 ft +/- @ spillway

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COTTONWOOD LAKE
Chaffee County, Colorado

(W.R. Smith, P.E.)
(Revised 10/15/01

Location	Elevation (feet)	Depth (feet)	Surface Area (acres)	Cap. of Segment (ac.ft.)	Available Storage (ac.ft.)		Surface Area (acres)	Area of Nat. Lake (acres)	Difference between nat. lake and seg. (acres)
	---Storage Capacity---						—Evaporation Area Calculations—		
Bottom of Channel	-4.0		31.72	0.00	0.00	Meas. Elev.			
	-3.0		33.43	0.00	0.00	Meas. Elev.			
Original Stream — Channel Flowline	-2.5	3.0	34.39	0.00	0.00		34.39	34.39	0.00
	-2.4	2.9	34.58	3.45	3.45		34.58	34.39	0.19
	-2.3	2.8	34.77	3.47	6.92		34.77	34.39	0.38
	-2.2	2.7	34.96	3.49	10.41		34.96	34.39	0.57
	-2.1	2.6	35.15	3.51	13.92		35.15	34.39	0.76
Bottom of F. S. — Spillway	-2.0	2.5	35.34	3.52	17.44	Meas. Elev.	35.34	34.39	0.95
	-1.9	2.4	35.75	3.55	20.99		35.75	34.39	1.36
	-1.8	2.3	36.15	3.60	24.59		36.15	34.39	1.76
	-1.7	2.2	36.56	3.64	28.23		36.56	34.39	2.17
	-1.6	2.1	36.97	3.68	31.91		36.97	34.39	2.58
	-1.5	2.0	37.38	3.72	35.63		37.38	34.39	2.99
	-1.4	1.9	37.78	3.76	39.39		37.78	34.39	3.39
	-1.3	1.8	38.19	3.80	43.19		38.19	34.39	3.80
	-1.2	1.7	38.60	3.84	47.03		38.60	34.39	4.21
	-1.1	1.6	39.00	3.88	50.91		39.00	34.39	4.61
	-1.0	1.5	39.41	3.92	54.83	Meas. Elev.	39.41	34.39	5.02
	-0.9	1.4	40.05	3.97	58.80		40.05	34.39	5.66
F.S. decree is 59.3 acre feet	-0.8	1.3	40.69	4.04	62.84		40.69	34.39	6.30
	-0.7	1.2	41.34	4.10	66.94		41.34	34.39	6.95
	-0.6	1.1	41.98	4.17	71.11		41.98	34.39	7.59
	-0.5	1.0	42.62	4.23	75.34		42.62	34.39	8.23
	-0.4	0.9	43.26	4.29	79.63		43.26	34.39	8.87
	-0.3	0.8	43.90	4.36	83.99		43.90	34.39	9.51
	-0.2	0.7	44.55	4.42	83.99		44.55	34.39	10.16
	-0.1	0.6	45.19	4.49	88.48		45.19	34.39	10.80
Top of F. S. — Spillway	-0.0	0.5	45.83	4.55	93.03	Meas. Elev	45.83	34.39	11.44
	+0.1	0.4	46.09	4.60	97.63		46.09	34.39	11.70
	+0.2	0.3	46.35	4.62	102.25		46.35	34.39	11.96
	+0.3	0.2	46.61	4.65	106.90		46.61	34.39	12.22
	+0.4	0.1	46.87	4.67	111.57		46.87	34.39	12.48
Top of 6" plate above current storage capability	+0.5	0.0	47.13	4.70	116.27		47.13	34.39	12.74
	+0.6**		47.39	4.73	121.00		47.39		
	+0.7**		47.65	4.75	125.75		47.65		
"	+0.8**		47.91	4.78	130.53		47.91		
"	+0.9**		48.17	4.80	135.33	Meas. Elev.	48.17		
"	+1.0**		48.43	4.82	140.15		48.43		
"	+2.0**		51.30	49.87	190.02	Meas. Elev.	51.30		

Up.Ark decree of 50.00 acre feet is at total available storage of 59.3 (F.S. Decree) +50.00 = 109.3

Measured elevations are from Timberlin survey of August 29, 1995.

