# SECWCD/ARKANSAS BASIN FUTURE WATER AND STORAGE NEEDS ASSESSMENT

## APPENDIX A

Water supply and use data is provided in Appendix A for the following municipal entities in the SECWCD that provided data during the Future Water and Storage Needs Assessment:

- **Buena Vista**
- **Salida**
- **Canon City**
- **Park Center**
- **Florence**
- **Penrose**
- **Colorado Springs Utilities**
- **Statmoor Hills**
- **Widefield**
- **Security**
- **Pueblo**
- **St. Charles Mesa**
- **Pueblo West**
- **Crowley County**
- **Ordway**
- **Fowler**
- **Rocky Ford**
- **LaJunta**
- **Bents Fort**
- **Las Animas**
- **Lamar**
- **May Valley**
- **Fountain**

# BUENA VISTA

# Survey of Water Users
# in the
# Southeastern Colorado Water Conservancy District

Please take a few minutes to fill out this important survey. It will assist the Southeastern Colorado Water Conservancy District in assessing the future demand for Fryingpan-Arkansas Project water and storage space. If you have questions or comments regarding this survey, you can call Steve Arveschoug (719-544-2040). Please complete and return the survey to the District in the enclosed envelope before Monday, September 23, 1996. Your cooperation is appreciated.

---

Name of Organization Town of Buena Vista

Contact Person Roy Gertson Phone 719-395-6898

User Group—Municipal ✓ Agricultural____ Industrial_____

Recreation____ Other____

What is your primary source of supply? (surface water rights, ground water rights, or leased water, please describe)

grnd. water - infiltration gallery

surface water - Direct filtration plant

Do you have a raw-water storage system? Yes_____ No ✓

(Please describe your existing water storage system, rights.)

Do you currently request Fryingpan-Arkansas Project Water? (If yes, please describe your existing use, amount and purpose, of Project Water)

yes ≈ 180 Acre ft ; for possible Augmentation for Decree Admin. to Arkansas River; Also future Transfers to Cottonwood Lake & Rainbow Lake; Banking & well Augmentation

Have you used Fry-Ark Project IF-and-When storage space for the storage of your own water rights? Yes______ No ✓

## Project Storage Space Use Trends

List your current and historic use of Project storage space for your own (non-Project) water. (acre-feet)

|  | Amt. of Stored Water (af) | Facility(s) |
|---|---|---|
| Currant Yr |  |  |
| 1995 |  |  |
| 1994 |  |  |
| 1993 |  |  |
| 1992 |  |  |
| 1991 |  |  |
| 1990 |  |  |
| 1985 |  |  |
| 1980 |  |  |

Not Applicable

## Water Use Trends

List your historic use of water for municipal or agricultural use, and your historic use of Project water (acre-feet).

|  | Population | Irr. Acreage | Water Use | Proj. Water Use | Per capita |
|---|---|---|---|---|---|
| Current Yr. | 2039 | - | 341.629 MG | None | 459 |
| 1995 |  |  | 266.395 |  |  |
| 1994 |  |  | 255.868 |  |  |
| 1993 |  |  | 266.184 |  |  |
| 1992 |  |  | 256.051 |  |  |
| 1991 |  |  | 265.355 |  |  |
| 1990 | 1752 |  | 258.036 |  | 403 |
| 1985 |  |  | 330.74 |  | 479 |
| 1980 | 2075 |  | 362.710 |  |  |

$\bar{X}$ = 447 gpd/d

## Municipal Population and Irr. Acreage Water/Storage Demand Projections

List your projected use of water and Project water (acre-feet).

| Year | Population | Irr. acreage | Water Use | Storage Use | Proj. Water Use |
|---|---|---|---|---|---|
| Current | 2039 | | 312 MG | None | None |
| 2000 | | | | | |
| 2010 | 2823 | | 413 MG | | |
| 2020 | 3794 | | 581 MG | | |
| | 3% increase | | | | |

} No estimate Available

Please describe your projected future demand for Fry-Ark Project Water and Storage (include copies of any reports or studies which provide the basis for your projections).

will definitely use Project water in the future, But volumes have not Been estimated at this Time.

## Water Resource Planning Efforts

Do you currently have a water resource plan to meet future water/storage demands? Yes ✓ No______ If yes, do your plans include the construction of raw-water storage facilities? Yes______ No ✓

Please describe your current water resource planning efforts and any construction plans.

1.) 1998 - Construct New 0.625 MG TANK; Add grnd. well & infiltration gallery;

2) working on ability to store project water in Rainbow Lake & Cottonwood Lake.

Would you be willing to participate in a cooperative effort to assess the future demands for water and storage in the Arkansas River Basin and the future need for Fry-Ark Project Water and storage.

Yes______ No______ Need more information ✓

Comments______

## Arkansas Valley Pipeline

Are you aware of the Fry-Ark Project's originally proposed Arkansas Valley Pipeline? Yes_____ No ✓ If yes, would you have an interest in taking another look at the cost/benefits of such a treated-water delivery system? yes

Comments ________________________________________

## Any additional comments?

Thank you for your help!

# FAX

**Public Works**

To: Tom Simpson
Company:
Fax number: +1 (719) 543 8467
Business phone:

From: Town of Buena Vista
Fax number: +1 (719) 395-8644
Business phone:
Home phone:

Date & Time: 1/15/98 1:34:17 PM
Pages: 4
Re: Buena Vista Water System

Tom-

The Base Population Projections for the Town of Buena Vista seem to be in order. Attached please find an information sheet on the Town of Buena Vista Water System.

If I may be of any further assistance please do not hesitate to contact me.

-Roy

## THE TOWN OF BUENA VISTA WATER SYSTEM

The Buena Vista water supply consists of groundwater and surface water sources within the Cottonwood Creek drainage's that are located west of Town on the east side of the Collegiate Peaks range.

The surface water treatment plant was constructed in 1974 with an FHA loan. The 1.5 MGD (million gallons per day) direct filtration plant includes: pre-sedimentation, coagulation, filtration, disinfection, fluoridation processes and corrosion control pH adjustment with Sodium Hydroxide. The Colorado Department of Health (CDH) requires a Class "B" water operators license. The filtration plant generally operates from mid April through October.

The groundwater system has an infiltration gallery consisting of perforated collection pipe buried 16 feet deep within the Gorrel meadow wetlands. Designed by Nielson-Dragos Engineers and approved by CDH, the system was constructed in 1980 with an expansion in 1982. Flows vary from 300 gallons per minute (gpm) to 800 gpm depending on seasonal groundwater availability through irrigation in the months of May, June, July, and August. Treatment involves disinfection with chlorine and fluoridation with hydrofluorosilicic acid (H2SiF6). The infiltration gallery provides 85% of the Town's total water supply. The supply is stored in two steel, above ground storage tanks of 0.276 MG (1957) and 1.5 MG (1980) "float" on the gravity flow distribution system.

| Water Use | System-Wide | Per Person |
|---|---|---|
| Winter average | 0.420 MGD (290 gpm) | 150 gal/day |
| Summer average | 1.320 MGD (900 gpm) | 450 gal/day |
| Peak Day | 2.100 MGD (1450 gpm) | 550 gal/day |

The oldest cast-iron water main, dating to 1947, is still in service from Linderman Avenue to South Railroad Street to the Department of Corrections. The remaining distribution system was totally reconstructed in 1966 using cast-iron pipe. Other distribution improvement projects were constructed in 1972, 1975, 1978 and 1982 using ductile-iron pipe. Service lines consist of type K copper for ¾" and 1" sizes, polyethylene pipe SDR 9 for 1 ½" and 2" sizes. The Ivy League Subdivision is served with a Town owned pump station off the 0.276 MG tank. The Subdivision maintains its own distribution system.

Town residents and businesses are served by a current total of 1101 taps. Since 1979, water customers have been required to install water meters on new construction and property transfers. Colorado law and Town ordinance requires all customers to be metered by the year 2009. During 1998 a metered rate will be initiated for all customers.

Watering restrictions during the summer irrigation season have proven to lower total water consumption by 1.0 million gallons/day, thus conserving water and also enabling the treatment processes to produce better quality water, especially during the spring when turbid runoff water increases treatment difficulty. Increased pressures are also realized for the water customers during their watering day. Total water metering along with conservation education could eliminate these mandatory watering restrictions.

### Upper Zone Water System Plant

The Town of Buena Vista has a water system that provides adequate water pressure for fire fighting flow and typical domestic and business use in the central and eastern part of Town. According to the Wright Water Engineers, Inc., "Upper Zone Water System Master Plan", August 1994, this "lower pressure zone" is generally located below 8010 feet elevation and east of Rodeo Road, Sangre De Cristo Avenue and Ice Lake Road. The upper limit of the lower pressure zone is called the "blue line". Town lands at elevations above the blue line currently do not have adequate water pressure for typical development requirements, and this area is called the "upper pressure zone".

The upper pressure zone is located up-hill (above 8010 feet elevation) and west of the lower pressure zone blue line. This zone extends west to CR 337, the upper part of the golf course and along a line east of CR 361 to its intersection with Crossman Avenue and then northeast to the Arkansas River. The service population of the upper zone is projected at 2000 people.

The "Upper Zone Water System Master Plan" of August 1994, outlines system improvements including a new 1.25 MG above ground storage tank ($550,000), 22,600 feet of 16" and 12" transmission lines ($1,022,000), along with a pump station ($20,000), and pressure reducing vault ($30,000). The total cost of the upper zone system in 1994 is estimated at $2,027,000.

### Fire Protection

The Town's water supply system is a very important part of actual fire protection and the fire fighting capability of the community. The water system's treatment plant, main capacity, and hydrant distribution are integral parts of overall fire protection and influence fire insurance rates and premiums of area residents and businesses.

A 1994 evaluation of the fire insurance classification of the Town indicated an improvement in the classification rate from Class 7 to Class 5. The improved classification effective February 1, 1995, was a result of the fire department and the water system's availability to respond to and suppress fires within the Town limits.

### Future Needs and Capital Improvements

The improvement needs of the Town's water system have a two part approach that involves maintaining and rehabilitating an aging infrastructure, and designing and funding new system growth.

- Continue to meet the water quality standards set by the Safe Drinking Water Act and the Colorado Department of Health.
- Evaluate treatment processes for improvement and possible expansions
- Construct treatment expansions including; infiltration gallery expansion and water well #2 for $115K

- Design and construction of the "upper zone" transmission lines, and pressure reducing vault ($727K)
- Design and construction of the "upper zone" 0.750 MG storage tank ($456K)
- Develop watershed management and groundwater protection plans. Land use policy development should be coordinated with Chaffee County by the Town to insure watershed protection in the Cottonwood Creek drainage
- Model the existing distribution system and growth area requirement
- Upgrade fire hydrants
- Add operators and distribution system personnel as the Town water system enlarges

*Water Rights*

The Town of Buena Vista owns a portfolio of water rights in North Cottonwood and Cottonwood Creeks. Most of these rights were purchased from the 1950's through the 1970's.

The Buena Vista Water Works Right, a year round use of 10 cfs (cubic feet per second), is the winter water right used for the operation of the municipal water system. Due to its junior appropriation date of June 1, 1883, other more senior rights are administered during the irrigation months of April through September. These senior rights are composed of the Thompson, Prior Right, and Cottonwood Irrigating. These equate to 3.88 cfs with appropriation dates of 1864 and 1866, some of the earliest recorded on Cottonwood Creek.

Other agriculture rights owned by the Town were changed for municipal use and points of diversion in District Water Court, Water Division #2, Case #83CW88 on June 19, 1989. At present the Leesmeagh and Gorrel water rights are being used for agriculture and can be switched to municipal use when necessary. This change of use would increase the Town's summertime water rights by 2.0 cfs or provide a total of 5.88 cfs.

The State Water Engineer, Division #2, administers the Town's water usage through the Town's flow meters and by computing a weekly average cfs. Presently, wintertime cfs averages 0.64, and summertime averages 2.0 cfs. Peak use day averages 3.2 cfs. According to the Buena Vista Public Works Department calculations using these flow averages, Buena Vista's water rights could support a population of 5880 people.

This water system report was prepared with direct involvement of Roy Gertson, Public Works Director, and with additional references identified in the bibliography as #3, #27 and #28.

3.88 ft³/sec [illegible] 86400) 335 sec

AF / 43560 ft³

9.5 AF [illegible]

**SALIDA**

DRAFT

# SOUTHEASTERN COLORADO WATER CONSERVANCY DISTRICT

## Arkansas River Basin Water Storage and Future Needs Assessment

WATER SYSTEM SURVEY (Compiled by BWR)

### 1. General Information

**Entity** CITY OF SALIDA

**Contact Name/District Manager** PAT BROOKS

**Address** PO BOX 417
SALIDA CO 81201

**Phone No.** (719) 539 - 4555

**Fax No.** ( ) -

**Primary Use** [✓ Municipal] Agricultural Industrial Recreational Other

**Master Plan or other Water Resource Planning Documents?** Y [✓ N]

(If yes we must obtain it)

**Prepared by:**

**Geographic Location of Service Area** (obtain service area map)

CITY LIMITS OF SALIDA

### 2. Demographics/Water Use

*Historic Water Use*

| Year | Population | Water Use, af | $^3/_4$ -in Domestic Taps (optional) |
|---|---|---|---|
| 1987 | 4800 | 3624 | |
| 1988 | 4500 | 3345 | |
| 1989 | 4400 | 3167 | |
| 1990 | 4400 | 2444 | |
| 1991 | 4500 | 2370 | |
| 1992 | 4500 | 2460 | |
| 1993 | 4600 | 2681 | |
| 1994 | 4800 | 2392 | |
| 1995 | 5200 | 2272 | |
| 1996 | 5600 | 2400 | |

*Projected Water Use*

| Year | Population | Water Use, af | $^3/_4$ -in Domestic Taps (optional) |
|---|---|---|---|
| 2000 | 5800 | 2500 | |
| 2010 | 6200 | 2700 | |
| 2020 | 6800 | 2900 | |
| 2040 | | | |

**Major industrial or other uses other than domestic**

DRAFT

# SOUTHEASTERN COLORADO WATER CONSERVANCY DISTRICT

## Arkansas River Basin Water Storage and Future Needs Assessment

WATER SYSTEM SURVEY (Compiled by BWR)

### 3. Estimated Monthly Water Use

| | as a percent of total annual use,% |
|---|---|
| JAN | |
| FEB | |
| MAR | |
| APR | |
| MAY | |
| JUN | |
| JUL | |
| AUG | |
| SEP | |
| OCT | |
| NOV | |
| DEC | |
| **TOTAL** | **100%** |

Notes: CITY IS NOT METERED, A LARGE VOLUME OF WATER IS USED FOR UN METERED IRRIGATION.

APPROXIMATE USEAGE:

| | |
|---|---|
| 1MGD | WINTER |
| 3.5MGD | SUMMER |
| 2-2.5MGD | APR-MAY, SEPT-OCT |

# SOUTHEASTERN COLORADO WATER CONSERVANCY DISTRICT

## Arkansas River Basin Water Storage and Future Needs Assessment

WATER SYSTEM SURVEY (Compiled by BWR)

### 4. Sources of Water

*Surface Water*

**Sources** SURFACE NORTH FORK RESERVOIR

**Point of Diversion** (for larger municipalities attach map, if available)

Location SOUTH ARKANSAS RIVER

Capacity

*Ground Water*

**Sources**

Tributary GALLARIES (2) IN SOUTH ARKANSAS

Nontributary

Number of Wells

**Combined Annual Flow Rate** (from decrees or based on conveyance capacity)

(May only be available as an annual total)

| | gpm | cfs | af |
|---|---|---|---|
| JAN | | | |
| FEB | | | |
| MAR | | | |
| APR | | | |
| MAY | | | |
| JUN | | | |
| JUL | | | |
| AUG | | | |
| SEP | | | |
| OCT | | | |
| NOV | | | |
| DEC | | | |
| **TOTAL ANNUAL** | | | |

DRAFT

# SOUTHEASTERN COLORADO WATER CONSERVANCY DISTRICT

## Arkansas River Basin Water Storage and Future Needs Assessment

WATER SYSTEM SURVEY (Compiled by BWR)

### 5. Firm Yield

**District Managers may not have this information, attorneys and/ or consulting engineers may need to be contacted**

| | |
|---|---|
| **Monthly Average Firm Yield for 1966-1995** | **af** |
| JAN | |
| FEB | |
| MAR | |
| APR | |
| MAY | |
| JUN | |
| JUL | |
| AUG | |
| SEP | |
| OCT | |
| NOV | |
| DEC | |
| TOTAL ANNUAL | 2240 AF |

Firm yield can estimated from:

Response of water rights during critical dry year
Potential volume limitation per decree or well permit
Ability to augment out of priority depletions

Consulting Engineer or Attorney JAY MONTGOMERY
at MOSES WITTEMEYER

### 6. Future Water Planning

Estimated future yield of existing water rights ____________ af/yr

Conditional Water Rights

Direct flow/wells

Storage DOUBLE STORAGE IN NORTH FORK RESERVOIR
CURRENTLY 575 AF SALIDA HAS 375 AF
UAWCD HAS 200 AF

# SOUTHEASTERN COLORADO WATER CONSERVANCY DISTRICT

## Arkansas River Basin Water Storage and Future Needs Assessment

WATER SYSTEM SURVEY (Compiled by BWR)

### 7. Raw Water Storage

Total Vol. in af 2500 AF

Type:

Fry-Ark BUY STORAGE IN TWIN LAKES, RIGHT TO 2500AF
ACTUALLY BUY 200AF/YR, USE 1 AF/YR @ AIRPORT

If and When

Shared NORTH FORK RESERVOIR 375 AF

Owned

### 8. Raw Water Conveyance

Type:

Pipeline

Canal

Estimated Raw Water Conveyance Losses

### 9. Treatment Plant Capacity

Type

Capacity

Also:

1. Attach copies of relevant tables and text from master plans, or water resource planning documents.
2. Compare data found in reports to data obtained from contacting entity via telephone or previous survey.

