



# Storage needs in the Arkansas River Basin

## INTRODUCTION

The Southeastern Colorado Water Conservancy District (District) commissioned GEI Consultants to complete a Water and Storage Needs Assessment in 1997, and the study was completed in 1998. The task was to assess the water and storage needs of District members.

The planning horizon for the study was 50 years. More than 20 years have elapsed since the completion of the study. This paper will look at the progress that has been made in meeting water and storage needs that has been made during that time, as well as discuss new needs that have arisen.

The District Board asked staff to draft a strategy to develop an integrated storage plan at the September 19, 2019 Board meeting. As outlined in this paper, the plan will look at four areas of storage needs:

⇒ **Recovery of Storage:** Sedimentation in Pueblo Reservoir has reduced the available storage space by 20,000 acre-feet over the past 45 years. Additional reductions may be shown at Turquoise Reservoir and Twin Lakes, but we are awaiting results of Reclamation surveys to be certain of the amount. A Recovery of Storage Program would look at methods such as dredging, enlargement or alternative storage to regain the amount of Project Storage that has been lost.

⇒ **Expansion of Storage:** The 1998 Needs Assessment identified the enlargement of Pueblo Reservoir for the best way to meet future M&I storage needs within the Arkansas River basin. Since



2000, nearly 100,000 acre-feet of long-term excess-capacity contracts have been issued in Pueblo Reservoir, so increasing the available storage is even more critical. Enlargement is a program within the Water Activity Enterprise.

⇒ **Lower Basin Storage:** The District has a 4.76 percent interest in the Restoration of Yield (ROY) Program developed as a result of the six-party Intergovernmental Agreement (IGA) in 2004. The IGA protects flows from Pueblo Dam through Pueblo to Fountain Creek. The ROY program allows participants to capture forgone flows for exchange to Pueblo Reservoir or other uses. As a participant, the District is obligated to fund its share of the ROY program.

⇒ **Upper Basin Storage:** The Upper Arkansas Water Conservancy District is developing multi-use projects that could provide storage opportunities for the Southeastern District. These have not been fully investigated, but are included in the Business Plan.

# Pueblo Reservoir Operations

Conservation and Joint-use space is reserved for Project purposes. Excess capacity in that space may be contracted for and if so is subject to the Districts Spill Priorities.  
Provisional 3-1-2018

Total capacity, 338,374 acre-feet

Flood control pool, 93,001 acre-feet

Maintained for exclusive flood control from April 15 to November 1 ~ 66,011 acre-feet of this space is considered joint-use space and may be utilized from November 1 - April 15

- 1 Space for the storage of out-of-District excess capacity contracts
- 2 Space for storage of in-District Ag. and M&I (without defined space) long term and temp. contracts

56,672 a/f  
Multi-purpose  
excess capacity

Winter Water over 70,000 a/f

4	Fountain Valley Entities 79,900 acre-feet of storage for Project water or non-project water	City of Pueblo 32,000 acre-feet of storage for Project or non-project water	West of Pueblo 12,800 a/f for Project or non-Project water	East of Pueblo 38,400 acre-feet of storage for Project or non-project water
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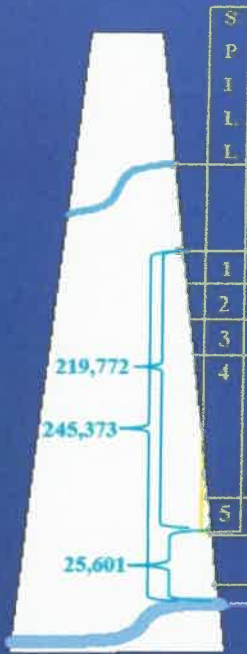
Total 163,100 a/f  
(Project water storage may not exceed 159,000 a/f)