RAINBOW LAKE

Chaffee County, Colorado

CAPACITY TABLE

Contour (*)	Elevation (**) (feet)	Depth (feet)	Surface Area (ac. ft.)	Cap. of Segment (ac. ft.)	Available Storage (ac. ft.)
-5			10.020		
			10.251		
			10.482		
			10.713		
			10.944		
			11.175		
			11.406		
-4.3	0	0	11.637	0.000	0.000
(bottom of	0.1	0.1	11.868	1.187	1.187
headgate)	0.2	0.2	12.099	1.210	2.397
-4.0	0.3	0.3	12.330	1.233	3.630
	0.4	0.4	12.672	1.267	4.897
	0.5	0.5	13.014	1.301	6.198
	0.6	0.6	13.356	1.336	7.534
	0.7	0.7	13.698	1.370	8.904
	0.8	0.8	14.040	1.404	10.308
	0.9	0.9	14.382	1.438	11.746
	1	1	14.724	1.472	13.218
	1.1	1.1	15.066	1.507	14.725
	1.2	1.2	15.408	1.541	16.266
-3.0	1.3	1.3	15.750	1.575	17.841
	1.4	1.4	15.930	1.593	19.434
	1.5	1.5	16.110	1.611	21.045
	1.6	1.6	16.290	1.629	22.674
	1.7	1.7	16.470	1.647	24.321
	1.8	1.8	16.650	1.665	25.986
	1.9	1.9	16.830	1.683	27.669
	2	2	17.010	1.701	29.370
	2.1	2.1	17.190	1.719	31.089
	2.2	2.2	17.370	1.737	32.826
-2.0	2.3	2.3	17.550	1.755	34.581
	2.4	2.4	17.727	1.773	36.353
	2.5	2.5	17.904	1.790	38.144
	2.6	2.6	18.081	1.808	39.952
	2.7	2.7	18.258	1.826	41.778
	2.8	2.8	18.435	1.844	43.621
	2.9	2.9	18.612	1.861	45.482
	3	3	18.789	1.879	47.361
	3.1	3.1	18.966	1.897	49.258
	3.2	3.2	19.143	1.914	51.172
-1.0	3.3	3.3	19.320	1.932	53.104
	3.4	3.4	19.460	1.946	55.050
	3.5	3.5	19.600	1.960	57.010
	3.6	3.6	19.740	1.974	58.984
	3.7	3.7	19.880	1.988	60.972
-0.5	3.8	3.8	20.020	2.002	62.974
(Spillway)	3.9				***
	4				
	4.1				
	4.2				
0.0	4.3				
(Water Line)					

* These contours are from the survey map developed by Timberline Surveying, Inc for the Upper Arkansas Water Conservancy District on September 12, 1995.

** The elevations are computed from the bottom of the spillway which is at contour -4.3.

*** Storage not available below this line with persent spillway.

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DIVISION ENGINEER
PUEBLO, COLORADO

O'HAVER RESERVOIR
CAPACITY TABLE
by
William R. Smith, P.E.

Contours used in developing this capacity table are based on the original plans and specifications. Contour intervals on the plans are at five foot intervals. In order to make the table easier to administer, one foot contours were interpolated with the top 2 feet interpolated to 0.1 foot.

Information from original plans and specifications.
Spillway elevation 118.8 feet.
Surface Area 15.2 ac ft.
Capacity of reservoir at spillway 193.4
Elev approx. 9000 ft
Sec. 12, T. 48 N., R. 7 E., NMPM

Elev.	Depth feet	Planimeter Reading	Area acres(a)	Average acres	Capacity of interval ac.ft.	Cumulative capacity ac. ft.	
118.80	0.00	608.6	15.20				
118.70	0.10		15.10	15.15	1.52	1.52	spillway
118.60	0.20		15.01	15.06	1.51	3.02	
118.50	0.30		14.91	14.96	1.50	4.52	
118.40	0.40		14.82	14.87	1.49	6.01	
118.30	0.50		14.72	14.77	1.48	7.49	
118.20	0.60		14.63	14.68	1.47	8.96	
118.10	0.70		14.53	14.58	1.46	10.42	
118.00	0.80		14.44	14.49	1.45	11.87	
117.90	0.90		14.34	14.39	1.44	13.31	
117.80	1.00		14.25	14.30	1.43	14.74	
117.70	1.10		14.15	14.20	1.42	16.16	
117.60	1.20		14.06	14.11	1.41	17.57	
117.50	1.30		13.91	13.99	1.40	18.97	
117.40	1.40		13.81	13.86	1.39	20.36	
117.30	1.50		13.72	13.77	1.38	21.74	
117.20	1.60		13.62	13.67	1.37	23.11	
117.10	1.70		13.53	13.58	1.36	24.47	
117.00	1.80		13.43	13.48	1.35	25.82	
116.90	1.90		13.34	13.39	1.34	27.16	
116.80	2.00		13.24	13.29	1.33	28.49	
116.70	2.10		13.15	13.20	1.32	29.81	
116.60	2.20		13.05	13.10	1.31	31.12	
116.50	2.30		12.96	13.01	1.30	32.42	
115.50	3.30		12.86	12.91	12.91	45.33	
115.00	3.80	509.00	12.72	12.79	12.79	58.32	
114.00	4.80		12.11	12.42	12.41	70.73	
113.00	5.80		11.51	11.81	11.81	82.54	
112.00	6.80		10.90	11.20	11.20	93.74	
111.00	7.80		10.30	10.60	10.60	104.34	
110.00	8.80	388.00	9.69	10.00	10.00	114.34	
109.00	9.80		9.08	9.39	9.39	123.73	
108.00	10.80		8.46	8.77	8.77	132.50	
107.00	11.80		7.85	8.16	8.16	140.66	
106.00	12.80		7.23	7.54	7.54	148.20	
105.00	13.80	265.00	6.62	6.93	6.93	155.13	
104.00	14.80		6.00	6.31	6.31	161.44	
103.00	15.80		5.38	5.69	5.69	167.13	
102.00	16.80		4.75	5.07	5.07	172.20	
101.00	17.40		4.13	4.44	4.44	176.64	
100.00	18.80	140.50	3.51	3.82	3.82	180.46	bottom of outlet
95.00	23.80	32.25	0.81	2.16	10.80	191.26	dead storage
94.00	24.80	12.00	0.30	0.56	0.55	191.81	dead storage