Notes:

RECEIVED

SEP [illegible]

Southeastern Colorado Water Conservancy District

# Survey of Water Users in the Southeastern Colorado Water Conservancy District

---

Please take a few minutes to fill out this important survey. It will assist the Southeastern Colorado Water Conservancy District in assessing the future demand for Fryingpan-Arkansas Project water and storage space. If you have questions or comments regarding this survey, you can call Steve Arveschoug (719-544-2040). **Please complete and return the survey to the District in the enclosed envelope before Monday, September 23, 1996.** Your cooperation is appreciated.

---

Name of Organization City of Salida

Contact Person Pat Brooks Phone 719-539-4555

User Group—Municipal ✓ Agricultural ____ Industrial ____ Recreation ____ Other ____

What is your primary source of supply? (surface water rights, ground water rights, or leased water, please describe)

Surface water rights and ground water rights

Do you have a raw-water storage system? Yes ✓ No ____

(Please describe your existing water storage system, rights.)

We have the right to store 375 acre-feet of raw water at North Fork Reservoir

Do you currently request Fryingpan-Arkansas Project Water? (If yes, please describe your existing use, amount and purpose, of Project Water)

yes - we currently use Fry-Ark water for well augmentation 1 to 3 acre-feet/yr

Have you used Fry-Ark Project IF-and-When storage space for the storage of your own water rights? Yes ____ No ✓

## Project Storage Space Use Trends

List your current and historic use of Project storage space for your own (non-Project) water. (acre-feet)

| | Amt. of Stored Water (af) | Facility(s) |
|---|---|---|
| Current Yr | | |
| 1995 | | |
| 1994 | | |
| 1993 | | |
| 1992 | | |
| 1991 | | |
| 1990 | | |
| 1985 | | |
| 1980 | | |

we do not store any non-project water in project storage - space

## Water Use Trends

List your historic use of water for municipal or agricultural use, and your historic use of Project water (acre-feet).

| | Population | Irr. Acreage | Water Use | Proj. Water Use |
|---|---|---|---|---|
| Current Yr. | 5600<br>thru August | | 1825.0 | / |
| 1995 | 5200 | | 2372.4 | / |
| 1994 | 4800 | | 2391.6 | / |
| 1993 | 4600 | | 2681.1 | / |
| 1992 | 4500 | | 2459.5 | |
| 1991 | 4500 | | 2389.7 | |
| 1990 | 4400 | | 2444.4 | |
| 1985 | 4990 | | | |
| 1980 | 4950 | | | |

## Municipal Population and Irr. Acreage Water/Storage Demand Projections

List your projected use of water and Project water (acre-feet).

| Year | Population | Irr. acreage | Water Use | Storage Use | Proj. Water Use |
|---|---|---|---|---|---|
| Current | 5600 | | 2400 | | 1 |
| 2000 | 5800 | | 2500 | | 50-100 |
| 2010 | 6200 | | 2700 | | 200 |
| 2020 | 6800 | | 2900 | | 100-200 |

Please describe your projected future demand for Fry-Ark Project Water and Storage (include copies of any reports or studies which provide the basis for your projections).

These #'s are a best guess based on current trends. We have not completed our comp plan + infrastructure update.

## Water Resource Planning Efforts

Do you currently have a water resource plan to meet future water/storage demands? Yes_______ No ✓ If yes, do your plans include the construction of raw-water storage facilities? Yes______ No______

Please describe your current water resource planning efforts and any construction plans.

Would you be willing to participate in a cooperative effort to assess the future demands for water and storage in the Arkansas River Basin and the future need for Fry-Ark Project Water and storage.

Yes ✓ No_________ Need more information__________

Comments

**Arkansas Valley Pipeline**

Are you aware of the Fry-Ark Project's originally proposed Arkansas Valley Pipeline? Yes_____ No__✓___ If yes, would you have an interest in taking another look at the cost/benefits of such a treated-water delivery system?

Comments ______________________________________________

______________________________________________________

______________________________________________________

**Any additional comments?**

______________________________________________________

______________________________________________________

______________________________________________________

______________________________________________________

______________________________________________________

Thank you for your help!

MOSES, WITTEMYER, HARRISON AND WOODRUFF, P. C.

LAW OFFICES

1002 WALNUT STREET, SUITE 300

BOULDER, COLORADO 80302

TELEPHONE: (303) 443-8782
FAX: (303) 443-8796

ADDRESS CORRESPONDENCE TO:
P. O. BOX 1440
BOULDER, CO 80306-1440

DAVID L. HARRISON
JAMES R. MONTGOMERY
TIMOTHY J. BEATON
VERONICA A. SPERLING

GILBERT Y. MARCHAND, JR.
AMELIA S. WHITING
KELLY J. CUSTER
KEVIN J. KINNEAR

CHARLES N. WOODRUFF
(1941-1996)

COUNSEL
RAPHAEL J. MOSES
JOHN WITTEMYER

SPECIAL COUNSEL
HUNTLEY STONE

DATE: 2/25/98 TIME: 3:29 p.m.

DELIVER TO: Steve Armstrong FAX NO.: (719) 543-8467

DELIVER TO: ____________ FAX NO.: ____________

DELIVER TO: ____________ FAX NO.: ____________

FROM: Kelly Custer

TOTAL NUMBER OF PAGES: 5 (including this cover sheet)

ORIGINAL WILL X WILL NOT ____________ FOLLOW BY MAIL

IF YOU DO NOT RECEIVE ALL PAGES, PLEASE CALL BACK AS SOON AS POSSIBLE

Fax Operator Phone No.: (303) 443-8782 Fax Operator: VO

MESSAGE:

To: D. Bamberger
From: D. Westmore

For Information and
for Checking Salida's Demand Figure

MOSES, WITTEMYER, HARRISON AND WOODRUFF, P. C.
LAW OFFICES
1002 WALNUT STREET, SUITE 300
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TELEPHONE: (303) 443-8782
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RAPHAEL J. MOSES
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ROBERT E. L. BEEBE
DAVID M. BROWN

SPECIAL COUNSEL
HUNTLEY STONE

February 25, 1998

**FAX**

Steve Arveschoug
Southeastern Colorado Water Conservancy District
P. O. Box 440
Pueblo, CO 81002

Re: Draft Report, Storage Needs Assessment

Dear Mr. Arveschoug:

I have reviewed Sections 2 and 5 of the draft report attached to your memo of February 17, 1998. I have the following comments on behalf of the City of Salida: There is an apparent error in Figure 5.9, the projected water demand for the City of Salida in the year 2040. The figure given in the table is significantly lower than the projections for Salida on the other tables in the report. Perhaps GEI could check the figure. Second, the discussion of conservation plans in Sections 5.2.1. through 5.2.2. fails to mention that the City of Salida passed a resolution regarding water conservation in accordance with House Bill 91-1154 (Resolution No. 1996-13, dated June 3, 1996). The resolution addresses the conservation measures discussed in the draft report, and set forth in Table 5.1. I am enclosing a copy of the resolution for your use.

Please call if you have any questions.

Faxed to Bruberger for checking

Sincerely,

Kelly J. Custer

Kelly J. Custer
for
MOSES, WITTEMYER, HARRISON AND WOODRUFF, P.C.

KJC/jt
Enclosure
cc: Scott Hahn

JKM ✓
KC ✓

Incorporated into report 3/2/98 (LAW)

RESOLUTION NO. 1996-13

# CITY OF SALIDA
# RESOLUTION OF THE CITY COUNCIL ON WATER USE EFFICIENCY

In 1991 the General Assembly of the State of Colorado enacted House Bill 91-1154, also known as the "Water Conservation Act of 1991". The Act requires any water utility which provides 2000 acre-feet of water or more per year to customers to consider certain water conservation measures as part of its water supply planning. The requirements of water use efficiency plans contained in the Act are codified in Colorado Revised Statutes §37-60-126.

The City shares the goal articulated by the legislature of efficient use of water supplies. The City's commitment to water conservation and the success of its efforts are shown in part by the fact that water usage in the City has decreased from a total of 1.1 billion gallons in 1987 to 740 million gallons in 1995.

Specific measures taken which address each of the items listed in §37-60-126(4) include:

(4)(a): The City has considered the use of water efficient fixtures and appliances, but at this time does not require their use by its water customers. Further consideration will be given to such measures as the City develops a comprehensive water use efficiency plan as provided below.

(b): The City encourages its water customers to use xeriscape methods of landscaping to reduce water use. Efficient irrigation is promoted in several ways: through public education on the volume of water consumed by lawn watering; by encouraging the installation of automatic sprinkler systems to replace manual watering; by mandatory restrictions on watering to even/odd days; and by mandatory restrictions on watering between the hours of 10:00 a.m. and 4:00 p.m..

(c): The City has few industrial and commercial customers and has not recommended specific water-using processes to them. Further consideration will be given to such measures as the City develops a comprehensive water use efficiency plan as provided below.

(d): The City makes use of re-used water for its own needs at its sewage treatment plant (landscaping and water application for dust control) and uses untreated ditch water for watering at the municipal golf course.

(e): The City has an aggressive leak repair program. Sections of pipe are added to the distribution system in an ongoing process to improve overall efficiency, and any leaks which are detected during this work are repaired. The City also services the water lines which connect its water mains to the individual customers, and repairs any leaks in those lines.

(f): Dissemination of information on efficient use of water to the public is achieved in several ways: information on lawn watering and the relative efficiency of automatic systems over manual watering is disseminated mainly by speaking firsthand with customers. Information on water conservation is also provided via newspaper articles and radio talk shows with the participation of City personnel. Finally, the City plans to include a water efficiency column as a regular feature of its bi-monthly newsletter to utility customers.

(g): A new water rate structure designed specifically to encourage water use efficiency is in the planning stage. The current "declining block" structure will be replaced with an "ascending block" structure in which the cost per unit of water increases as the volume of water use increases. The new rate structure is currently undergoing computer modelling, and may be in place as soon as September 1, 1996.

(h): Two water use efficiency measures have been codified by the City. First, lawn watering is restricted to even or odd days, year-round. This measure was introduced in 1990 as a voluntary program and was changed to a mandatory restriction in 1991. Second, watering is prohibited during the hours of 10:00 a.m. and 4:00 p.m., at such times of the year and under such conditions as the City Council determines the restriction is necessary.

(i): The City provides an incentive to its customers to install connections for meters, by requiring that such connections be installed whenever a water user is installing a sprinkler system or when a leak is repaired. The customer receives the benefit of free City labor, rather than paying a contractor to install the connection.

Section 37-60-126(5) requires a statement of the City's judgment of the role of water use efficiency plans in its water supply planning. The City considers water use efficiency to be critical to the planning and operation of its water supply. Efficient water use helps the City to achieve the following goals: to reduce the costs of producing water, to increase the longevity of its water delivery system, and to avoid the need to purchase additional water supplies in the future.

IT IS HEREBY RESOLVED, and the City Council hereby finds and gives public notice at its regular meeting of this date pursuant to §37-60-126(2), that the City of Salida has satisfied the provisions of Colorado Revised Statutes §37-60-126(4) and (5) by considering each of the water-saving measures listed in the statute as part of its water supply operations.

AND IT IS HEREBY FURTHER RESOLVED, that, notwithstanding the initial determination that the City has substantially satisfied subsections (4) and (5) of Section 37-60-126, the City should develop a comprehensive, written water use efficiency plan covering all the elements set forth in §37-60-126. Such plan should set forth the results of the consideration of water efficiency measures and techniques implemented since June 4, 1991 in accordance with §37-60-126(6) and should provide for public notice and comment in accordance with §37-60-126(7).

In addition to the water use efficiency measures already undertaken by the City and described herein, the Council hereby directs City staff, working with the City's legal counsel and engineer, to develop a draft water use efficiency plan, give public notice of such plan and solicit public comments on such plan and present such plan and public comment to the City Council for consideration.

Indroduced, read, and adopted at a regular meeting of the City Council held June 3, 1996.

Nancy E. Sanger, Mayor

Deanna Cantril
Deanna Cantril, City Clerk

# CANON CITY

RECEIVED
SEP 6 1996
Southeastern Colorado Water Conservancy District

# Survey of Water Users in the Southeastern Colorado Water Conservancy District

---

Please take a few minutes to fill out this important survey. It will assist the Southeastern Colorado Water Conservancy District in assessing the future demand for Fryingpan-Arkansas Project water and storage space. If you have questions or comments regarding this survey, you can call Steve Arveschoug (719-544-2040). **Please complete and return the survey to the District in the enclosed envelope before Monday, September 23, 1996.** Your cooperation is appreciated.

---

Name of Organization City of Canon City

Contact Person PAUL S FISHER Phone (719) 269-9022

User Group—Municipal X Agricultural____ Industrial_____
Recreation____ Other_____

What is your primary source of supply? (surface water rights, ground water rights, or leased water, please describe)

ARKANSAS RIVER SURFACE WATER RIGHTS

Do you have a raw-water storage system? Yes X No ________
(Please describe your existing water storage system, rights.)

NOT STORAGE AS YOU DESCRIBE IT. WE HAVE A 48 million GALLON SETTLING BASIN AS PART OF OUR TREATMENT PROCESS

Do you currently request Fryingpan-Arkansas Project Water? (If yes, please describe your existing use, amount and purpose, of Project Water)

Annual Purchases of 90 Acre Feet; 87 of which is to REPLACE WATER USED TO EXTINCTION BY COTTER CORPORATION Considered use of BALANCE is TO OFFSET PEAK DEMANDS IN SUMMER MONTHS; ALTHOUGH WE HAVE NOT USED TO DATE.

Have you used Fry-Ark Project IF-and-When storage space for the storage of your own water rights? Yes______ No X

## Municipal Population and Irr. Acreage Water/Storage Demand Projections

List your projected use of water and Project water (acre-feet).

| Year | Population | Irr. acreage | Water Use | Storage Use | Proj. Water Use |
|---|---|---|---|---|---|
| Current | 24,000 | | 6296 Acft | | -0- |
| 2000 | NOT AVAILABLE | | | | |
| 2010 | 31,544 | | 7420 Acft | | 3 Acft estimate only |
| 2020 | 36,238 | | 9535 Acft | | 6 Acft " " |

Please describe your projected future demand for Fry-Ark Project Water and Storage (include copies of any reports or studies which provide the basis for your projections).

STATE DEMOGRAPHER STATISTICS INSIDE CITY LIMITS SAME GROWTH RATE APPLIED TO OUTSIDE CITY LIMITS PROJECTIONS.

## Water Resource Planning Efforts

Do you currently have a water resource plan to meet future water/storage demands? Yes_______ No X If yes, do your plans include the construction of raw-water storage facilities? Yes______ No______

Please describe your current water resource planning efforts and any construction plans.

Although not in an ideal location, the city has ample diversion rights; storage considerations will be for peak periods so a release can be made to offset usage.

Would you be willing to participate in a cooperative effort to assess the future demands for water and storage in the Arkansas River Basin and the future need for Fry-Ark Project Water and storage.

Yes X No_________ Need more information X

Comments limited now to staff time

## GOVERNING THE CAÑON CITY WATER SYSTEM

**The Role of City Council:**
Under the City Charter, the City Council is the governing body of the City and, as such, has plenary authority to exercise both legislative and administrative powers and duties. Council historically has delegated many of its administrative and executive duties to the City Administrator. Among the administrative powers and duties assigned by the Charter to City Council are those which " embrace the management, supervision, and operation of the City water works...". Consistent with its authority under the Charter, City Council, through Ordinance No. 36, Series of 1993, formally declared the Water Department to be a Water Activity Enterprise, pursuant to Article 45.1 of Title 37, C.R.S., and designated itself as the governing body of the Water Department. This booklet focuses on the City Council's role as governing body of the Water Department and the City's Water System.

The Cañon City Water Department fiscally is made up of two funds, the Water Fund and The Raw Water Acquisition and Preservation Fund . The 1996 budget for Water Fund is $3,790,760.00 and the 1996 Raw Water Acquisition and Preservation Fund budget is $337,232.00. The Water Department will issue bonds in 1996 for the approximate amount of $4,600,000.00 and will expend those funds beginning in 1996 and complete expenditures by early 1998 for improvements to the water treatment plant. Pursuant to the City Charter and Ordinance No. 36, Series of 1993, the Water Department is a self-supporting, City-owned business, providing water through 7,422 meters within the metropolitan area of Cañon City to a service population of about 23,000, and growing.

The American Water Works Association (AWWA) defines the organization and management philosophy of publicly owned water utilities as follows:

> Organization Directly Under Municipal Government.
> a) The governing body should set broad lines of policy and should delegate to its appointed City Administrator or department head those powers and functions that will permit the City Administrator to provide long-range planning, sound financing, essential engineering, and a high standard of utility service.
> b) In order to carry out these duties properly, the City Administrator or department head must be a qualified professional experienced in water utility operations.
> c) The accounting for the funds of the water utility should be separate from other municipal funds, and the use of the funds should be subject only to such budgetary restrictions as are imposed by the legislative authority of the governing body.
>
> Fundamental Philosophy of Management [slightly abridged].
> 1. Publicly owned water utilities must be operated on a sound financial basis and in a businesslike fashion. The form of management should be that of a utility as distinguished from other types of service-furnishing entities.
> 2. The City Administrator of the utility should be responsible for recommending policies for the utility to the appropriate policy-setting board [Public Works Committee of City Council] or Council and should be responsible for all phases of utility planning.
> 3. The utility's income, expenses, assets, and liabilities should be accounted for in a manner consistent with generally accepted enterprise-accounting principles and practices. Revenue

requirements should be determined annually, and rates and other charges should be set to meet these needs during the budgetary process well in advance of the effective dates of such rates and charges so that the customers have advance notice of adjustments and understand the reasons for them. Balance-sheet items and results of operation of the water utility should be clearly distinguished, in detail, from those of other departments to facilitate analysis by management, financial institutions, other interested agencies, and the public.