5 70,000 a/f Winter Water

Inactive Pool, 23,706 a/f

Maintained for recreation & fishery protection

Dead Pool 1,895 a/f



## RECLAMATION

### RECOVERY OF STORAGE: BACKGROUND

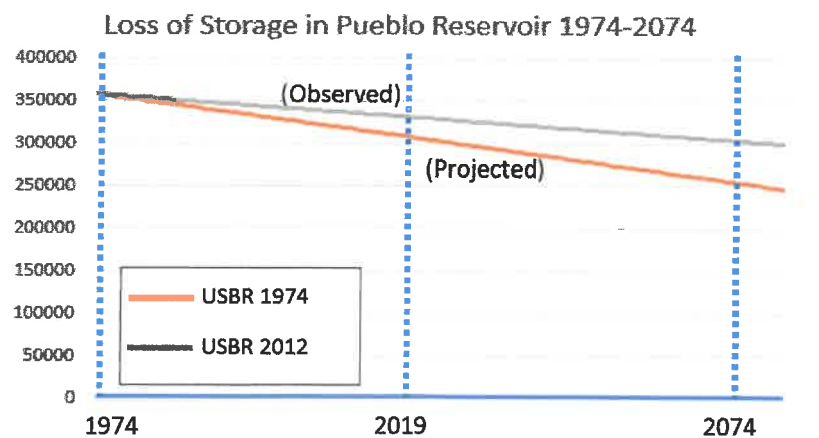
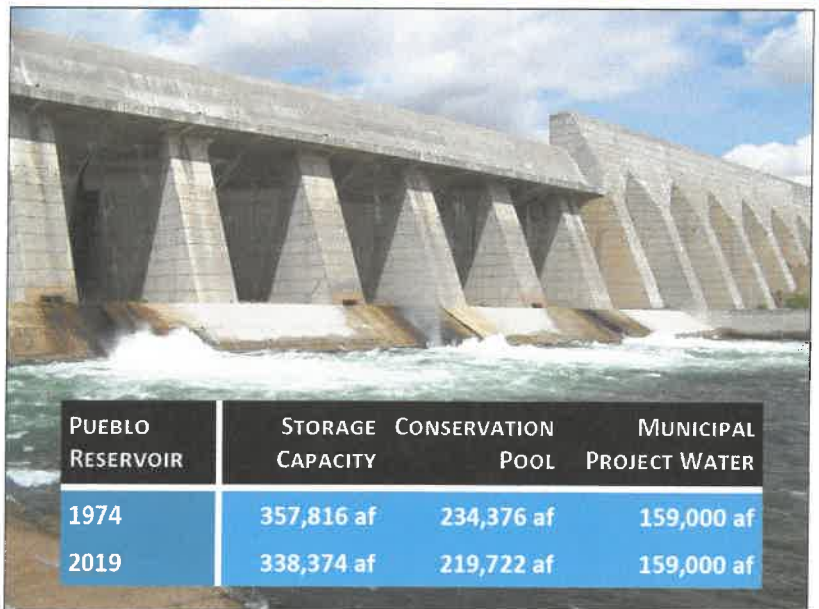
The Bureau of Reclamation reported in 2012 that Pueblo Reservoir had lost about 20,000 acre-feet of storage space due to sedimentation since opening in 1974. The reduction of storage was shown by bathymetric surveys of Pueblo Reservoir.

Reclamation is planning to release data on similar surveys of Turquoise Lake and Twin Lakes.

While the reduction in space is not as great as originally anticipated, the loss will need to be addressed as it continues.

Sedimentation is spread broadly over the reservoir, affecting not only the conservation pool, but the inactive pool that protects the fishery and recreation. The flood control pool must remain at 93,000 acre-feet in able to maintain protection from modeled flooding.

Large wildfires have the potential to accelerate sedimentation, as has been observed elsewhere in Colorado.





Maintaining storage capacity at Pueblo Reservoir benefits fish and recreation as well as those with storage accounts.