(a) Area in sq. ft. = 15.2acres / 608.6 units =0.0250
0.025 X number of planimeter units

Note:
There is a difference in the total storage area between this calculation and the area indicated on the original plans. The only explanation for this would be the small scale from which the calculations were made.

APPENDIX B – GREENBACK CUTTHROAT SPECIES INFORMATION

The following information was considered during the analysis of effects for the greenback cutthroat trout (*Oncorhynchus clarki stomias*; greenback) in addition to that contained in Chapter 3. The information was taken from the Greenback Cutthroat Trout Recovery Plan (USFWS 1998).

The greenback is native to the headwaters of the South Platte and Arkansas River drainages within Colorado and a small segment of the South Platte drainage within Wyoming. However, the greenback declined so rapidly in the 1800's that the original distribution of the subspecies is not precisely known. At the time of the enactment of the Endangered Species Act in 1973, only 2 small historic populations of greenbacks were known to exist in Como Creek and South Fork Cache La Poudre River. By the writing of the Greenback Cutthroat Trout Recovery Plan, the greenback was in 61 sites that totaled 166 hectares of lakes and 165 kilometers of stream habitat in the upper tributaries of the South Platte and Arkansas River drainages. Also by this time it was believed that 20 populations were stable self-sustainable populations, with only 3 occurring in the Arkansas River drainage. These historic populations are located in the higher elevations of the species' historic range, probably because of less habitat disturbance and less accessibility to humans than occurred in the lower elevations.

Greenbacks are very susceptible to land and water exploitation, mining, agriculture, logging, and unregulated fishing. However, the most long-term impacts have been caused by the introduction of non-native trout species which hybridize and compete with native fishes for space and food. The mechanism by which brook trout displace greenbacks is not thoroughly understood, but probably includes an advantage gained through a one year earlier sexual maturation by brook trout. Also, brook trout spawn in the fall leading to larger young-of-the-year at any given point in the year, which allowed them to better compete for food and deal with energy expenditures. Brown trout of equal-sized greenbacks are more aggressive and able to displace greenbacks. Greenbacks are easier to catch by anglers than other trout species.

The habitat requirements of greenbacks are similar to those of other trout species. Greenbacks inhabit cold water streams and cold water lakes that have stream spawning habitat present in the springtime. However, habitat unoccupied by other trout species is optimal. Stable reproducing populations of greenbacks above timberline in Colorado are rare since there is not sufficient time for spring spawning, hatching, and establishment of fry in the ice-free period. At the time of the writing of the Greenback Cutthroat Trout Recovery Plan, the highest elevation known was 3,402m. The lower elevation limit is not known, but stocking efforts at 1,889m have been successful.

Spawning is initiated in the spring when temperatures reach 5-8C. Females in most subalpine streams of Colorado are thought to mature after their 3rd-4th summer of life. Greenback size and growth varies based upon the elevation and population size, between 356-510mm.

Greenbacks are reported to feed upon terrestrial organisms during the summer, primarily adult Hymenoptera and adult Diptera. This diet was observed to decline rapidly in October with temperature decreases. Greenbacks are not known to be cannibalistic.

Although greenbacks generally show no overt signs of whiling disease infection such as skeletal deformities and tail chasing, mortalities for infected greenbacks are higher than for infected rainbow

trout. The threshold concentration of pH in the absence of aluminum is pH 5.0, but adverse affects occur at pH 6.0. Greenback eggs are particularly sensitive to heavy metals.

"The objective of the Greenback Cutthroat Trout Recovery Plan is the removal of this subspecies from the list of Threatened and Endangered Species. This subspecies will be considered recovered when 20 stable greenback cutthroat trout populations are documented representing a minimum of 50 hectares of lakes and ponds and 50 kilometers of stream habitat within its native range. A minimum of five of these populations will exist in the Arkansas River drainage. Once recovery objectives have been met, a long range management strategy will be implemented for the continued restoration of the species."

A stable self-sustaining greenback population is one that maintains a minimum of 22 kg of greenbacks per hectare of habitat through natural reproduction. There should be at least 500 adults greater than 120mm in length and there should be a minimum of 2 year classes within a 5 year period established through natural reproduction. The population cannot be considered stable unless it is separated by physical or biological barriers from other trout. The locations the team selected for recovery have concentrated on headwater streams and high elevation lakes for these reasons.