4. Publicly owned water utilities should, when practical, provide for their own administrative and operational facilities. They may utilize the facilities or services of the governing body's specialists or officials and employees, reimbursing the general fund of the governing body for the cost of any such services or facilities. Conversely, the water utility should be reimbursed by the general government for the cost of any facilities or services provided by the utility's specialists to the general government.
5. An audit should be performed annually by a private certified public accounting firm. Recommendations by such a firm for improvements in financial management should be studied carefully and implemented if practical.
6. Publicly owned utility organizations must have capable administrators, encourage long-range planning, provide for sound financing, and stimulate the sound management and engineering practices essential to providing a high standard of service and producing water that meets all national, state, and local water-quality standards.
7. The utility employees should be covered by a merit or civil service system. Recruitment, promotions, and in-service training must be designed to assure that the utility will always be able to meet its responsibilities to the community.

The common thread of advice from the AWWA to Council members is "Publicly owned water utilities must be operated on a sound financial basis and in a business-like fashion" and be operated as a utility as distinguished from other types of service-furnishing entities. The Cañon City Water System is a large business. A private sector business comparison would liken the Council as the Board of Directors; the Mayor as Chairperson of the Board; the City Administrator as Chief Executive Officer.

> **Publicly owned water utilities must be operated on a sound financial basis and in a businesslike fashion.**
> AWWA, Organization and Management of Publicly-Owned Water Utilities

AWWA further identifies the following:

- A properly run water utility is absolutely essential to the health, safety, and welfare of the entire community.
- The basic philosophy should be that of furnishing the standard of service expected by the customer, conditioned only by limitations of water supply and pricing techniques designed to provide the service at the optimum economic level.

Embracing the management, supervision, and operation of the Cañon City Water System is a large responsibility in itself. Some elected officials have just one area of responsibility, such as a sewer or recreation district. The City's water works is only one part, but a very important part of the demanding responsibilities City Council members have.

> **The City's water works is one part, but a very important part of the demanding responsibilities Council members have.**

The Cañon City Council annually appoints at least two standing committees, the General Government Committee and the Public Works Committee. The Public Works Committee with the assistance of the City Administrator, administers the Cañon City Water System. The City Administrator with the assistance of the Public Works Director and staff, and the Water Billing and Accounting divisions of the City's Finance Department operate the system in accord with the policies and directions of the City Council and its Public Works Committee.

Water rates, connection fees and other charges; requirements, rules and policies applicable to the operation, repair, maintenance and expansion of the water system; and the rights and obligations of users of the system, are established and periodically amended by the City Council through its exercise of legislative powers. Ordinances applicable to the Water Department are codified within Title 13 of the Cañon City Municipal Code. Certain of these ordinances authorize the City Administrator to promulgate and amend regulations pertaining to day-to-day Water Department operations and its dealings with users. Water Department long-term debt for capital improvements may be incurred, secured and retired through City Council's exercise of legislative powers. However, voter authorization is required under Section 13 of Article XIII of the Charter prior to the issuance of water revenue bonds to finance capital improvements to Water Department facilities.

# SOURCES OF SUPPLY

## A. HISTORY OF THE CITY'S WATER SUPPLY SOURCES

The City of Cañon City's water comes from melting snow and rainfall of the Arkansas River headwaters watershed. The Arkansas River originates on the east slope of the Rocky Mountains near Leadville, Colorado. The river is a total of 1,450 miles long, and is the largest tributary of the Mississippi-Missouri river system.

In 1806 Zebulon M. Pike explored the upper part of the Arkansas River. John C. Fremont explored Colorado from 1842 to 1853. The Arkansas River flows through the Royal Gorge canyon between Parkdale and Cañon City, Colorado. Perhaps both of them marveled at the scenic Royal Gorge canyon. This canyon is about ten miles long, and since 1929 the world's highest suspension bridge crosses approximately 1,000 feet above the river. The Royal Gorge Bridge and the Royal Gorge Canyon are a major tourist attraction.

### CITY OWNED DITCH STOCK & OTHER WATER RIGHTS

Old Canon City Water Works - **3.5 cfs, priority date of 12/13/1864.**

A City Attorney's opinion dated 11/27/1989, stated the following:

> This water was acquired from the old Cañon City Water Works some time prior to 1910. It was not adjudicated until February 14, 1916 in cause No. 2637 in the District Court of Fremont County, Colorado. On **April 11, 1910** in cause No. 3203 in the District Court of Fremont County, Colorado, the point of diversion of this 3.5 cfs, was changed from its decreed point to a point located in the Royal Gorge approximately one-half to one mile west of the Royal Gorge Bridge. It was diverted into a wood stave pipeline from the Royal Gorge into the settling and treatment facility by gravity.

In 1975 the City changed this point of diversion from the wood stave line to the point of the City's low head dam. The low head dam is located in the Arkansas River stream bed at the western edge of the City.

The District Court Water Division No. 2 State of Colorado on 7/7/1983 Ordered that 1.0 cfs of water out of the 3.5 cfs may be diverted at a point within the Royal Gorge Canyon in order to supply the tourist-oriented structures and businesses located on the canyon rim.

Canon City Hydraulic & Irrigating Ditch Co. - **1,144.25** shares

In **1910** the City owned 750 of 3,500 total shares of stock of the Hydraulic Ditch. The City changed the point of diversion of 19 cfs of Hydraulic Ditch water (along with the 3.5 cfs mentioned above) to the wood stave line. In 1975 the City changed this point of diversion from the wood stave line to the point of the City's low head dam. The City is required to leave .8857 of 1 cfs to remain in the Hydraulic Ditch to compensate for all possible loss by other shareholders. The Hydraulic Ditch is now entitled to 77 cfs of its 96 cfs decree, since 19 cfs are diverted to the low head dam.

The City presently owns 1,144.25 shares of 3,500 total shares, or 32.6929%. The 96 cfs times 32.6929% equals 31.38518 cfs available to the City, less the .8857 of 1.0 cfs required to remain in the ditch for all shareholders except the City, equals 30.49948 cfs. This amount, 30.49948 may be utilized by the City - 19 cfs at its low head dam, and 11.4998 cfs in the ditch. For a number of years, the City has routinely purchased Hydraulic Ditch shares offered

for sale to the City.
The price offered by the City prior to 3/3/86 was $2,000.00 per share.
The price the City offered from 3/3/86 until 1/1/91 was $1,500.00 per share.
The price offered by the City from 1/1/91 until 9/1/94 was $1,000.00 per share.
The temporary price offered by the City from 9/1/94 until 12/31/94 was $1,750.00 per share. During this three month bonus period 82.5 shares were purchased. Only 12.75 shares were purchased by the City at $1,000.00 per share from 1/1/91 to 9/1/94.
The price offered by the City since 1/1/95 is $1,500.00 per share.
The price per share is presently under evaluation, and City Council is expected to consider a new price in early 1996.

Diverted from the Frank Mayol Ditch - **4.68 cfs**

In 1975 the City purchased 5.0 cfs out of the Frank Mayol Ditch located near Buena Vista in Chaffee County, Colorado. It is an 1871 decree. When the water was transferred to the present intake of the City it was reduced from 5.0 cfs to 4.68 cfs for transmission loss. The 4.68 cfs can be taken from the Arkansas River at the City's low head dam during the period from April 15th to October 15th, limited to 360 acre feet per year.

DeWeese Dye Ditch & Reservoir Co. - **142** shares

This reservoir and ditch was incorporated in about 1895. The Dam in Westcliffe was constructed in 1904, and Lake Lincoln was constructed to store water for subsequent distribution in Lincoln Park. The City's shares are in Division 1 (there are 3 divisions) and the City's usage is available on Mondays and Thursdays, only at Lakeside Cemetery. These shares go with the land, and cannot be sold nor additional shares purchased except with the land the shares are assigned to.
The division 1 water flow averages 22 cfs and there are 1200 shares (of a total of approximately 7,200 shares) assigned to division 1 water. The City owns 142 shares (142 / 1200 = 11.83%) and 11.83% of 22 cfs is 2.6 cfs (less loss) available on Mondays & Thursdays to the City. Previous evaluations of how to efficiently and effectively use this water at Lakeside Cemetery have resulted in the realization these shares cannot be totally used by the City, and since they go with the land cannot be sold. These shares are used to irrigate the nursery area next to the Cemetery, but total use has not been possible. Several substantial evaluations by the City in the past to better utilize these shares have not been successful. These shares run with the land and therefore cannot be transferred, leased or sold for separate use from the land. The use of the land is now and perpetually will be a cemetery. The shares cannot be beneficially used by the cemetery, therefore these shares have a diminished value, and the water will basically be left in the ditch. These shares, except as a trade for Hydraulic Ditch shares, other treatable raw water rights or an agreement to allow transporting this raw water from the south side of the Arkansas River to the treatment facility have a limited value as a source of water for the City's domestic water supply.

South Cañon Ditch Co. - **382** shares

Mr. Anthony Lippis, President of the South Canon Ditch Company recited the following information:

> The South Cañon Ditch Company has 6,000 shares outstanding valued at $30.00 per share (recent purchase price of shares), of which 78 shares have been surrendered back to the company.. The ditch company owns **34.51** cfs (decree dates 2/28/1866, 7.91

cfs; 10/1/1880. 0.75 cfs; and 5/31/1882, 23.2 cfs), and receives the water into the ditch by direct flow from the Arkansas River. The ditch runs from 1 mile west of the weir at the end of Riverside Drive, along the bluff in the Riverside Drive area, crosses 9th Street in the 1200 block of south 9th street and goes to the top of Pump Hill. The shares must be used north of the ditch. The City's shares of water can be used anytime there is water in the ditch, no restrictions.

The ditch company requires 20 shares per acre. The City owns 382 shares or 2.197 cfs (34.51 cfs / 6000 shares = 0.005752 cfs per share), and therefore could irrigate up to 19 acres with its shares. The City's shares have a current market value of $11,460.00, but must be sold with the property. Since the property is Centennial Park, and will not be sold the real value of the shares relate to their irrigation value to the property. Centennial Park is not being irrigated from water from the South Canon Ditch. Unless the park is irrigated by use of the ditch water, the shares have no value.

The duck pond at Centennial Park uses tail end waste ditch water before it returns to the river. The ditch company informs the City it does not allow any shareholder or user to store water from the ditch, and further states tail or waste water must return directly to the river.

Cañon Heights Ditch - shares (**none**):

March 17, 1986 - Council authorized sale of the City's 30 shares of this ditch stock. These shares were acquired with the purchase of the (now) Mountain View Park property in 1980. Council determined the water represented by these shares cannot be used beneficially by the City. Final sale of these shares was made in late 1989.

Fruitland Water Company - shares (**none**)

The then City Attorney reported to City Council per the minutes of its 2/1/88 meeting:

> The city no longer owns shares in this water company. He said the Council several years ago determined assessment costs were not worth it.

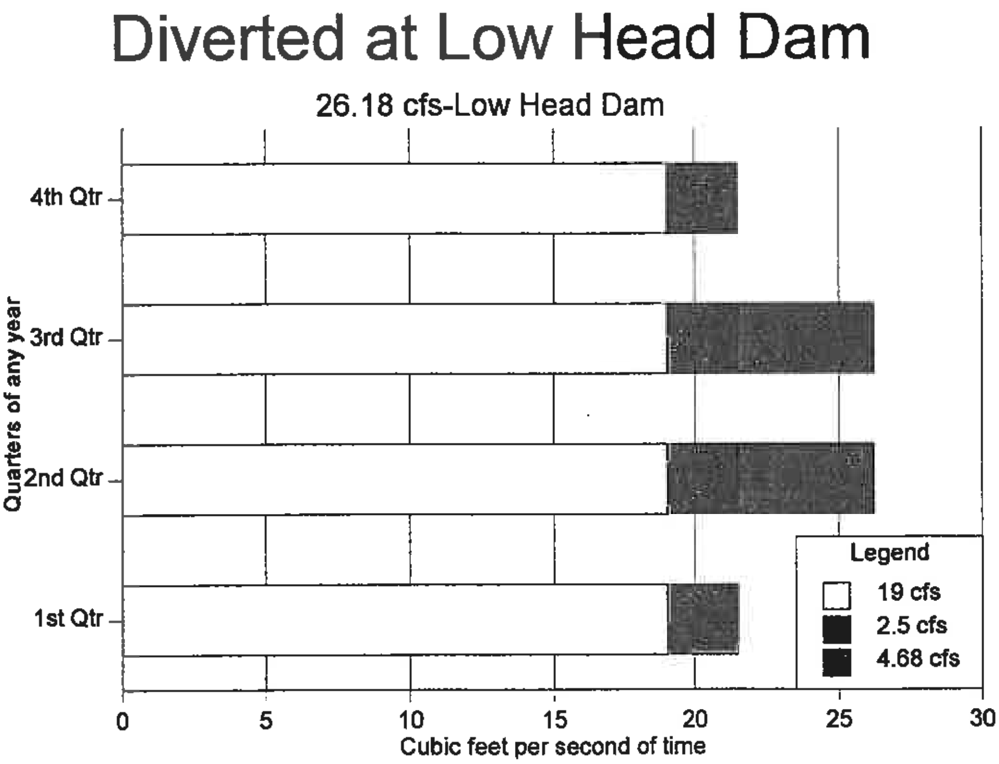
The Secretary/Treasurer of this ditch company states the City failed to pay its assessment, and therefore the stock is forfeited. The last assessment notice was dated 2/1/76, but was not paid. He identifies there are about 21,000 to 22,000 shares of stock, and as he recalls the City **did own 7,525 shares**, which was about 25% of the total shares, until forfeited for non payment of the assessment some years ago. These shares were transferred to the City during the period when new subdivisions were required to surrender shares of water for the subdivided property to the City, to be eligible for City Water service.

A Council member, appointed by Resolution of the Council serves as the City's representative to perform certain functions pertaining to the City's ownership of stock in the various ditch companies. This includes serving on the Ditch company's Board of Directors, if elected.

## A (1). HISTORY OF THE CITY'S WATER SUPPLY SOURCES - WATER RIGHTS AVAILABLE AT LOW HEAD DAM

The City of Cañon City Water System's main supply of water is diverted at the City's Low Head Dam at the western edge of the City. The City of Cañon City owns 26.18 cubic feet per second of time (cfs) of direct flow water rights which can be diverted from this point. Direct flow water is water which can be diverted from the Arkansas River for immediate treatment and use, but is not allowed to be stored. When its rights are in priority, the City can divert from the river: a) 2.5 cfs (Old Canon City Water Works rights) from the river at its low head dam into the settling pond for transmission to the treatment plant, b) 19.0 cfs (Hydraulic Ditch share rights) from the river at its low head dam into the settling pond for transmission to the treatment plant, and c) 4.68 cfs (Frank Mayol Ditch rights) at its low head dam during the period from April 15th to October 15th, limited to 360 acre feet per year.

> [the City can also divert from the river 1.0 cfs (Old Canon City Water Works rights) at the Royal Gorge canyon for the City's Royal Gorge Bridge attraction area]



19 cfs = 13,755 AF

26.8 = 18,953 AF

## A (2). HISTORY OF THE CITY'S WATER SUPPLY SOURCES - AVAILABILITY OF OTHER WATER RIGHTS

### Ditch Stock:

#### Canon City Hydraulic and Irrigation Ditch Company:

The City of Cañon City owns shares of stock in the Canon City Hydraulic and Irrigation Ditch Company. The shares represent the City's right to use certain amounts of state decreed water from the ditch. The ditch's decree and adjudication allow for irrigation and municipal use. It is the "municipal use" or domestic use the Cañon City Water System utilizes, and makes shares in this ditch so important to the City.

The Canon City Hydraulic and Irrigation Ditch Company owns 96 cfs of water with a priority right date of December 31, 1863, adjudicated by the District Court of Fremont County in the General Adjudication of Water District 12 under date of February 3, 1894. The ditch company has 3,500 shares of stock outstanding. The ditch company has direct flow rights from the Arkansas River.

**It is the "municipal use" right which makes shares in this ditch so important.**

The City of Cañon City presently owns 1,144.25 shares of the outstanding stock of the ditch company. Nineteen (19) cfs of the 96 cfs has been diverted to be taken out at the City of Cañon City's low head dam (listed in item "a" on the previous page), and is a Direct Flow source of water for the City. Of the 77 cfs remainder available to the ditch, the City is presently entitled to use 11.5 cfs for "municipal use" from the ditch. The 11.5 cfs is available to be pumped from the Hydraulic Ditch by the City's auxiliary pump station directly to the treatment plant.

#### DeWeese Dye Ditch & Reservoir Co.- 142 shares:

These shares run with the land and therefore cannot be sold for separate use from the land. The use of the land is now and perpetually will be a cemetery. The shares are not fully used by the cemetery, therefore these shares have a diminished value. The water is basically left in the ditch. These shares do not have a value as a source of water for the City's domestic supply needs.

**These shares have a limited value as a source of treatable water for the City's domestic supply.**

#### South Cañon Ditch Co. - 382 shares

The City owns 382 shares or 2.197 cfs (34.51 cfs / 6000 shares = 0.005752 cfs per share), and therefore would be permitted to irrigate up to 19 acres with its shares. The City's shares, if sold, must be sold with the property. Since the property is Centennial Park and will not be sold, the real value of the shares relate to their irrigation value to the property. Centennial Park is not being irrigated from water from the South Canon Ditch. Unless the park is irrigated by use of the ditch water, the shares have limited value.

Tail end waste water from this ditch runs through the Duck Pond at Centennial Park before it returns to the river.