**RECOVERY OF STORAGE: OPTIONS**

To recover the 20,000 acre-feet already lost to sedimentation, the Bureau of Reclamation, in conjunction with the District, could look at several options:

- ⇒ **Conventional Dredging:** This method was used at John Martin Dam and Reservoir in 2009 (upstream) and 2018-19 (stilling basin) to remove accumulated sediment.
- ⇒ **Enlargement:** Gaining additional space in Pueblo Reservoir by increasing the top elevation of storage pools.
- ⇒ **New Construction:** Building other reservoirs to recover storage space.

Beyond recovering storage already lost, the District and Reclamation could act proactively to increase available storage in order to attain space for future years. At the current rate of sedimentation, an additional 30,000 acre-feet of storage will be lost in the next 50 years.

The costs associated with this are estimated in the table (right), based on cost estimates prepared by GEI Engineering and the Bureau of Reclamation.

ENLARGEMENT		Low End (GEI 2000)	High End (USBR 1999)
Increase by 25,000 acre-feet		\$78 M	\$90 M
Increase by 60,000 acre-feet		\$148 M	\$190 M
Increase by 75,000 acre-feet		\$197 M	\$250 M
DREDGING		Low End	High End
Dredge 20,000 acre-feet		\$135 M	\$170 M

*Costs for Enlargement from 1999 and 2000 are adjusted to 2019 dollars using Engineering News Review Construction Cost Index. USBR costs have include contingency costs.  
Dredging costs on based on recent comparable projects.*



Dredging at John Martin Reservoir in 2009.

## EXPANSION OF STORAGE: BACKGROUND

The 1998 Water and Storage Needs Assessment led to the Preferred Storage Options Plan (PSOP), which was finalized in September 2001. PSOP was seen as a way to collectively develop needed storage in the Arkansas River basin, rather than potentially competing projects by individual entities.

A shift toward municipal use was seen, and has already begun to occur. Municipal demand in 1998 totaled 148,000 acre-feet, and was projected to increase to 253,000-345,000 acre-feet by 2040. Demand currently is about 166,000 acre-feet, which is just 7,000 acre-feet more than the 1998 assessment, and 30,000 acre-feet less than the projected 2020 need.

PSOP identified three major strategies to obtain more storage:

- ⇒ **Reoperations:** Allocating excess-capacity (“if-and-when”) space in Pueblo Reservoir.
- ⇒ **Expanded Project Storage:** Enlargement of Pueblo Reservoir and Turquoise Reservoir.
- ⇒ **Expanded Non-Project Storage:** Enlargement of Lake Meredith and construction of an El Paso County reservoir to meet the greatest need in the Colorado Springs area.

Since 2001, several major trends have developed which could alter the findings of the PSOP report in significant ways. The following are examples of long-term storage that largely fulfill the “reoperations” component of PSOP.

- ⇒ **Aurora Contract:** In 2001, the District opposed Aurora’s use of Project storage and transmission of water. Agreements were reached with the District and other entities that allowed Aurora to get a 40-year contract with Reclamation to store and move water in 2007.
- ⇒ **Southern Delivery System:** Phase 1 of SDS was completed in 2016, providing a 38-year contract for Colorado Springs, Fountain, Security and Pueblo West to store water in Pueblo Reservoir.
- ⇒ **Southeastern’s Excess Capacity Master Contract:** Signed in 2016, the contract provides storage for 37 municipalities, towns, districts or water companies to store up water in Pueblo Reservoir.

M&I WATER USE	Deliveries	Max Supply	Storage
Colorado Springs	91,000	152,000	263,460
Pueblo	39,000	85,000	72,239
Other FVA	11,153	20,000	31,317
East of Pueblo (AVC)	10,464	11,287	51,450
Pueblo West	5,163	8,300	14,333
West of Pueblo	9,113	34,000	20,000
Fry-Ark Project Muni		22,600	
Total	165,893	333,187	452,799

Estimated average water deliveries (in acre-feet) are shown in the table above, along with the maximum yield from water rights, and maximum storage from all sources available to municipal entities, towns or water companies. Deliveries reflect non-potable uses, such as feedlots and park irrigation, but not water that is leased

Excess capacity contracts are one of the big changes of storage patterns in Pueblo Reservoir.