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**"The City's shares would only irrigate about half of Centennial Park, and would require a holding/settling pond to pump from."**

John Nichols, Director of City Parks

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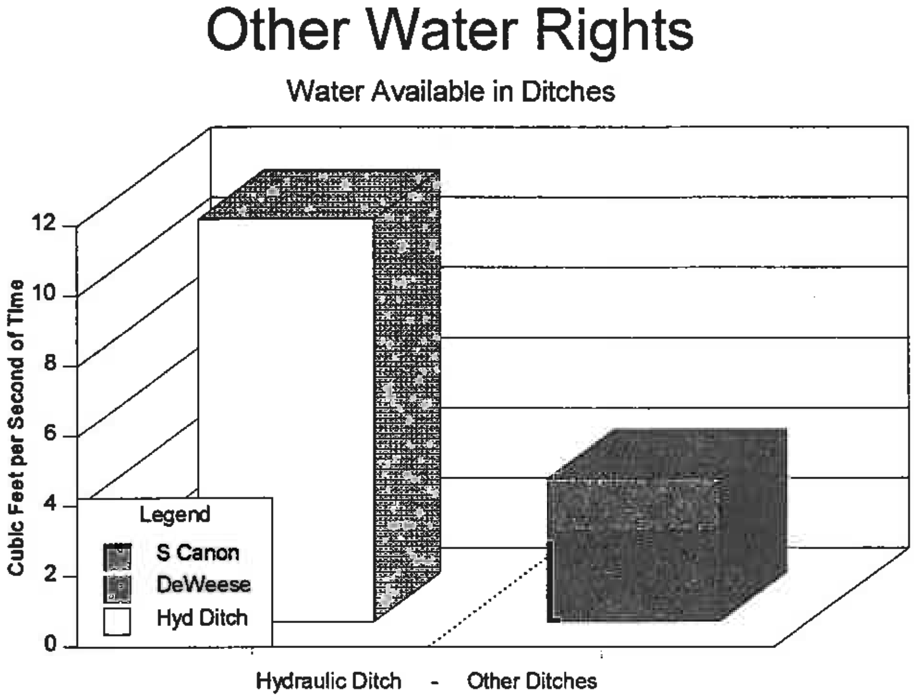
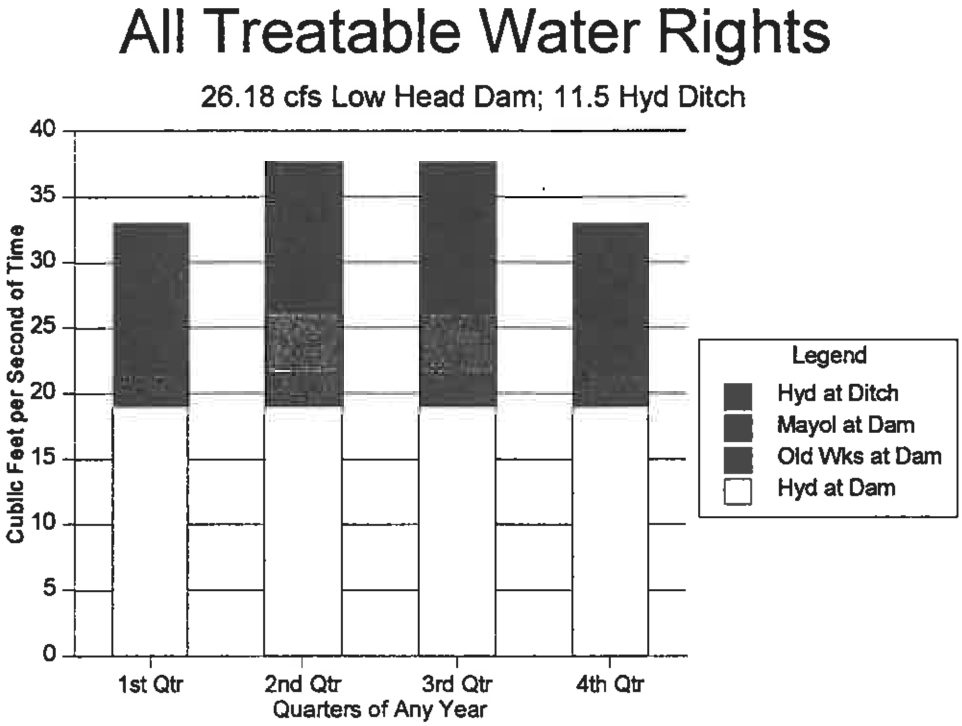


## A (3). HISTORY OF THE CITY'S WATER SUPPLY SOURCES - AVAILABILITY OF ALL TREATABLE WATER RIGHTS

The chart below shows all the City's owned raw water rights presently available to be treated at the City's treatment plant. There is 26.18 cfs available at the Low Head Dam, and 11.5 cfs available from the Hydraulic Ditch at the auxiliary pump station, for a total of 37.68 cfs.

| Source | cfs | Maximum gallons Per 24 hour Period | Maximum gallons Per Year |
|---|---|---|---|
| Hydraulic Ditch at Dam | 19.0 | 12,280,023 | 4,482,208,395 |
| Old Canon Water Works- at Dam | 2.5 | 1,615,793 | 589,764,263 |
| F. Mayol Ditch at Dam | 4.68 | 3,024,764 * | 117,306,360 |
| Hydraulic Ditch at Ditch | 11.5 | 7,432,646 | 2,712,915,608 |
| Totals | 37.68 | 24,353,226 ** | 7,902,194,626 |

* - Limited to seasonal take out from 4/15 to 10/15, and further limited to a maximum of 360 acre feet in any one season. Limited to 38.78 days per season at 3,024,764 gallons per day maximum.
** - This daily maximum, exceeds the present treatment plant capacity of 15 mgd, and will exceed the new expanded capacity of 22 mgd.



## B. TRANSMOUNTAIN WATER

Southeastern Colorado Water Conservancy District:
The City of Cañon City is part of the Fryingpan-Arkansas transmountain diversion water project. The project extends from Buena Vista to Lamar, Colorado. The project diverts water from a collection system (north and south of the Fryingpan River) on the western slope of the continental divide to the eastern slope through the Boustead Tunnel located northwest of Leadville, Colorado. The Arkansas River is that part of the project's transportation system which is available to Cañon City.

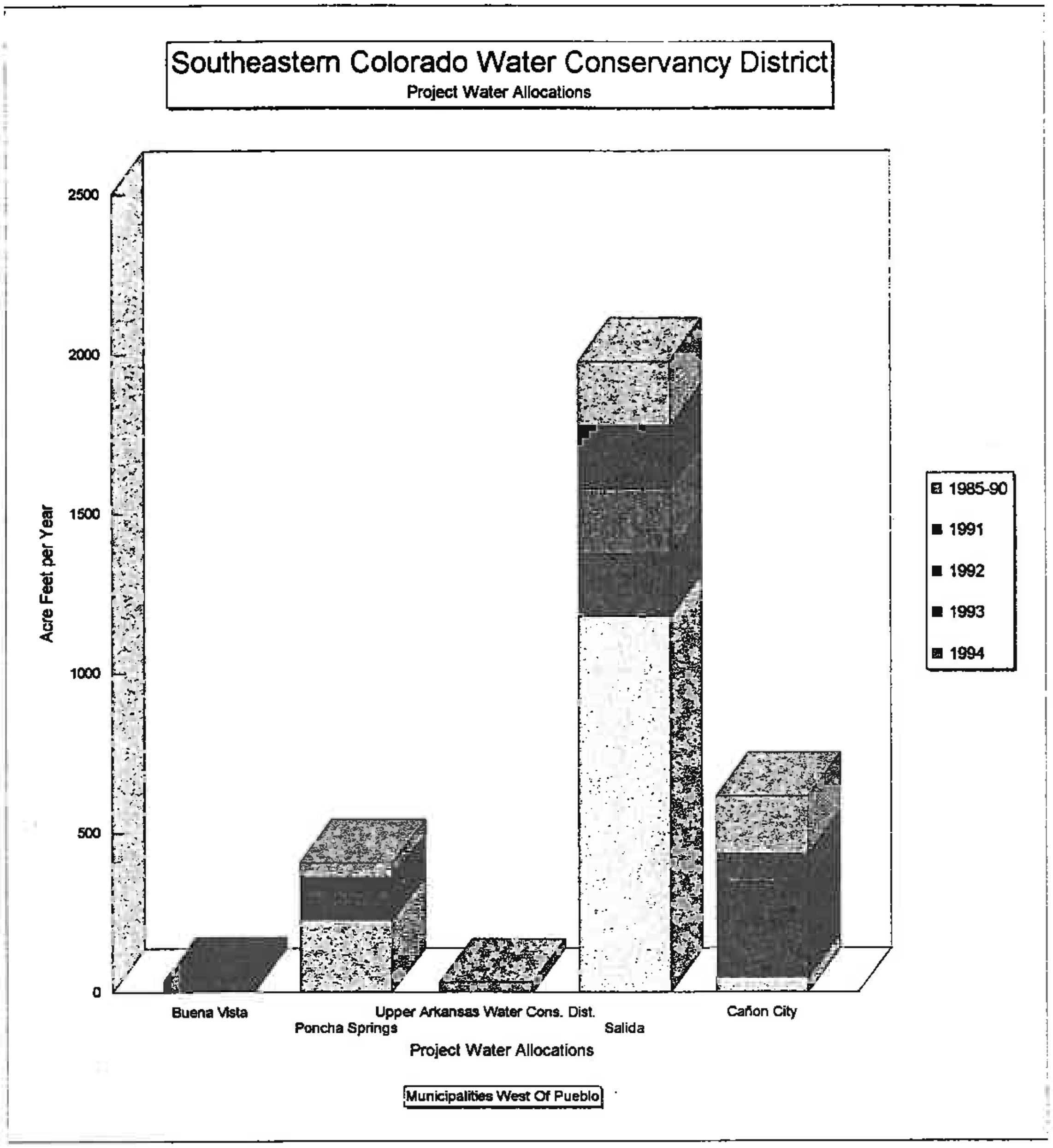
A minimum of 51% of the annual Project water is allocated to municipal and domestic use for supplemental use only. Twenty-five (25%) percent is allocated for the use of the Fountain Valley Pipeline. The remainder of the 51% is allocated for all political subdivisions within the SCWCD, including all cities, towns, water districts, private water companies, water associations and entities not served by the Fountain Valley Pipeleine:

- 25% for the Fountain Valley Pipeline: ( Colorado Springs, Fountain, Security, Stratmoor Hills and Widefield), estimated to be an average of 20,100 acre-feet.
- 10% for Pueblo, estimated to be an average of 8,040 acre-feet.
- 12% for Arkansas Valley cities, towns, and entities lying east of Pueblo, estimated to be an average of 9,643 acre-feet.
- 4% for Arkansas Valley cities, towns, and entities lying west of Pueblo, estimated to be an average of 3,200 acre-feet.

The City of Cañon City has a right to request an allocation of a portion of the 4% of Project Water (3,200 acre-feet average per year) reserved for the project municipalities and domestic water users west of Pueblo. The other current project municipalities or domestic water users west of Pueblo are Buena Vista, Poncha Springs, Upper Arkansas Water Conservancy District, and Salida. If the City receives an allocation of water in a given year, it is entitled to its use in accord with the allocation terms. Allocations are premised on the utilization of carryover storage space in Project reservoirs, in an amount not less than 12,400 acre-feet (storage space) for Arkansas Valley cities, towns and entities lying west of Pueblo. Many of the municipalities take advantage of Project water and like to have one or two years of allocation in storage for its potential future use. It is the intent of the Board that entities within the confines of the District which do not buy Project water in any single year will not be prejudiced against in the future, and will not be placed in jeopardy for subsequent allocations.

> **It is the intent of the Board that entities within the confines of the District which do not buy Project water in any single year will not be prejudiced against in the future, and will not be placed in jeopardy for subsequent allocations.**
> Southeastern Colorado Water Conservancy District - Water Allocation Policy, Amended 1993.

The City of Cañon City has not had an immediate need for these supplemental waters, and therefore had not been an assertive purchaser of these allocated Project waters for the period until 1991. Of the 614 acre-feet purchased in the time period 1985 to 1994, 7% was purchased from 1985-1990 and 93% from 1991-1994. The need to supply Cotter Corporation with water has focused the need for the SCWCD water as a supplemental source to the City's supply. The present and future availability of this source of supply is an important security to the City as a alternate supplement to the City's other water rights.



Southeastern Colorado Water Conservancy District
Project Water Allocations (acre feet)

| | 1985-90 | 1991 | 1992 | 1993 | 1994 |
|---|---|---|---|---|---|
| Buena Vista | | | | 35 | |
| Poncha Springs | 225 | 45 | 45 | 45 | 45 |
| Upper Arkansas Water Cons. Dist. | 0 | 0 | 0 | 0 | 30 |
| Salida | 1,176 | 200 | 200 | 200 | 200 |
| Cañon City | 44 | 300 | 90 | 0 | 180 |
| Total for Municpalities West of Pueblo | 1,445 | 545 | 335 | 280 | 455 |
| All Others | 293,331 | 55,459 | 32,566 | 67,910 | 51,242 |
| Totals | 294,776 | 56,004 | 32,901 | 68,190 | 51,697 |

## C. SAFETY PROCEDURES FOR SOURCE OF SUPPLY

The City has a single source of raw water available to its treatment plant, the Arkansas River. The City has DIRECT FLOW rights which refer to water that can be diverted from the Arkansas River for immediate treatment and use. The City does not have, nor could it have a reservoir to store raw water from these rights. The City depends on an adequate daily, non-polluted flow of water in the Arkansas River from which to take its water to be treated and distributed throughout the Cañon City Water System.

The City's settling (presedimentation Basin A) basin is the first step in the treatment process. Raw water is removed from the river at the City's Low Head Dam, and pumped into the settling pond. This settling pond has an as built capacity of 45,000,000 (44.8 mg) gallons. This is its capacity when the basin is twenty (20') feet deep. If the settling basin is cleaned to its twenty (20') foot depth and filled with water to its full capacity, it provides capacity to hold enough raw water from the river for about 14 average days in January (45 mg / 3.2 mgd = 14.06) or 5.4 average days in August (45 mg / 8.3 mgd = 5.42).

**Pollution in the River:**
If the Arkansas River becomes polluted upstream the City cannot take out of the river once the pollution reaches the City's intakes, until the pollution has cleared. Once the City has been alerted to an upstream pollution, the Treatment Plant Personnel guardedly continue to take out until pollution reaches the City's take out points. At that point the City is limited to the amount of raw water in the settling pond, until the pollution has cleared.

What amount of time is there to "fill the system" if the river becomes polluted? This varies and is determined by the distance upstream from the City's intakes that the pollution occurs, the then rate of flow of the river (transit rate - Appendix B) and the duration of the pollutant. Pollutants can be gasoline or diesel spills from a truck or train, over-turned coal cars, clay like particles from the Chalk Creek area runoff (particles are light and do not settle easily), mine leeching acid spills or any concentration of contaminants entering the river and flowing downstream. It may take only 24 hours for the pollutant to flow past and clear the City's in-takes or it may take up to a week.

The operation policies of the treatment plant personnel in regards to a pollution alert upstream of the City's take outs are as follows:

- During the summer particularly, the treatment plant personnel keep the Settling Basin A full, throughout a 24 hour period. This is the best assurance against an interruption of treatable water.
- A maintenance policy assuring at least two of the three low head dam pumps are in working order allows two pumps to remove 15,000 gpm. This rate would exceed the City's rights ((21.5 cfs + 4.68 cfs) x 448.8 gpm = 11,749.58 gpm). However, when notified of a spill in the river or other pollution by the Water Commissioner the treatment plant personnel ask permission of the Water Commissioner to take out at a rate in excess of our 21.5 cfs plus the summer 4.68 cfs rate until the pollution reaches the City's takeout or the Settling Basin A is filled, and the clear well is filled.

- The City's auxiliary pump station near the head gate of the Hydraulic Ditch has three 3,000 gpm pumps. Two of the three pumps in service will pump 5,600 gpm. The City has shares which provide 11.5 cfs in the Hydraulic Ditch (5,161.2 gpm), and therefore can pump water out of the ditch from its auxiliary pump station rather than from the settling basin to the treatment plant. The City concurrently continues to fill the settling pond from the Low Head Dam diversion point until the pollution reaches the headgate, thereby maximizing the filling of the Settling Basin during this emergency.
  These auxiliary pumps require priming to be placed on line. The limitation of time from being alerted of river pollution to the polluted water's arrival at the Hydraulic Ditch headgate and the low head dam will determine if there is time to place this station in service. If this auxiliary pump station is used, due to no settling time this raw water requires more treatment. Also, this action is negated if the ditch company shuts their headgate before the City has benefitted from this auxiliary pumping.
- Another interruption can be icing ( frazzle or slush ice) at the low head dam in-take or at the auxiliary pump in-take. This has happened infrequently at the low head dam (when there are several below zero days in a row which is very seldom), but is a winter problem at the auxiliary station.

Although pollution in the Arkansas River upstream from the City's take out points is infrequent, the safety of the City's Water System and thereby the health of the users is always paramount and the City is therefore ever alert and prepared.

## A. HISTORY OF THE CITY'S TREATMENT PLANT AND CAPABILITIES

The Cañon City Water Treatment Plant (CCWTP) was constructed in 1908. The original treatment facilities at the CCWTP site included two (2) primary settling basins, six (6) secondary sedimentation basins, two (2) slow sand filters and two (2) storage reservoirs with a total capacity of three million gallons(3 mgd). A very interesting aspect of the facility was the raw water feed to the water plant. It consisted of a wood stave pipeline that originated approximately eight (8) miles up the Arkansas River in the Royal Gorge Canyon. Intake chambers in the canyon took water in and fed two (2) raw water capture basins. These basins in turn supplied the 30" wood stave pipeline. This pipeline, because of elevation differences, gravity fed the raw water through the eight (8) mile wood pipeline to the water treatment plant. The Treatment Plant then and now, is located on top of a hill just west of the City. Raw water was treated and distributed to the City's users. The distribution system was a gravity feed, because of the elevation of the water plant.

As Cañon City grew, the need for more water also grew. Water filtration technology also changed and with that the original East Filtration Building was constructed in 1957. A filtration building with rapid sand filters was much different from the slow sand filtration that had been used to this point.

The Safe Drinking Water Act of 1974 and the need for more water created the demand to again upgrade the water treatment plant. The City also made a change in the raw water supply system. The wood stave pipeline in the Royal Gorge was costly to maintain and dangerous for those who had to maintain the pipeline. The decision was made to transfer the diversion point downstream out of the gorge to just west of Cañon City. The raw water pipeline in the gorge was abandoned. Water is now pumped out of the river and into a 45 million gallon settling pond. A second station pumps the water up the hill to the CCWTP. A second filtration building was constructed next to the East Filtration Building. It is known as the West Filtration Building. With that upgrade, the CCWTP is capable of treating up to a maximum day capacity of 15 million gallons per day (15 mgd).