Meanwhile, enlargement stalled due to political pressure. The District Board voted to halt active efforts to pass PSOP legislation in 2007. A legal analysis at the time concluded the District still has obligations under the PSOP agreements, and subsequent intergovernmental agreements (IGAs), that require continued actions.

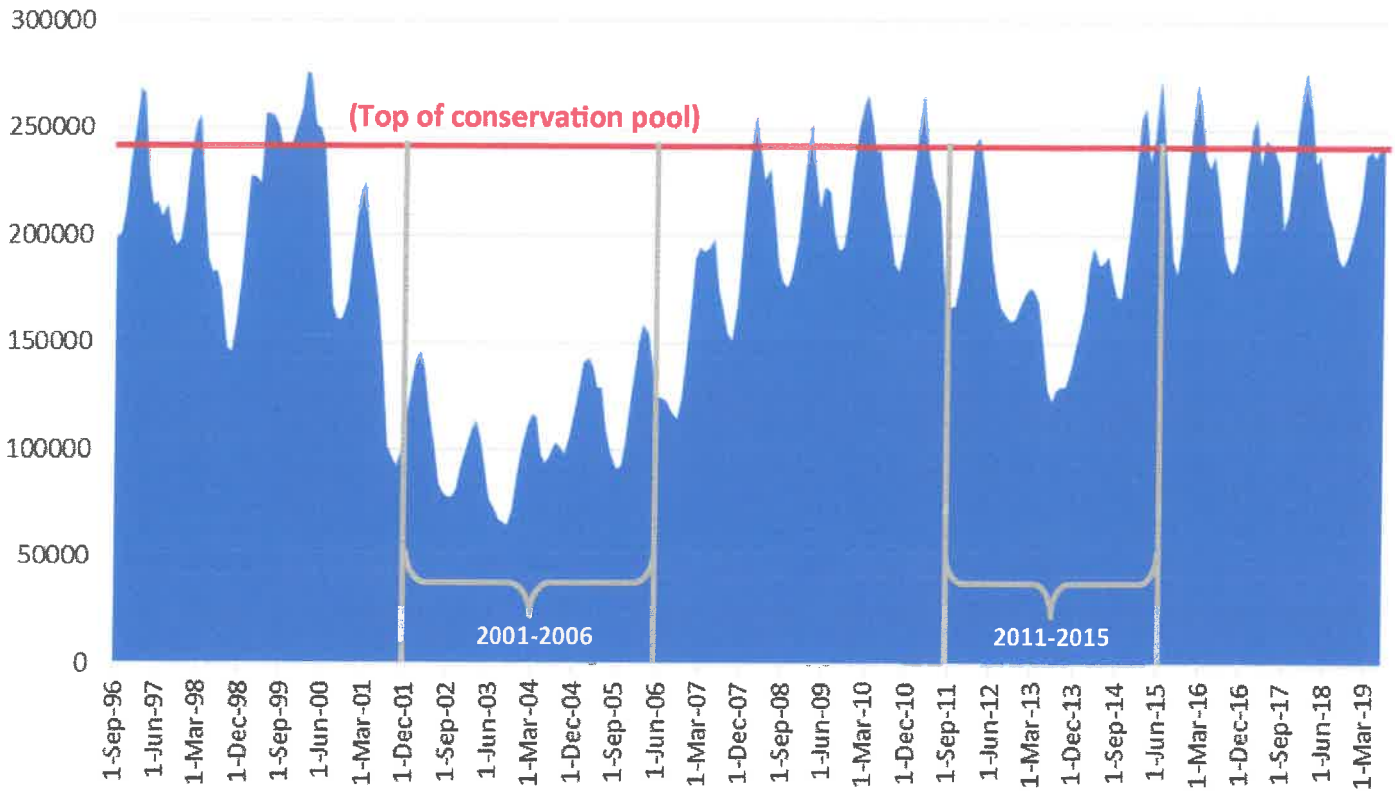
Among the most prominent is the U.S. Geological Survey Water Quality Monitoring Program that was initiated under PSOP, and continues. Participants are still providing annual funding for this program.