Effective November 7, 1995 the City Electorate authorized a $4.6 million revenue bond issue to finance the construction of a new pretreatment facility which will replace the sedimentation basins and chemical building. This coupled with the improvements to be completed in 1996, will increase the Treatment Plant capacity from 15 million gallons per day to 22 mgd. Design and construction will increase the treatment plant capacity to 22 mgd, and is expected to take until early to mid 1998 to complete construction. This 1998 upgrade and expansion will provide the capacity to **meet** the needs of growth and economic opportunity.

## B. TREATMENT PATH AND PROCESSES

The City of Cañon City Water Works has a diversion dam at the western edge of the city in the Arkansas River streambed to divert water into the Low Head Pump Station. This pump station uses 100 horsepower, 7500 gallon per minute vertical turbine pumps to put water into a 45 million gallon storage pond known as "A Pond". This pond serves as a settling pond for sand and other sediment found in the fresh surface raw water of the swift Arkansas River. It is the first step of the treatment process. A second pump station known as the High Head Pump Station pumps the settled water from "A Pond" to the top of the CCWTP hill through a 30" pipeline. These pumps are 250 horsepower, 3500 gallon per minute centrifugal pumps.

This supply has a backup pump station which is upstream of the diversion dam on the Arkansas River. The Auxiliary Pump Station takes water directly from the Hydraulic Ditch (whose source is also the Arkansas River) and pumps directly to the water plant. However, this water has a degraded quality because it lacks the benefit of settling time that "A Pond" provides. Therefore, this water requires more treatment.

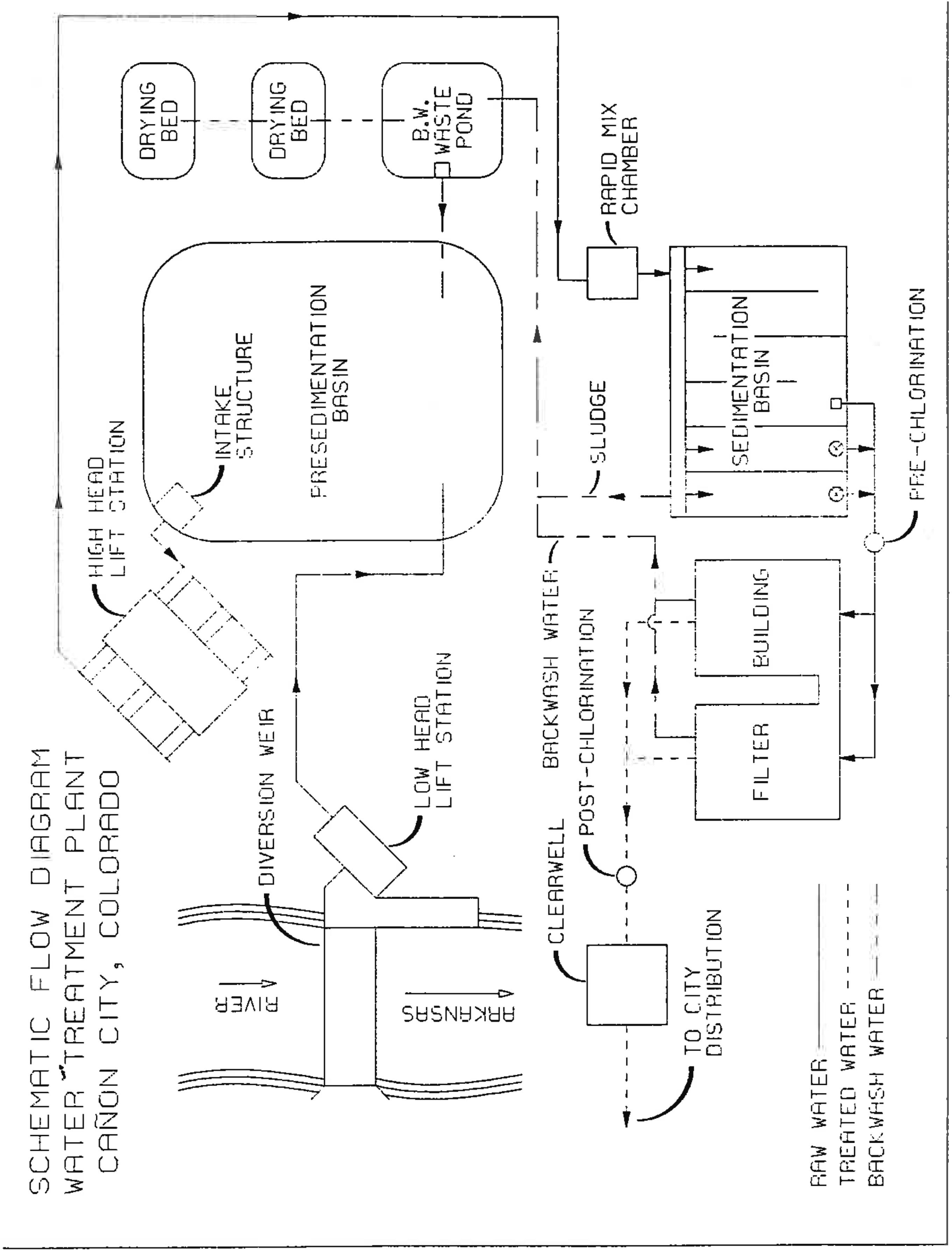
Once the raw water is on top of the water plant hill it enters the plant headworks through a Parshall Flume and into a rapid mix chamber. Here, the primary chemical coagulant is added. The coagulant used is aluminum sulfate. Chemical coagulation is an important treatment process for surface waters. After the coagulant has been added, a gentle stirring process causes the particles in the water to draw together and settle out as the water is slowly routed through the flocculation basins. The settled raw water is then transferred to a 48" pipeline where it gets chlorine is added. This "pre-chlorinated" water is then sent to the Filtration Buildings.

The Filtration Buildings utilize multi-media filters. These filters use anthracite coal, filter sand and a garnet sand as its media. Filters of this design have a maximum flow capacity of 5 gpm/sq ft or 1400 gpm. There are a total of 12 multi-media filters in the East and West Filtration Buildings. After the water has been filtered it gets another dose of chlorine for "post-chlorination". This will ensure a lasting chlorine residual to keep the water safe in the distribution system. The water is then stored in the reservoirs known as the Clearwells which hold 3 million gallons. The treated water gravity flows through any one of four large transmission lines into the distribution system from the clear wells.

In addition to aluminum sulfate and chlorine, other chemicals used in the treatment process include:

Powder Activated Carbon- Taste & Odor Control
Copper Sulfate- Algae control on "A Pond"
Polymer- Filter Aid

A schematic flow diagram of the Water Treatment Plant and information about the 1994 production year are shown in next two pages.



SCHEMATIC FLOW DIAGRAM
WATER TREATMENT PLANT
CAÑON CITY, COLORADO

## D. WATER TREATMENT AND DISTRIBUTED IN 1994

1995

| | | |
|---|---|---|
| 74,362 | 1,819,960,000 | gross gallons treated in 1994 |
| 01,196 | 1,751,127,000 | gallons treated and delivered to distribution system in 1994 |
| | 1,462,244,000 | gallons billed in 1994 |
| | 357,716,000 | gallons lost in production or delivery in 1994 |
| | 80.34% | percent billed of gross gallons treated in 1994 |
| | 83.50% | percent billed of gallons treated and delivered to distribution system in 1994 |
| | 4,797,608 | average gallons treated and delivered to distribution system per day in 1994 |
| | 792,128 | avg. gals unbilled per day - unmetered uses or leaks in distribution system |
| | 4,005,479 | avg. gallons billed per day in 1994 |

| | |
|---|---|
| 12,606,000 | Peak gallons treated - 7/26/95 |
| 10,360,000 | Peak gallons treated - 8/18/94 |
| 11,100,000 | Peak gallons treated - 6/17/93 |

**Treatment Plant capacity must accommodate peak days/periods, and also provide unused capacity for growth. Treatment Plant capacity in 1994 & 1995 is 15,000,000 gallons per day. A proposal to finance an increase in the Treatment Plant capacity to 22,000,000 gallons per day was approved by the Electorate 11/95.**

| | |
|---|---|
| 7,200 | active meters in 1994. There were 6,000 active meters in 1988, and had been at that number for several years prior to 1988. In November, 1995 there are 7,422 active meters, a substantial growth of 1,422 new users/services in seven years. 70% of users (meters) are inside City limits. |
| 252,772 | average gross gallons treated per meter in 1994 |
| 692 | avg. gross gallons treated per meter per day in 1994 |
| 203,055 | avg. gallons delivered into distribution system for use per meter in 1994 |
| 556 | avg. gallons used per meter per day in 1994. |
| 21.5 | cubic feet of water per second of time is available (to be treated) at low head dam -19 cfs provided by some of the Hydraulic Ditch shares owned by the City and 2.5 cfs of water rights of the Old Cañon Water Works shares owned by the City. |
| 11.5 | cubic feet per second of time is available directly from the Hydraulic Ditch. |
| 4.68 | There is also 4.68 cfs of the Mayol Ditch diverted to the low head dam available from April 15th to October 15th limited to 360 acre feet of water in each year (360 acre feet is 99.45% of 1 cfs for six months). |
| 51.76% | % of total rights available to be treated in summer, treated/consumed on peak day in 1995 (12,606,000/ 24,353,226 = 51.76%). |
| 84.04% | % of treatment capacity treated/consumed on peak day in 1995 (12,606,000/15,000,000 = 84.04%). |
| 35.07% | % of water diverted to and available at the low head dam, was treated and used in 1994. |

Reference - In one cubic foot of water per second of time there are:

| | |
|---|---|
| 448.8 | gallons per minute. |
| 646,317 | gallons per day. |
| 235,905,705 | gallons per year. |

## E. QUALITY CONTROL

Ensuring proper water system operation and protection of public health is the primary concern and serious responsibility of the City and its water system employees. The State of Colorado and the Federal Government have stringent regulations and requirements to further ensure a safe drinking water program. This includes mandatory certification of water plant operators, cross-connection control programs, and monitoring for additional water contaminants.

The Cañon City Water Treatment Plant (CCWTP) employs six City employees who are all certified A operators. It is their responsibility to produce water of the highest quality possible at the lowest cost while continuing to meet or exceed the requirements of the Safe Drinking Water Act of 1974, and its amendments.

On-site daily tests are taken to ensure the quality of the water, and periodically these test results are reported to the state agency. Tests include pH, turbidity, alkalinity, hardness and chlorine residual. The CCWTP collects 40 samples a month for bacteriological testing. Other samples collected throughout the year are tested for organic, inorganic and radiological contaminants.

This close and exact monitoring of the waters produced by CCWTP, and the dedication of the City and its employees to the health and well being of the water users assures the limits of the Safe Drinking Water Act of 1974 or any of its amendments have not, and will not be exceeded.

# WATER TRANSMISSION AND DISTRIBUTION

## A. THE DISTRIBUTION SYSTEM

The Engineering Co. of Ft. Collins was engaged to evaluate the City's water system and the projected need for improvements to meet the expected growth of the Cañon City area. The <u>Water System Improvement Plan</u> report was submitted to the City December 14, 1992. In that report they identified the following:

> The existing distribution system covers approximately ~~14~~ 15 square miles [includes 121.3 miles of distribution pipes] and serves 6,850 customers [increased to 7,422 by 11/95]. The service area extends from an elevation of 5500 to 5250. Static pressures in the system range from 45 psi to 138 psi. During peak demands the dynamic pressures range from 40 psi to 114 psi. The system includes three pump stations [now 5 pump stations], and three storage tanks [the 1.5 mg tank was removed in 1993 and placed in service by the Department of Corrections at its East Complex]. Water is delivered from the treatment plant clearwell to the system through three 20 inch, a 16 inch and a 12 inch transmission lines. A schematic of the distribution system components is shown on the following page.
>
> The system is essentially divided into the north and south half with the dividing line being the Arkansas River. Most of the customers are located in the north half with the south half (Lincoln Park) being a sparsely populated area. Consequently, the distribution system in the north half is better developed with more loops and larger lines. The system in the Lincoln Park area is characterized by smaller, more widely spaced lines. Some of those lines are very small (2") and were installed as a part of a rural water system. Such lines cannot be considered of much benefit for a municipal system and should be replaced as a part of the continuing capital improvement program.
>
> The goal [of the design] of a water distribution system is to provide the peak-hour demands while maintaining a minimum acceptable pressure. In addition, the system should be capable of supplying the average demands on the maximum-day plus the needed fire flows.

Most of Canon City's distribution system is gravity fed. The Water Treatment Plant (WTP) storage is at a high water level of 5573 feet and low water level of 5561 feet elevation. Approximately 70% of the total demand is at or below an elevation of 5470, which provides a static water pressure of 40 pounds per square inch (psi). Since approximately 30% of the water users need service above the 5470 elevation, the City has the following three pump zones:

Zone 0: This zone is the Lincoln Park area. Water flows by gravity into a 4 MG concrete tank and then is pumped out through the Lincoln Park Pump Station, a variable-speed pump system which boosts the water pressure in this zone, which is an isolated portion of the water system. This area is located south and east of the City and represents about 18% of total demand.

Zone I: One Zone I area serves the northwest part of the City and represents about 2.5% of total demand. This area includes Tamarisk Estates Subdivision, Skyline Village I Subdivision and North 9th Street to Washington Street, including the Orchard Park Water District.

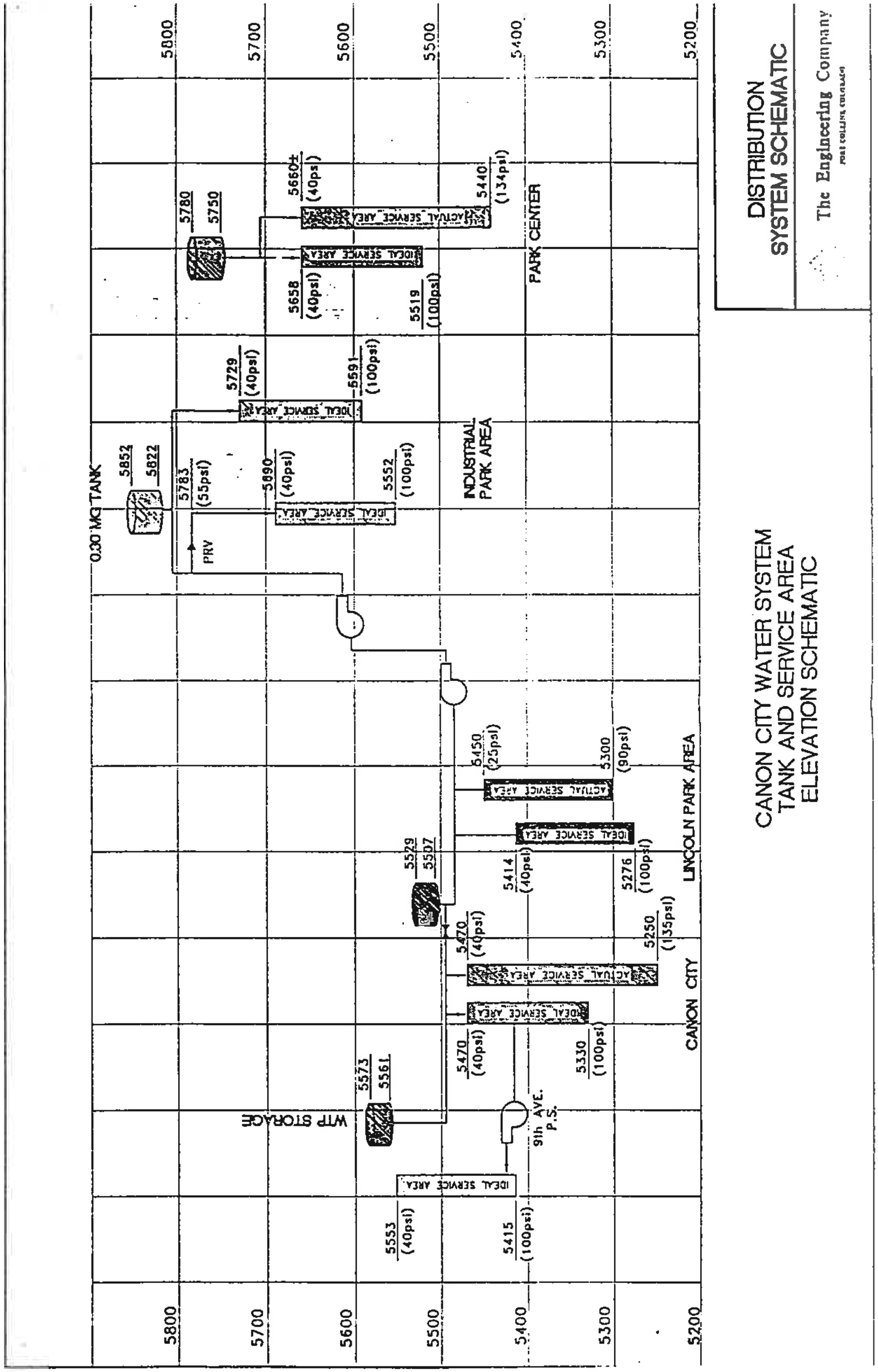
The North Ninth Street Pump Station, located at 9th and Meadows, is a variable-speed pump system which boosts the water pressure in this zone.

The other Zone I area is the Industrial Park area located in the southwest area of the City and represents about 8% of total demand. Pump Station No. 1, located at South Ninth and Poplar, also receives water from the 4 MG tank and pumps to Pump Station No. 2, which then pumps into the 0.3 MG steel tank located near the south end of Forge Road where it becomes Evelyn Drive. The water then is back-fed into this zone by gravity-flow from the tank. These two pump stations have constant-speed pumps designed to fill the tank, and are not true pressure boosting pumps.

Zone II: Zone II is the area lying south of the 0.3 MG tank and represents about 2% of total demand. Flow from the tank is pumped through the Eagle Heights Pump Station, which is a variable-speed pump system which boosts the water pressure in this zone. Currently, this zone is comprised of Eagle Heights and Greenhorn Estates Subdivisions.