Agreements related to PSOP include:

- ⇒ Water court case settlements
- ⇒ 2001 Excess Capacity MOAs
- ⇒ 2001 Enlargement MOAs
- ⇒ 2001 Otero County-Aurora IGA
- ⇒ 2003 Aurora IGA
- ⇒ 2003 Upper Ark-Aurora IGA
- ⇒ 2004 3-party and 6-party IGAs
- ⇒ 2004 Twin Lakes Exchange

Some new (non-Project) storage is contemplated in Phase 2 of SDS with a 30,500 acre-foot reservoir on Upper Williams Creek, which is anticipated to occur during the next few years. In addition, new storage is foreseen in the Restoration of Yield program.

Pueblo Reservoir end-of-month levels 1996-2019 in acre-feet



**STORAGE PATTERNS ARE CHANGING**

During the dry periods from 2001-06, and from 2011-15, storage in Pueblo Reservoir was affected, as municipal water users chose to store more water in accounts.

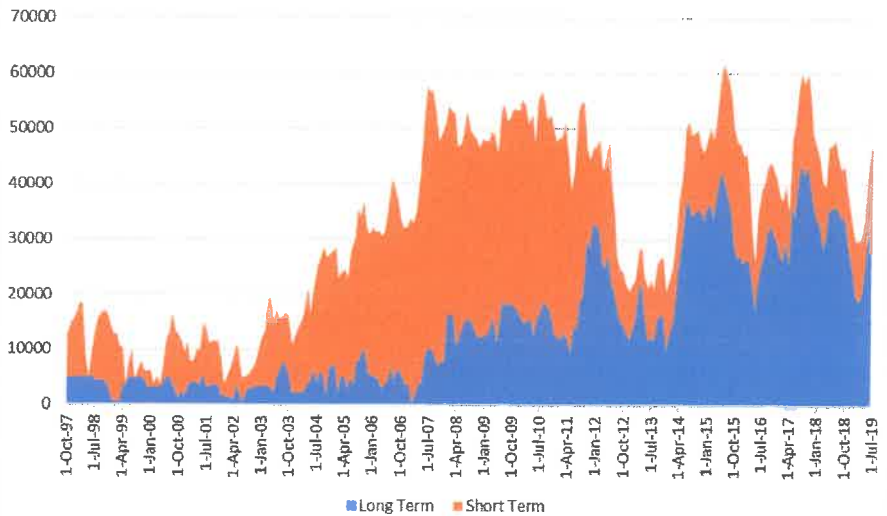
The graph above shows how Pueblo Reservoir was drawn down in order to meet demand in the 2001-05 period. There was a similar, but not as severe effect in 2011-15.

The difference is twofold:

- ⇒ Municipalities are using more of their Project space.
- ⇒ Storage levels were boosted by more non-Project water storage, shown in the graph to the right.

In addition, more of the excess capacity storage came under long-term contracts, which are shown in blue as a percent of the total excess capacity storage.

Excess Capacity Contracts, Pueblo Reservoir, 1997-2019, in AF



Long Term Contracts	Period	Maximum af	Contracted af
Pueblo Water	2000-2025	15,000	12,000
Aurora Water	2007-2047	10,000	10,000
Southern Delivery System	2010-2048	42,000	33,183
SECWCD Ex Cap MC	2017-2056	29,938	6,575

**Long-term excess-capacity contracts for storage in Pueblo Reservoir now total almost 100,000 acre-feet, but only 61,758 acre-feet have been activated. Non-Project water stored in these accounts could spill in future years. All figures in the table are in acre-feet.**

## DEMAND PROJECTIONS FALL SHORT

Two factors have lowered the M&I demand projected in the 1998 Water and Storage Needs Assessment.