With the two storage tanks mentioned and the Clearwell storage reservoirs at the CCWTP, the City of Cañon City has a treated water storage capacity of 7,300,000 gallons, and an emergency use supply of treated water storage capacity in a storage tank owned by the Colorado Department of Corrections.

The Colorado Department of Corrections has agreed to provide an emergency use storage capacity in its 1.5 mg storage tank at its East Cañon City Prison Complex. The CDOC shall make available to the City 600,000 gallons of emergency use storage capacity in the Tank for two full years beginning when the tank is first placed in service (4/7/94) at the ECCPC. CDOC shall thereafter (beginning 4/7/96) make available 400,000 gallons of emergency use storage capacity. The emergency use storage capacity available to the City (after 4/7/97) is subject to a reduction of the 400,000 gallons emergency storage capacity. If the average daily population increases above 3,184 inmates, the emergency storage capacity may be reduced from 400,000 gallons at the rate of 50,000 gallons per 500 inmates. If a physical space increase in housing occurs, then the storage capacity may be reduced from 400,000 gallons at the rate of 133,000 gallons per 500 inmates.


CANON CITY WATER SYSTEM
TANK AND SERVICE AREA
ELEVATION SCHEMATIC
DISTRIBUTION
SYSTEM SCHEMATIC
The Engineering Company
5800
5700
5600
5500
5400
5300
5200
0.30 MG TANK
5852
5822
5783
(55psi)
PRV
5690
(40psi)
5552
(100psi)
IDEAL SERVICE AREA
5729
(40psi)
5591
(100psi)
INDUSTRIAL PARK AREA
5780
5750
5658
(40psi)
5519
(100psi)
5660±
(40psi)
5440
(134psi)
ACTUAL SERVICE AREA
PARK CENTER
5529
5507
5450
(25psi)
5300
(90psi)
5414
(40psi)
5276
(100psi)
LINCOLN PARK AREA
5470
(40psi)
5250
(135psi)
CANON CITY
5573
5561
WTP STORAGE
5470
(40psi)
5330
(100psi)
9th AVE.
P.S.
5553
(40psi)
5415
(100psi)

DATE: DEC. 1995
CANON CITY WATER DISTRIBUTION SYSTEM PHYSICAL SURVEY
CANON CITY ENGINEERING DEPARTMENT

**INFORMATION IS COMPILED FROM EPANET MODEL, IMPROVEMENT PLANS, & HISTORIC RECORD

PIPE MATERIALS:
CONCRETE (CON)
POLYVINYL CHLORIDE (PVC)
ASBESTOS CEMENT (AC)
CAST IRON (CI)
DUCTILE IRON (DI)
STEEL (ST)

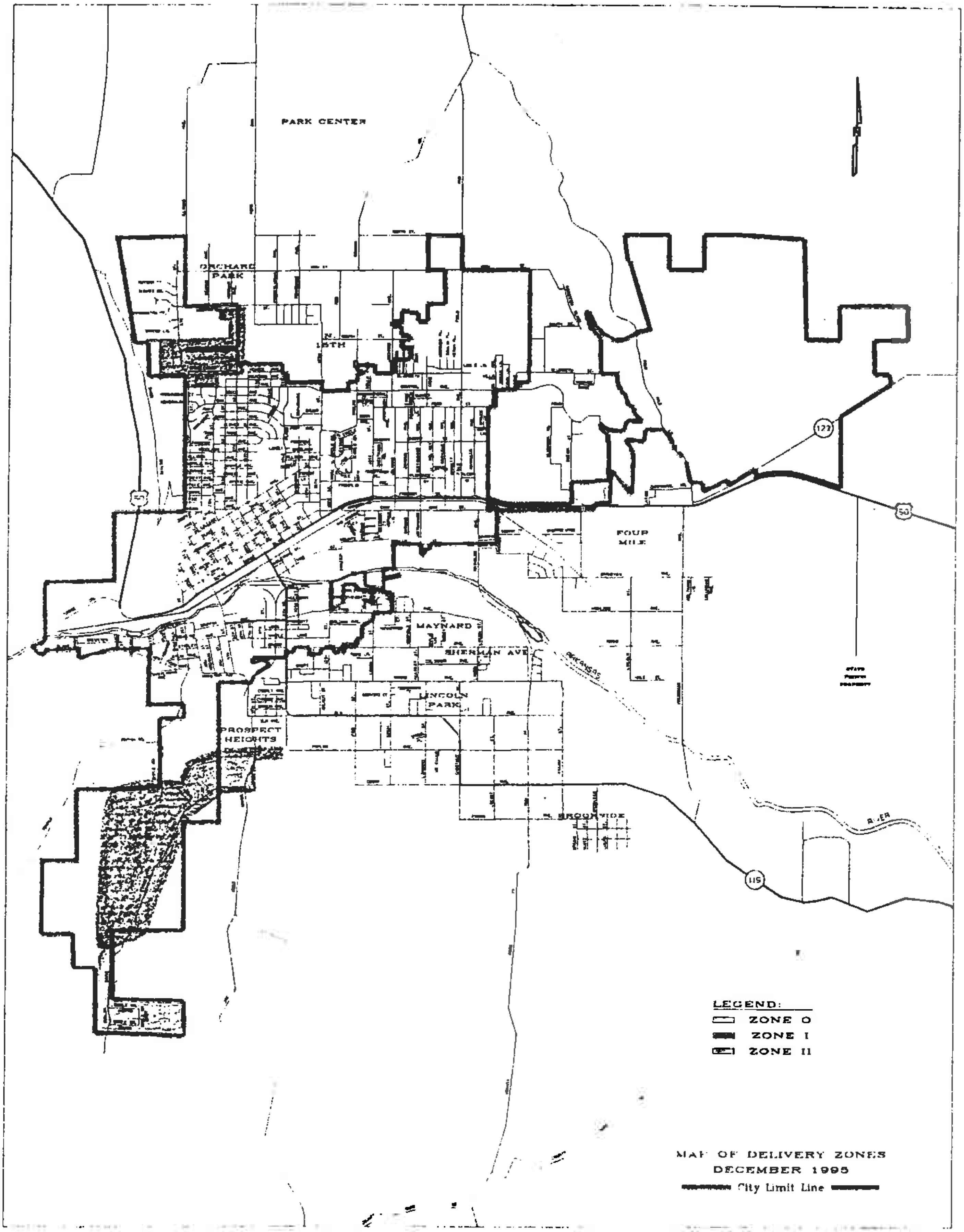
PIPE SIZES GROUPED BY MATERIAL TYPE:

| MATERIAL TYPE | PIPE DIA. | LENGTH | |
|---|---|---|---|
| <4" | 3/4" | 1,941 | |
| | 1" | 3,725 | |
| | 1-1/4" | 620 | |
| | 1-1/2" | 5,170 | |
| | 2" | 16,970 | |
| | 2-1/2" | 240 | |
| | 3" | 3,545 | |
| | TOTAL | 32,211 | LF |
| | | 6.10 | MILES |
| AC | 4" | 125,125 | |
| | 6" | 69,755 | |
| | 8" | 26,581 | |
| | 12" | 6,895 | |
| | 14" | 7,965 | |
| | TOTAL | 236,321 | LF |
| | | 44.76 | MILES |
| CI | 4" | 71,736 | |
| | 6" | 50,669 | |
| | 8" | 33,910 | |
| | 10" | 9,110 | |
| | 12" | 22,018 | |
| | 14" | 9,280 | |
| | 16" | 17,010 | |
| | 20" | 3,420 | |
| | TOTAL | 217,153 | LF |
| | | 41.13 | MILES |
| DI | 16" | 6,970 | |
| | 18" | 2,950 | |
| | 20" | 14,242 | |
| | | 24,162 | LF |
| | | 4.58 | MILES |
| PVC | 4" | 4,560 | |
| | 6" | 64,069 | |
| | 8" | 24,415 | |
| | 10" | 4,700 | |
| | 12" | 23,870 | |
| | 16" | 1,450 | |
| | | 123,064 | LF |
| | | 23.31 | MILES |
| ST | 4" | 1,020 | |
| | 6" | 5,055 | |
| | | 6,075 | LF |
| | | 1.15 | MILES |
| CON | 30" | 1,470 | LF |
| | | 0.28 | MILES |

MATERIAL TYPE GROUPED BY PIPE SIZES:

| PIPE DIA. | MATERIAL TYPE | LENGTH | |
|---|---|---|---|
| 4-INCH | AC | 125125 | |
| | CI | 71736 | |
| | PVC | 4560 | |
| | ST | 1020 | |
| | | 202,441 | LF |
| | | 38.34 | MILES |
| 6-INCH | AC | 69,755 | |
| | CI | 50,669 | |
| | PVC | 64,069 | |
| | ST | 5,055 | |
| | | 189,548 | LF |
| | | 35.90 | MILES |
| 8-INCH | AC | 26,581 | |
| | CI | 33,910 | |
| | PVC | 24,415 | |
| | | 84,906 | LF |
| | | 16.08 | MILES |
| 10-INCH | CI | 9,110 | |
| | PVC | 4,700 | |
| | | 13,810 | LF |
| | | 2.62 | MILES |
| 12-INCH | AC | 6,895 | |
| | CI | 22,018 | |
| | PVC | 23,870 | |
| | | 52,783 | LF |
| | | 10.00 | MILES |
| 14-INCH | AC | 7,965 | |
| | CI | 9,280 | |
| | | 17,245 | LF |
| | | 3.27 | MILES |
| 16-INCH | CI | 17,010 | |
| | DI | 6,970 | |
| | PVC | 1,450 | |
| | | 25,430 | LF |
| | | 4.82 | MILES |
| 18" TO 20" | DI & CI | 20,612 | LF |
| | | 3.90 | MILES |
| 30-INCH | CON | 1,470 | LF |
| | | 0.28 | MILES |

TOTAL ALL TYPES AND SIZES = 640,456 LF
121.3 MILES


PARK CENTER
ORCHARD PARK
N. 18TH
FOUR MILE
MAYNARD
SHERMAN AVE
LINCOLN PARK
PROSPECT HEIGHTS
BROOKSIDE
ARKANSAS
RIVER
50
122
115
LEGEND:
▭ ZONE O
▬ ZONE I
▭ ZONE II
MAP OF DELIVERY ZONES
DECEMBER 1995
City Limit Line

# WATER BILLING

## A. WATER FUNDS OF THE CITY:

### WATER FUND:

The Water Fund shall consist of all revenues of the water department. Such revenues shall not be used or appropriated for any purpose other than payment of the operating expenses of the water department, for improvements, repairs, replacements and enlargements to the water plant or facilities, and the payment of the principal of, and interest on, the obligations of the City payable out of the revenues of the water department.

**Water Fund - An enterprise fund; revenues used only for water system expenditures.**
Steve Thacker - City Administrator's 1996 Budget Message.

This fund is authorized at Article VII, Section 5 - Funds of the City, Subsection A - Water Fund, of the Charter of the City of Canon City, Colorado. Consistent with the City Council's authority under the Charter, City Council, through Ordinance No. 36, Series of 1993, formally declared the Water Department to be a Water Activity Enterprise, pursuant to Article 45.1 of Title 37, C.R.S., and designated itself as the governing body of the Water Department.

An enterprise fund differs from a usual government fund. Usual government funds focus on the flow of expenditures. An enterprise fund focuses on cost (expenses) and cost recovery. An enterprise fund's operations are financed and operated similar to private business enterprises, with the notable exception that the Water Fund does not operate to generate profits for owners or investors. As a Water Activitiy Enterprise the activities of the Water Department are financed or recovered through user charges. Costs (expenses, **including depreciation**) of providing the goods and services of the Cañon City Water System on a continuing basisare financed and recovered through user charges.

### RAW WATER ACQUISITION AND PRESERVATION FUND:

This fund is authorized at Chapter 3.28 of the Municipal Code. This fund, as a companion fund to the Water Fund, is also operated as an enterprise fund, and the preceding description of an enterprise fund shall also describe the accounting for this fund.

Appropriations and expenditures of this fund shall be made in the acquisition, preservation and protection of raw water sources for the city's water system. Since its initial establishment all revenues derived from the investment of funds have been deposited to this fund.

From the effective date of establishment of this Fund until 2/1/93, revenues of thirty (30%) percent of the amount collected annually for raw water and plant investment charges (fees charged when service is initialized or size of Tap increased) have been deposited to this fund.

Subsection B of Section 3.28.030 of the Cañon City Municipal Code was amended to read, effective 2/1/93:

> B. Three Hundred Dollars ($300.00) from the amount paid by any water user or consumer referenced at subsection A [inside City] of Section 13.08.030 of this Code as a base raw water and plant investment fee and Three Hundred Seventy Five Dollars ($375.00) from the amount paid by any water user or consumer referenced at subsection B [extraterritorial] of Section 13.08.030 of this Code as a base raw water and plant investment fee.

When City Council found that the amount payable into this fund, with respect to tap fee charges for water connections larger than 3/4 inches was insufficient since 2/1/93, they amended the appropriate section of the City code.

Subsection B of Section 3.28.030 of the Cañon City Municipal Code was amended to read, effective 11/11/95:

> B. Fourteen percent of the amount collected for raw water and plant investment charges, pursuant to Section 13.08.030 of this code.

As an example $308.00 of the base Raw Water and Plant Investment Fee, which is $2,200.00 for a 3/4 inch connection for inside the City, and $385.00 of the base Raw Water and Plant Investment fee, which is $2,750.00 for a 3/4 inch connection outside the City goes into the Raw Water Acquisition and Preservation Fund. [refer to the "Raw Water and Plant Investment (Tap) Fees:" schedule later in this Water Billing section]

Since 1/1/93 the amount of the base Raw Water and Plant Investment Fee not transferred to the Raw Water Acquisition and Preservation Fund is isolated from operating revenues in the Water Fund. The use of that amount is restricted for expenditures attributable to growth for Capital Improvements. The City more than doubled the previous schedule of charges for the base Raw Water and Plant Investment Fee beginning 2/1/94.

The City of Cañon City Finance Department maintains separate fund accounting for the Water Fund, and it is accounted for as an enterprise fund. The general accounting division of the Finance Department accounts for all transactions, has the fiscal responsibility, and prepares financial statements of the Water Fund.

## B. How Consumption and Use Is Measured and Billed

### How Consumption is Measured:

To provide water service to a property, the water main is tapped through a tapping saddle with a corporation stop, and a line then extends to either a curb stop or meter stop valve. A curb stop is used if the meter is installed inside the building being served and a meter stop is used if a pit meter is installed. Either the curb stop or the meter stop provide a valve for emergency shut-offs. The cost of the entire installation from the water main to the meter and beyond is the responsibility of the property owner. The City, after inspection and acceptance, assumes responsibility for the service line from the main through the meter, but not beyond.

Once service has been started, the consumption of water by the user is measured through and by a water meter. The City of Cañon City Water System is a metered system, and uses velocity meters. Velocity meters commonly measure water flow by means of propellers, turbines, positive displacement and electronic sensing. The flow rate is then automatically translated into gallons by the meter register.

### How Consumption is Billed:

Two full time members of the Public Works Department staff have the responsibility to read the 7,422 meters. Their duties are coordinated by the staff of the Water Billing office in the finance department. A fully integrated meter reading and computerized accounts receivable accounting system is utilized. The Water Billing staff loads information directly from the computer into a Hand-held battery powered electronic device that is used for capturing and recording meter readings. The hand-held device is loaded with lists of properties, and describes a portion of the City's Water System the same as the former "route books" did. The meter reader picks up the hand-held device, and proceeds to read the meters and insert those reads into the hand-held device. When the reads are complete, the Water Billing staff connects the hand-held device to the accounts receivable computer system, and the reads and information about observed potential repairs or problems are automatically unloaded to the computer. The accounts receivable records are updated with the new information and meter reads, consumption is then calculated and billings prepared and mailed.

The Water Billing staff directs the reading of meters in three sections or cycles for residential service. One section is read each month. Customers receive quarterly billings which bill in advance for the minimum charge for the next three months service. Gallons consumed in excess of the gallons allowed by the minimum charge during the prior three months, are billed in arrears on that same statement. Commercial users meters are read each month, and are billed in arrears each month. The Water Billing staff is responsible for public contacts, accounts receivable accounting, coordination of meter services and readings, timely and efficient collections and cashiering.

### How Zone Surcharges are Billed:

Zones, as an area or territory are described in this booklet in a previous section (The Distribution System). Surcharges which might apply where pumping occurs in those zones, are explained in this Water Billing section.

Most of the Water System's users are not subject to a surcharge. because they receive gravity fed service or the electricity cost of pumping does not exceed $0.04 per 1,000 gallons. The current surcharge, when applicable, are $0.13 per 1,000 gallons for Zone I users, and $0.36 per 1,000 gallons for Zone II users. The following excerpts from Section 13.08.095 of the Municipal Code identify when a surcharge is to be charged.

> A. Establishment of Zones. There are hereby established three water surcharge zones within the City's water service area, to be designated as Zone 0, Zone I and Zone II, respectively.
>
> B. Zone 0. Zone 0 shall include territory within which water users receive water that is pumped at the City's expense at least one time, but not more than twice, after such water leaves the City's water treatment plant and before it reaches water users within the zone where the City's pumping costs are determined to be insignificant relative to pumping costs incurred in other designated zones. If electricity charges attributable to pumping in the territory are less than $0.04 per 1000 gallons of water, the territory will be designated for inclusion within Zone 0, notwithstanding that the territory otherwise meets the criteria for inclusion in Zone I.
>
> C. Zone I. Zone I shall include territory within which water users receive water that is pumped at the City's expense at least one time but not more than twice after such water leaves the City's water treatment plant and before it reaches the water users within the zone. Zone I territory shall be distinguished from Zone 0 territory on the basis that pumping costs incurred by the City are determined to be significant relative to pumping costs incurred in Zone 0. Average electricity charges attributable to pumping in Zone I territory must equal or exceed $0.04 per 1000 gallons of water.
>
> D. Zone II. Zone II shall include territory within which water users receive water that is pumped at the City's expense more than twice after such water leaves the City's water treatment plant and before it reaches the water users within Zone II.
>
> G. Zone Surcharges. Water users within Zone I and Zone II shall be assessed on their periodic water billing statements zone surcharges calculated by multiplying the water user's actual water consumption for the billing period (measured by meter and expresses in thousands of gallons) times the applicable zone surcharge rate. Zone surcharges shall be in addition to all other charges payable by the water user.
>
> H. Zone Surcharge Rates.
>
> 1. No zone surcharges shall be imposed upon water users who receive water service within Zone 0.
>
> 2. The Zone surcharge rate applicable to water users who receive water service at any place within Zone I shall be $0.13 per one thousand gallons.
>
> 3. The zone surcharge rate applicable to water users who receive water service at any place within Zone II shall be $0.36 per one thousand gallons.
>
> 4. The zone charge rates applicable for each zone shall be recalculated and adjusted upward or downward as necessary at least one each year.

# WATER BILLING

## C. Water Rates:

Effective 3/11/95

Billed per quarter in advance:

| Description | Meter Size | Minimum Charge per qtr. (*) | Maximum gallons | Per 1,000 gallon charge in excess of max gallons |
|---|---|---|---|---|
| Residential - Inside City | 3/4 inch or less | $36.24 | 12,000 | $0.92 |
| | 1 inch | $64.47 | 21,000 | $0.92 |
| Residential - Outside City | 3/4 inch or less | $45.99 | 9,000 | $1.44 |
| | 1 inch | $81.87 | 18,000 | $1.44 |

* - Add $0.13 per one thousand gallons for water service in Zone I
Add $0.36 per one thousand gallons for water service in Zone II

Billed per month, end of month:

| Description | Meter Size | Minimum Charge per month (*) | Maximum gallons | Per 1,000 gallon charge in excess of max gallons |
|---|---|---|---|---|
| Multi-dwelling or multi-business units: | | | | |
| Inside City | Per unit | $12.08 | 4,000 | $0.92 |
| Outside City | Per unit | $15.33 | 3,000 | $1.44 |
| Commercial/Industrial/Other User - | | | | |
| Inside City | 3/4 inch or less | $12.08 | 4,000 | $0.92 |
| | 1 inch | $21.49 | 7,000 | $0.92 |
| | 1 1/4 inch | $33.57 | 11,000 | $0.92 |
| | 1 1/2 inch | $48.30 | 16,000 | $0.92 |
| | 2 inch | $85.86 | 28,000 | $0.92 |
| | 3 inch | $193.21 | 64,000 | $0.92 |
| | 4 inch | $343.45 | 114,000 | $0.92 |
| | 6 inch | $772.87 | 256,000 | $0.92 |
| | 8 inch | $1,373.89 | 448,000 | $0.92 |
| Commercial/Industrial/Other User - | | | | |
| Outside City | 3/4 inch or less | $15.33 | 3,000 | $1.44 |
| | 1 inch | $27.29 | 6,000 | $1.44 |
| | 1 1/4 inch | $42.62 | 9,000 | $1.44 |
| | 1 1/2 inch | $61.34 | 12,000 | $1.44 |
| | 2 inch | $109.02 | 21,000 | $1.44 |
| | 3 inch | $245.34 | 48,000 | $1.44 |
| | 4 inch | $436.09 | 86,000 | $1.44 |
| | 6 inch | $981.36 | 192,000 | $1.44 |
| | 8 inch | $1,744.54 | 336,000 | $1.44 |

* - Add $0.13 per one thousand gallons for water service in Zone I
Add $0.36 per one thousand gallons for water service in Zone II

## C. Water Rates:

Effective 3/11/95

(continued)

Billed per contract:

| Description | Meter Size , or other measurement | Charge Per 1,000 gal | Charge per day per meter | Charge-other measurement |
|---|---|---|---|---|
| Bulk (tank) Water Purchasers | cash at dispensing station | $3.50 | | |
| Group Users - Outside City: | per contract - billed per month | | | |
| First 5,000 gallons or less | minimum charge | | | $27.68 |
| Next 95,000 gallons | any size meter | $2.07 | | |
| Next 300,000 gallons | any size meter | $1.81 | | |
| Next 600,000 gallons | any size meter | $1.52 | | |
| All over 1,000,000 gallons | any size meter | $1.44 | | |
| or | | | | |
| Per water user - per month | 3,000 gallons | | | $15.33 |
| Bulk (tank) Water Purchases | any size meter at fire plug | $3.50 | $5.00 | |
| Temporary Water Purchases | any size meter at fire plug | $3.50 | $5.00 | |
| | **Water purchases at any fire plug (are non-potable) and require deposit & approved meter.** | | | |
| Two historic contract users | per contract | $0.55 | | |
| Raw water - one historic contract | per acre foot ($16.30 + $8.00) | | | $24.30 |
| Public Fire Protection | any size hydrant- per hydrant | | | $0.00 |
| Private fire protection | non-metered or hydrant | | | $0.00 |

Raw Water and Plant Investment (Tap) Fees:
(effective 2/1/1994)

The base Raw Water and Plant Investment Fee for the initial privilege of being furnished City water through a new connection at a particular property shall be as follows:

| Connection Size | Amount- Inside City | Amount- Outside City |
|---|---|---|
| 3/4 inch or less | $2,200.00 | $2,750.00 |
| 1 inch | $3,674.00 | $4,592.50 |
| 1 1/4 inch | $5,126.00 | $6,407.50 |
| 1 1/2 inch | $7,326.00 | $9,157.50 |
| 2 inch | $11,726.00 | $14,657.50 |
| 3 inch | $23,474.00 | $29,342.50 |
| 4 inch | $36,674.00 | $45,842.50 |
| 6 inch | $73,326.00 | $91,657.50 |
| 8 inch | $117,326.00 | $146,657.50 |

# EXCERPTS FROM WATER SYSTEM IMPROVEMENT PLAN FOR CAÑON CITY

The following paraphrased sections or remarks are from (or consistent with) the December 14, 1992 Water System Improvement Plan by T. F. Ullmann, P.E. of The Engineering Co. The reader may wish to refer to the full report, copies of which are available at the Offices of the Director of Public Works and the City Engineer.

The report summarized, as taps are added to the system and demands increase, the City will find it more difficult to maintain high quality water with the existing treatment plant facilities. The report recommended significant improvements be made in the next few years to the treatment plant to enable the City to meet the projected demands as well as upgrade the facilities to enable it to meet the ever increasing water quality regulations.

This report served as the foundation of the analysis and decision to make substantial treatment plant improvements, financed by a 15% rate increase in 1995 and by a $4, 600,000.00 water revenue bond to be issued in early 1996, and construction to be complete in 1998. Repayment of the bonds will be from collection of Plant Investment Fees from new users, and from user revenues.

This report also addressed the distribution system improvements required to supply the projected demands for the anticipated development. The Distribution System improvements can be made in phases. Generally, the phases can be constructed at the actual time of the growth. The Distribution System improvements are not expected to require bond financing, but will be financed from collection of Plant Investment Fees, user required/financed installations and from user revenues.

## PROJECTED GROWTH:

The primary area of concern is with the new growth centers around the north and northeast portion of the City's service area. These include the increased demands of the prison, the proposed 4-Mile Ranch Development, the undeveloped Abbey property, undeveloped property along MacKenzie, and other smaller parcels along Four Mile Creek. These areas could increase population by 13,693, acres of area to be served by 2,254 and maximum gallon day by 7.842 (MGD). These totals represent a substantial growth of the Cañon City area, an increase of 59%.

## PROJECTED DEMANDS:

In 1986, The Engineering Company under an engagement contract with the City of Cañon City developed a hydraulic model of the Cañon City water distribution system. The 1992 updated demand figure is nearly the same as the figure used in 1986. The figure of 1.07 gpm per unit is fairly low when compared to other communities and is probably due to the large percentage of the customers that irrigate with ditch water. Considering the unlikely probability that the future taps will be able to use ditch water for irrigation, a figure of **1.32 gpm/tap** is recommended for planning and correlates well with other utilities. It is recommended this figure be used for the projected taps.

## WATER TREATMENT PLANT:

The additional demand represented by the projected development is 7.842 MGD on the maximum-day and 7,921 gallons per minute during the peak-hour. The additional maximum-day demand primarily impacts the water treatment plant capacity while the peak-hour demand impacts the transmission and distribution lines. The historical maximum-day output through the treatment plant was 11.25 MGD in July 1989 and July 1991 [12.6 MGD in July 1995]. Adding the projected demand from the proposed developments would result in a total maximum-day demand of 19.09 MGD.

In January 1996 the City has authorized the design and immediate future construction of the improvements to the Water Treatment Plant which will increase its capacity from 15 MGD to 22 MGD, and modernize the plant in anticipation of increased water quality regulations. This improved treatment plant is expected to be on line in 1998.

The improvementsare also needed to meet the ever increasing water quality regulations. If there would be no increased demand for new service, the water treatment facilities still have to be improved to meet tougher water quality regulations.

## DISTRIBUTION SYSTEM:

### Pipelines:

Unfortunately, the projected demands are located at the extremities of the existing distribution system. In addition, possible areas of development include some elevations above the generally accepted limit of 5470 (the so called "blue line") for gravity service from the treatment plant storage. Since the transmission of water from one location to another requires a driving force (i.e., gravity) and results in pressure losses along the way, the further the customer is from the source, the lower the resulting pressure. In addition, the higher the flow rates in the pipes. the greater the pressure losses. Consequently, in order to deliver the projected demands to the proposed developments, it will be necessary to lower the pressure gradient of the system. The maximum quantity of water that can be delivered by the existing system is limited by the necessity to maintain adequate pressure to existing customers.

For instance, if the proposed taps are located at an elevation of 5450 and the desired pressure is 40 psi, the maximum flow that can be supplied is only 12 gpm. This would be adequate to serve only 10 taps at the average peak-hour demand of 1.2 gpm/tap. However, if the taps are located at an elevation of 5400 (70 ft. below the "blue line"), the system could supply 1,600 gpm to the area. This should be sufficient for 1300 taps.

It is recommended Cañon City adopt regulations that require a 12-inch grid system every half mile with alternating 8-inch and 6-inch lines within each quarter section for the urban-type development areas. For more rural areas such as Lincoln Park, a 12-inch grid system every mile, with a minimum of 6-inch interior lines, is recommended.

### Storage:

The existing storage tanks available to the system include:

| | |
|---|---|
| Treatment Plant Clearwells | 3,000,000 gallons |
| Lincoln Park Tank | 4,000,000 gallons |
| South Tank | 300,000 gallons |
| Total Storage | 7,300,000 gallons |

Also, some emergency storage capacity is provided through an agreement with the Colorado

Department of Corrections in its 1.5 mg tank (refer to "The Distribution System" a previous section of this booklet).

Recommended storage should include average-day demand plus fire storage. The current average-day demand is estimated to be 4.86 MGD. The recommended fire storage, assuming a needed fire flow of 4,000 gpm with a 3-hour duration, is 0.72 MG. Therefore, the minimum recommended storage is 5.58 MG which is well below the 7.3 MG of active storage available. Adding sufficient storage to equalize the peak-hour demands requires a volume equal to approximately 25% of the maximum-day demand. With the current maximum-day demand of 11.25 MGD [12.6 MGD in July 1995], the equalizing volume is 2.81 MG. Adding this to the (Health Dept.) criteria results in a recommendation of 8.39 MG ((5.58 MG + (11.25 MGD X 25% = 2.81 MG)= 8.39 MGD).

Projected Storage Requirements:
Under the maximum-day criteria, the recommended storage volume would be 11.25 MG which is considerably higher than the total volume available. The projected maximum-day demand, including the proposed developments, is 19.09 MGD while the average-day demand is projected at 8.25 MGD. The minimum recommended storage volume is:

| | |
|---|---|
| Equalizing Storage (25% of maximum-day) | 4.77 MG |
| Fire Storage (4,000 gpm, 3 hrs) | 0.72 MG |
| Emergency Storage (average day) | 8.25 MG |
| Total | 13.74 MG |

The maximum-day storage guideline would indicate 19.09 MG of storage should ultimately be provided. The existing storage volume is 4.9 MG short of the minimum criteria, and 10.3 MG short of the maximum-day criteria. The City will have to increase its present 7.3 MG storage capacity by an additional 4.9 MG to maintain at least the minimum recommended storage volume. This can be timed to correlate as phased distribution improvements are built.

## COMMON WATER CONVERSION FACTORS

1 Cubic Foot Per Second equals 1 Cubic Foot of water passing a point in one second of time.

1 Acre Foot equals Quantity of water required to cover 1 acre of land 1 foot deep.

### SURFACE

1 Square Mile= 27,878,400 Square Feet
1 Square Mile= 640 Acres
1 Acre= 43,560 Square Feet

### VOLUME

1 Acre Foot= 325,851 Gallons
1 Acre Foot= 43,560 Cubic Feet
1 Cubic Foot= 7.4805 Gallons
1 Cubic Foot/Second = 448.8 Gallons/Minute
1 Cubic Foot/Second = 646,317 Gallons/Day
1 Cubic Foot/Second = 86,400 Cubic Feet/Day
1 Cubic Foot/Second = 1.9835 Acre Feet/Day
1 Cubic Foot/Second = 723.96 Acre Feet/Year
1 Million Gallons/Day = 1.547 Cubic Feet/Second
1 Million Gallons/Day = 3.07 Acre Feet/Day
1 Million Gallons = 133.681 Cubic Feet
1 Cubic Foot/Second = 0.68 Miles/Hours
1 Cubic Foot/Second falling 8.81 Feet = 1 Horsepower
1 Cubic Foot/Second falling 10.0 Feet = 1.135 Horsepower
1 Cubic Foot/Second flowing for one year will cover 1 Square Mile 1.131 feet deep.

### WEIGHT

1 Gallon of Water = 8.33 Pounds

1 Cubic Foot of Water = 62.4 Pounds

### WATER FACTS

In 1900 Americans consumed less than 5 gallons per person per day, while in 1967 Americans consumed an average of 50 gallons per person per day. In 1967 Americans used 370 trillion gallons per day, and it is estimated that in the year 2000 Americans are expected to use 1 quadrillion gallons per day.

There are 326,074,000 cubic miles of water in the world found in oceans, ice fields, lakes, rivers, underground, and humidity.

A cubic mile contains 1.1 trillion gallons which is more water than the U.S. will need every day by the 2,000, and is three times as much as we use today. A cubic mile would drench all of New England by an inch of water and would flood Connecticut to a depth of one foot.

317 million cubic miles are in the seas, 7 million cubic miles are in polar icecaps and glaciers, 1 million in ground water more than a half mile deep, 1 million in ground water less than a half mile deep, 30,000 in lakes, 16,000 in surface soil, and 300 cubic miles in rivers and streams.

A city dweller uses an average of 150 gallons a day, but can survive on 5 to 6 pints.

It takes 188,500 gallons to make a ton of paper; 770 gallons to refine one barrel of petroleum; 600,000 gallons to make a ton of synthetic rubber; 25,000 gallons to make a ton of steel; 300 gallons to make one loaf of bread; and 4,000 gallons to provide one pound of beef.

### WATER USE IN UNITED STATES

**Billions of gallons per day:**

| | 1967 | 1980 |
|---|---|---|
| Public Water Supplies | 32 | 39 |
| Industry | 73 | 115 |
| Steam Power Plants | 119 | 162 |
| Agriculture | 148 | 178 |

There is the same amount of water on earth today as when it was created 3 billion years ago. It is estimated that one billion tons of sediment are washed into the seas each year; suffi-cient to bury Washington, D.C. under 1 0 feet.

Hydrological Cycle:
1. Water on earth surface is heated and evaporates.
2. Evaporated water rises, cools, forms clouds.
3. Particles in clouds grow until they fall as snow or rain.
4. Some rain or snow soaks into the earth.
5. Some rain and snow falls into streams, lakes and oceans.

Hydrological cycle has no beginning —no end.

At any given moment 3,100 cubic miles remain floating in clouds, equivalent to one inch of rain over the entire earth every two weeks.

Each year 95,000 cubic miles of moisture ascends into the atmosphere; 71,000 of which falls back into the sea and oceans; 15,000 strikes land, and the remainder falls into lakes, rivers, etc.

One acre of corn may deliver 4,000 gallons per day into the atmosphere, and one cottonwood tree may deliver 1,500 gallons per day.

## APPENDIX 'A'

There is enough water locked up in the Antarctic Icecap to feed the Mississippi River for 50,000 years.
The melted ice could match flow of all rivers for about 800 years.

At any one time, the rivers contain only about 1/100th of one percent of the water on the globe.

The amount of water underground is 3,000 times larger than all the water in all the rivers in the world, and 20 times larger than in all lakes or inland seas.