- ⇒ **Population growth:** While El Paso and Chaffee counties have significantly increased population since 1998, growth has been slower in Pueblo and Fremont counties. Counties east of Pueblo generally lost population.
- ⇒ **Conservation:** Per capita water use, particularly in El Paso and Pueblo counties, has dropped significantly.

The 1998 study was completed at the end of two decades of the largest population growth and wettest weather on record in the Arkansas River basin.

In addition, growth rates in the region were higher overall (about 47 percent from 1980-2000) and particularly in El Paso County (68 percent from 1980-2000). In the 2000-2017 period, growth overall has slowed to 26 percent, and El Paso County to 34 percent.

During the severe drought of 2002, many communities were on water restrictions. Following the drought, there was an increase in active conservation programs by some cities within the District. There was also direction from the Colorado Water Conservation Board to conserve water, and it was included as a statewide goal in the 2015 Colorado's Water Plan.

### **Population in Southeastern Colorado by County 1980-2017**

COUNTY	1980	1990	2000	2010	2017
Bent	6,000	5,000	6,000	6,500	5,900
Chaffee	13,200	12,700	16,300	17,800	19,600
Crowley	3,000	3,900	5,500	5,900	5,800
El Paso	309,400	397,200	519,700	626,800	699,200
Fremont	28,600	32,200	46,278	46,800	47,600
Kiowa	1,900	1,700	1,600	1,400	1,400
Otero	22,500	20,100	20,200	18,800	18,300
Prowers	13,000	13,300	14,400	12,500	12,000
Pueblo	126,000	123,000	141,800	159,500	166,500
<b>TOTAL</b>	<b>523,600</b>	<b>609,100</b>	<b>771,778</b>	<b>896,000</b>	<b>976,300</b>

The figures reflect the total in all counties. Only parts of the counties are within District boundaries. Using GIS technology, District staff estimates 893,261 people live within District boundaries in 2019.

PROJECTIONS	Population	Water Use
1998	620,917	148,114 af
2019 (Actual)	893,261	165,682 af
2020 (Low)	973,927	213,572 af
2020 (High)	1,107,661	244,072 af
2040 (Low)	1,192,598	243,470 af
2040 (High)	1,626,678	335,013 af

Population growth rate and water use are far below levels pre-

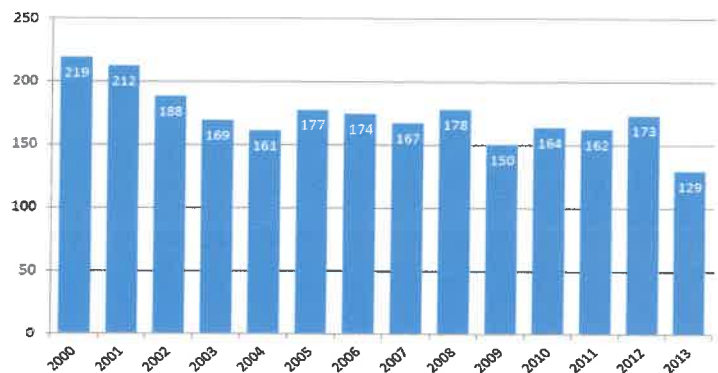


Figure 8: System-wide per capita use has declined significantly since 2000

Per capita water use in Colorado Springs decreased from 219 gallons per day in 2000 to 129 gallons per day in 2013, according to the 2015 Water Use Efficiency Plan.

Strategies for reducing water use included increasing block water rates, reducing outdoor use through education programs and realizing savings through more efficient appliances.

Many residential customers have reduced water use on their own as a response to drought or pricing.

For instance, a study by Pueblo Water found water use decreased by about 17 percent from 1996-2007. Fountain water users cut back on use when rates increased as a result of SDS.

The outcome has been a reduction in total water use despite and increase in population. The downside of the conservation trend is "demand hardening" that will reduce municipal options in times of shortage. This is a major reason for increasing the amount of water in storage to manage growth.



The ROY program maintains flows through Pueblo to protect recreation and fishing as part of a 2004 IGA.

**LOWER ARKANSAS RIVER BASIN STORAGE**

There are two major possibilities for storage in the Lower Arkansas River basin:

- ⇒ Restoration of Yield
- ⇒ John Martin Reservoir Storage Accounts

An intergovernmental agreement (IGA) in 2004 established a program designed to keep flows in the Arkansas River through Pueblo called the Flow Management Program. As part of that effort the Restoration of Yield (ROY) group was formed

The City of Pueblo at the time was developing its Whitewater Park, and feared that increased exchanges on the Arkansas River would deplete the amount of water in the river, diminishing the city’s investment. The IGA cleared the way for Pueblo’s Recreational In-Channel Diversion.

Other parties in the agreement were Aurora, Colorado Springs, Pueblo Board of Water Works, Fountain, and the Southeastern Colorado Water Conservancy District. All had an interest in protecting future exchange potential into Pueblo Reservoir. Pueblo West joined the group in 2015 because of common interests and subsequent legal agreements.

In the past three years, the group’s technical committee has been investigating sites for small reservoirs east of Pueblo.

The idea is to capture releases which otherwise

could be exchanged, but are bypassed to ensure certain flow levels. At times, some water may be released to bolster flows.

Initial reconnaissance for reservoir sites is complete, and now the ROY group is preparing to move ahead to develop storage.

The District anticipates it will pay its share of costs toward planning, design and site acquisition for the ROY reservoir.

The timing of the construction of reservoirs is controlled by the larger partners in the ROY group, CSU, Aurora and Pueblo Water.

In recent financial planning, District staff estimated that as much as \$7 million could be needed over the next 20 years to meet its obligations.

The District is among several entities looking at John Martin Reservoir accounts. Details are still emerging. Approval for this proposal is needed from the Arkansas River Compact Administration.

BENEFITS TO DISTRICT FOR LOWER ARKANSAS BASIN STORAGE	
✓	Recovery of bypassed flows in the ROY program
✓	Exchange potential to capture Return Flows
✓	Space for excess imports in order to avoid spills
✓	Delivery efficiencies for some users
✓	Low-flow releases for hydroelectric power



The Trout Creek Multi-Use Project near Buena Vista is a multipurpose project that includes storage.

**UPPER ARKANSAS RIVER BASIN STORAGE**

Innovative projects by the Upper Arkansas Water Conservancy District propose to add integrated surface and underground storage in the Upper Arkansas River.

Two projects also will explore new concepts for an interruptible water supply for cities in order to avoid “buy and dry” of irrigated farmland; enhance recreational and environmental opportunities; provide low-impact hydroelectric power generation; educate the public; and encourage public-private collaboration.

The two projects share many of the same components, but different in scale.

Currently, the Upper Ark District is doing a feasibility study at Lake Ranch.

The Trout Creek Multi-Use Project, for which the Upper Ark District is seeking funds in the form of partnerships, is a larger, more complex version of the Lake Ranch Multi-Use Project.

The project is located just west of Trout Creek Pass near Buena Vista, in an area that presently contains wetlands, wildlife habitat, and irrigated agriculture.

The goal is to keep all of those values in a sustainable project. Crucial to that is the need for storage. Trout Creek Reservoir, underground storage, and aquifer recharge ponds will all work in concert to fulfill the goal.

Part of the mission of the Southeastern District has been to improve water resources and storage potential for all of its members.

It is anticipated that the District would provide financial support for this new approach toward water conservation, and receive benefits from storage space in the Upper Arkansas basin.

The timing of the project is uncertain, and depends on the Upper Arkansas Water Conservancy District, and conditions for Southeastern participation.

**BENEFITS TO DISTRICT FOR UPPER ARKANSAS BASIN STORAGE**

- ✓ Timing of imports, whether from shortfall or excess delivery
- ✓ Delivery to Upper Arkansas basin entities
- ✓ Releases for Voluntary Flow Management Program