City of Cañon City 8-11-97

## MILLION GALLONS PER MONTH

| Month | 1987 | 1988 | 1989 | 1990 | 1991 | 1992 | |
|---|---|---|---|---|---|---|---|
| January | 63.26 | 72.08 | 80.25 | 82.40 | 91.15 | 94.54 | |
| February | 57.21 | 71.17 | 70.40 | 71.83 | 78.42 | 89.09 | |
| March | 76.56 | 81.04 | 94.50 | 87.44 | 101.50 | 93.31 | |
| April | 92.00 | 126.40 | 160.00 | 109.35 | 142.55 | 142.67 | |
| May | 123.13 | 169.40 | 164.60 | 156.65 | 189.46 | 186.23 | |
| June | 184.49 | 180.55 | 189.50 | 252.60 | 207.82 | 179.18 | |
| July | 205.49 | 214.40 | 253.09 | 185.34 | 211.32 | 220.23 | |
| August | 163.04 | 200.80 | 209.61 | 171.67 | 166.50 | 167.43 | |
| September | 131.50 | 148.90 | 161.80 | 169.76 | 162.48 | 176.95 | |
| October | 120.46 | 124.25 | 141.88 | 108.87 | 153.49 | 167.92 | |
| November | 83.40 | 86.26 | 100.31 | 87.66 | 86.64 | 88.33 | |
| December | 68.79 | 101.71 | 87.42 | 91.67 | 92.02 | 87.64 | |
| TOTAL : | 1,369.33 | 1,576.96 | 1713.36 | 1,575.24 | 1683.35 | 1,693.52 | 1,7 |
| AVG MONTHLY: | 114.11 | 131.41 | 142.78 | 131.27 | 140.28 | 141.13 | 1 |

## SECWCD Information Request - August 11, 1997

| YEAR | 1987 | 1988 | 1989 | 1990 | 1991 | 1992 | 1993 | 1994 | 1995 | 1996 |
|---|---|---|---|---|---|---|---|---|---|---|
| Annual Water Use (MG) | 1,369.33 | 1,576.96 | 1,713.36 | 1,575.24 | 1,683.55 | 1,693.52 | 1,754.18 | 1,753.5 | 1,709.57 | 1,956.67 |
| Average monthly usage as a percentage of annual use | 114.11 | 131.41 | 142.78 | 131.27 | 140.28 | 141.13 | 146.18 | 146.13 | 142.46 | 163.06 |
| Population | 21,283 | 21,602 | 21,926 | 22,255 | 22,589 | 22,927 | 23,270 | 23,619 | 23,974 | 24,333 |
| Gallons/ Day per capita | 176.27 | 200.00 | 214.09 | 193.68 | 204.19 | 202.37 | 206.53 | 203.40 | 195.36 | 220.31 |

$\bar{x}$ = 201.6 gpc/d

DRAFT

# SOUTHEASTERN COLORADO WATER CONSERVANCY DISTRICT
## Arkansas River Basin Water Storage and Future Needs Assessment
WATER SYSTEM SURVEY (Compiled by BWR)

## 1. General Information

**Entity** CITY OF CANON CITY

**Contact Name/District Manager** PAUL S. FISHER

**Address** P.O BOX 1460
CANON CITY, CO 81215

**Phone No.** (719) 269-9022

**Fax No.** (719) 269-9034

**Primary Use** [✓ Municipal] Agricultural Industrial Recreational Other

**Master Plan or other Water Resource Planning Documents?** Y [✓ N]
(If yes we must obtain it)
**Prepared by:**

**Geographic Location of Service Area** (obtain service area map)

## 2. Demographics/Water Use

*Historic Water Use*

| Year | Population | Water Use, af | 3/4 -in Domestic Taps (optional) |
|---|---|---|---|
| 1987 | 21283 | 4201 | |
| 1988 | 21602 | 4840 | |
| 1989 | 21926 | 5257 | |
| 1990 | 22255 | 4833 | |
| 1991 | 22589 | 5168 | |
| 1992 | 22927 | 5199 | |
| 1993 | 23270 | 5383 | |
| 1994 | 23619 | 5380 | |
| 1995 | 23974 | 5247 | |
| 1996 | 24333 | 6005 | |

*Projected Water Use*

| Year | Population | Water Use, af | 3/4 -in Domestic Taps (optional) |
|---|---|---|---|
| 2000 | | | |
| 2010 | 31544 | 7420 | |
| 2020 | 36238 | 9535 | |
| 2040 | | | |

**Major industrial or other uses other than domestic**

# SOUTHEASTERN COLORADO WATER CONSERVANCY DISTRICT

## Arkansas River Basin Water Storage and Future Needs Assessment

WATER SYSTEM SURVEY (Compiled by BWR)

### 3. Estimated Monthly Water Use

| | as a percent of total annual use,% |
|---|---|
| JAN | |
| FEB | |
| MAR | |
| APR | |
| MAY | |
| JUN | |
| JUL | |
| AUG | |
| SEP | |
| OCT | |
| NOV | |
| DEC | |
| **TOTAL** | **100%** |

Notes:

DRAFT

# SOUTHEASTERN COLORADO WATER CONSERVANCY DISTRICT

## Arkansas River Basin Water Storage and Future Needs Assessment

WATER SYSTEM SURVEY (Compiled by BWR)

### 4. Sources of Water

*Surface Water*

**Sources** ARKANSAS RIVER SURFACE WATER RIGHTS

**Point of Diversion** (for larger municipalities attach map, if available)

Location

Capacity

*Ground Water*

**Sources**

Tributary

Nontributary

Number of Wells

**Combined Annual Flow Rate** (from decrees or based on conveyance capacity)

(May only be available as an annual total)

| | gpm | cfs | af |
|---|---|---|---|
| JAN | | | |
| FEB | | | |
| MAR | | | |
| APR | | | |
| MAY | | | |
| JUN | | | |
| JUL | | | |
| AUG | | | |
| SEP | | | |
| OCT | | | |
| NOV | | | |
| DEC | | | |
| **TOTAL ANNUAL** | | | |

# SOUTHEASTERN COLORADO WATER CONSERVANCY DISTRICT

## Arkansas River Basin Water Storage and Future Needs Assessment

WATER SYSTEM SURVEY (Compiled by BWR)

### 5. Firm Yield

**District Managers may not have this information, attorneys and/ or consulting engineers may need to be contacted**

| **Monthly Average Firm Yield for 1966-1995** | **af** |
|---|---|
| JAN | |
| FEB | |
| MAR | |
| APR | |
| MAY | |
| JUN | |
| JUL | |
| AUG | |
| SEP | |
| OCT | |
| NOV | |
| DEC | |
| TOTAL ANNUAL | 23 900 AF |

Firm yield can estimated from:

- Response of water rights during critical dry year
- Potential volume limitation per decree or well permit
- Ability to augment out of priority depletions

Consulting Engineer or Attorney

### 6. Future Water Planning

Estimated future yield of existing water rights ____________ af/yr

Conditional Water Rights

Direct flow/wells

Storage

# SOUTHEASTERN COLORADO WATER CONSERVANCY DISTRICT

## Arkansas River Basin Water Storage and Future Needs Assessment

WATER SYSTEM SURVEY (Compiled by BWR)

### 7. Raw Water Storage

| | |
|---|---|
| Total Vol. in af | PURCHASED STORAGE 90 AF |
| Type:<br>Fry-Ark<br><br>If and When<br><br>Shared<br><br>Owned | <br>PUEBLO RESERVOIR |

### 8. Raw Water Conveyance

| | |
|---|---|
| Type:<br>Pipeline<br><br>Canal | |
| Estimated Raw Water Conveyance Losses | |

### 9. Treatment Plant Capacity

| | |
|---|---|
| Type | |
| Capacity | |

Also:

1. Attach copies of relevant tables and text from master plans, or water resource planning documents.
2. Compare data found in reports to data obtained from contacting entity via telephone or previous survey.

Notes:

# Φ GEI Consultants, Inc.

5660 Greenwood Plaza Blvd., Suite 202
Englewood, CO 80111-2418

Tel. (303) 779-5565
Fax (303) 779-5653

# FAX

DATE 8/1/97

PROPOSAL/ PROJECT NO. 97411

NO. OF PAGES 3 (including this page)

Task Code 1010

TO: PAUL G. FISHER

FAX NO. (719) 269 - 9034

FROM: BRAD RASTALL

MESSAGE: THANKS FOR ANSWERING MY QUESTIONS. PLEASE SEND A COPY OF YOUR FACILITIES PLAN AND ANY OTHER INFORMATION THAT ANSWERS MY ATTACHED REQUESTS.

PLEASE LET US KNOW IF THE TRANSMISSION IS UNSATISFACTORY
** THANK YOU **

## SERVICES

**Geotechnical Engineering**
- Site Evaluation
- Foundation Design
- Construction

**Forensic Engineering**
- Failure Investigation
- Litigation Support
- Construction Claim Analysis
- Expert Testimony

**Environmental Engineering**
- Process Engineering
- Site Evaluation
- Remediation
- Litigation Support

**Geohydrology & Hydrology**
- Water Supply Development and Protection
- Contaminated Ground Water Remediation
- Construction Dewatering
- Flood Routing Studies

**Dam Engineering**
- Site Studies
- Dam Design
- Inspection

**Air Quality**
- Operating Permits
- Emission Inventories
- Control Technology Engineering
- Measurements and Modeling

We need the following information to complete the Arkansas River Basin Water Storage and Future Needs Assessment for the SECWCD:

1. Population and historic water use for 1987-1989 and 1991-1994.
2. Estimated monthly water use as a percent of total annual water use.
3. Annual firm yield, and monthly firm yield if available.
4. Location of service area.
5. Water use in gallons per capita per day.

TO: BRAD RASTALL

FROM: PAUL FISHER, PWD City of Cañon City 8-11-97

We need the following information to complete the Arkansas River Basin Water Storage and Future Needs Assessment for the SECWCD:

1. Population and historic water use for 1987-1989 and 1991-1994. SEE ATTACHED
2. Estimated monthly water use as a percent of total annual water use. SEE ATTACHED
3. Annual firm yield, and monthly firm yield if available.
4. Location of service area. SEE ATTACHED
5. Water use in gallons per capita per day. SEE ATTACHED

| ANNUAL | MONTHLY |
|---|---|
| 7,784,898,707. | 648,741,559 gallons |

8-7-97

*Note From*

**Paul Fisher** (719) 269-9022

TO: BRAD RASTALL

To the best of our ability, find enclosed information to answer the questions you have asked.

Paul S. Fisher

As you can see, our need for additional water source(s) begins @ 2030.

tion, please

y,

l S. Fisher

Compliments of the Daily Record, Cañon City, Colorado, (719) 275-7565

RECEIVED

AUG 1 1997

PUBLIC WORKS

# The City of Cañon City
# Water Department

## A Water Activity Enterprise,
## governed by and through
## The City Council of the City of Cañon City
## for the City of Cañon City and Extraterritorial Service Area

**City Council of the City of Cañon City**
Ruth Carter, Mayor
Fred Barnes, Councilman
Lavelle Craig, Councilman
Bill Jackson, Councilman
Ann Swim, Councilwoman
Glenn Vaughn, Councilman
James Verkaik, Councilman
Ed Whitcraft, Councilman

**Management, Supervision and Operation**
Public Works Committee, a City Council Committee

Steve Thacker, City Administrator
Paul Fisher, Director of Public Works
Jim Allan, Director of Finance & Human Resources

Technical Advice and Legal Counsel:
Bob Saulmon, City Engineer
John Havens, City Attorney

Compiled and edited by
Harold L. Lewis

First printing 1/22/96

## TABLE OF CONTENTS

# INTRODUCTION

The manner in which water circulates between earth and atmosphere determines where ample supplies of water can be found and used. Although water constantly replenishes the earth, many areas almost entirely lack this prized liquid. The location and availability of water help decide where people can settle. Early explorers referred to the Great Plains, which rise gradually from the Kansas-Nebraska border to the Front Range of the Rocky Mountains as the "great American desert". Rainfall is limited, and much of it is irrigated.

The City of Cañon City and its Water System is part of Fremont County which for years has been called the "Climate Capital of Colorado". The area enjoys a mild and semi-arid climate with low humidity, and 300 days of sunshine per year. Add the water delivered by the Cañon City Water System to that climate and you have an oasis in the "great American desert". The Cañon City Water System has been established since 1908 and includes water rights and works for collection, purification, transmission, storage, and distribution of water.

**Add water delivered by the Cañon City Water System to the climate of the "Climate Capital of Colorado" and you have an oasis in the "great American desert".**

The Water Department of the City of Cañon City (sometimes herein called the Water System) is a self supporting Water Activity Enterprise governed by and through the City Council of the City of Cañon City. ~~The system belongs to the Users and is the responsibility of the elected City Council of The City of Cañon City, Colorado and the elected Mayor~~. The Public Works Committee (a City Council Committee) and the City Administrator direct the system and manage the operation. The City Administrator with the assistance of a Director of Public Works and staff, and the financial assistance of a Director of Finance and Human Resources and staff administer and manage the daily operation. The City Engineer and staff, and City Attorney provide valuable ongoing technical and legal advice.

Excellent water is available in the Cañon City Water System. With adequate acquisition and preservation of water rights, good and timely planning, repairs and new investment for improvement and expansion, adequate supplies of water will continue to flow to meet the needs of the system. City Council and its staff are charged with the responsibility to manage, maintain and improve that system to assure future quality and availability of an adequate supply of water to the present and future users of the Cañon City Water System.

The information contained in this booklet attempts to summarize many elements of Water Department structure and operations. Each summary is believed to be accurate as of the publication date of this booklet. Such information is intended to be used as a reference source and guide for the City Council and staff. None of the information contained herein shall be referenced or relied upon by any third party for any purpose.

Steve Thacker

Steve Thacker
City Administrator

## A CONSOLIDATED SYSTEM

The City of Cañon City Water System represents the consolidation of several communities and water districts, and encompasses an area which is more than ~~fourteen~~ square miles. This includes the jurisdiction of the City, and extraterritorial areas around the City. 15

The City system was first constructed around 1908, and represents the oldest part of the consolidated system. The City was a neighbor city to South Canon, East Canon, Prospect Heights, Brookside and to seven water districts. The two communities of South Canon and East Canon were annexed into the City of Cañon City. Five of the seven neighbor water districts have chosen to dissolve and receive service directly from the City's system. Prospect Heights chose to unincorporate, abandon a private water system and then receive its water service from Cañon City's system. This consolidated system serves 7,422 metered water users. The estimated population of the City of Cañon City in 1995 is 15,000 (65% of total system population), and the estimated population for the extraterritorial service area in 1995 is 8,000 (35% of total system population) for a total population of 23,000 served by the City's water system.

There are still two active contiguous neighbor water districts and one near neighbor community which provide water service to their respective district users.

- Park Center Water District has its own water supply and treatment facilities, and distributes that water to its users, some of whom are within the City of Cañon City on the northern edge of the City. It is a large geographic area covering a majority of nine sections of land, part of which is within the City but basically is contiguous to the northern boundary of the City. This district serves 868 users.
- Orchard Park is a district which purchases its potable water from the City of Cañon City, and distributes that water through its distribution system to 36 users in its district. The district is northwest of the City of Cañon City.
- Brookside is an incorporated community which is a near neighbor to the southeast of the City of Cañon City. This town purchases its potable water from the City of Cañon City and distributes the water through its distribution system to 50 users.

### Annexation of the Town of South Canon

At an election held July 28, 1959 the electorates of The Town of South Canon and of Canon City approved annexation of the Town of South Canon to the City of Cañon City. An attempt to void the annexation by a complainant was finally put to rest May 22, 1961. The trial court decided to allow the City's motion to dismiss the anti annexation litigation. The City of Cañon City received the town's assets and assumed its liabilities. Within the terms and conditions of the annexation which set out many specifics, the part about its water system was addressed in Items 4 and 5, Ordinance No.4, Series of 1959, Town of South Canon, Colorado. Section 4 states, "That part of the City of Canon City after such annexation now comprising South Canon shall be furnished equal police, health, sanitation, fire protection and **water supply** as like territory within the present boundaries of the City of Canon City . . . ". Section 5 states, "That the City of Canon City after such annexation shall furnish and maintain at all times as adequate a water supply to the territory now comprising South Canon as it supplies to the territory now comprising Canon City.".

## Annexation of the Town of East Canon

The electorate of the Town of East Canon rejected a concurrent annexation when South Canon was annexed in 1959. However, at an election held fifteen years later April 2, 1974 the electorates of The Town of East Canon and the City of Cañon City approved annexation to the City of Cañon City. The City of Cañon City received the town's assets and assumed its liabilities. Within the terms and conditions of the annexation which set out many specifics, the part about its water system was addressed in Items 4 and 5, Ordinance No. 2, Series of 1974, Town of East Canon, Colorado. Section 4 states, "That part of the City of Canon City after such annexation which comprises the Town of East Canon shall be furnished equal police, health, sanitation, fire protection and **water supply as** like territory within the present boundaries of the City of Canon City . . . ". Section 5 states, "That the City of Canon City after such annexation shall furnish and maintain at all times as adequate a water supply to the territory now comprising the Town of East Canon as it supplies to the territory now comprising Canon City.".

## The Former Lincoln Park Domestic Water District

This water district entered an agreement with the City of Cañon City June 16, 1975, which effective upon the dissolution of the district the City would get the district's assets free of any liabilities and after that be the water system for those users. Before this agreement the City was selling potable water to the district, which was distributed by the district through the district's system to its 1,060 users (12/24/1973).

The agreement read in part that after June 16, 1975 or upon dissolution of the district:

> "2. Except as hereinafter provided, the rates and charges for such water service to the users now within the District shall not be increased, and no tax, toll, or charge of any kind shall be imposed or levied on the water users of the District in connection with the construction of the capital improvements set forth in paragraph 1(b) above. Any future rate increases to the users of the District shall only be imposed in conjunction with a rate increase to the users within the City, and any such increase in rates to users in the District shall be in the same proportion as the increase in rates to users in the City. Fees charged for the new taps shall be the same as those charged by the City for new taps within the City."

This required Tap Fees ( Plant Investment Fees) for future water users who initiate water service within the original district legal description boundary to equal inside the City Tap Fees.

It also established a perpetual limit on water rate increases. Rates could increase only when the inside City users had a rate increase and in the same proportion.

There are some properties of the former district who had paid the district for a Tap Fee. When a claim is made that the Tap Fee has been paid to the former district, and research confirms the physical presence of the Tap, no further Plant Investment Fee for that property is charged by the City.

## The Former Four Mile Domestic Water System

This water district entered into an agreement with the City of Cañon City February 28, 1980, that effective April 1, 1980 the City would acquire the district's assets and assume its liabilities and thereafter be the water system for those users. Prior to this agreement the City was selling potable water to the district, which was distributed by the district through the district's system to its 291 users (10/27/1978).

Until March 31, 1983 there were some transitional considerations for district water users. It was agreed after March 31, 1983 the district area would be serviced, administered and charged without special consideration. The agreement read in part, after March 31, 1983 "...all water users in the Four Mile area shall pay the rates and charges, respectively, applicable to all individual water users located outside the corporate limits of City, exclusive of the water users of the area formerly comprising The Lincoln Park Domestic Water District, set by ordinance, rule or regulation by City from time to time.".

There were some shareholders of the district who had paid the district for a Tap Fee. The district surrendered its records to the City, which are in storage. When a claim is made that the Tap Fee has been paid to the former district, and research of the former district's records confirm it, no further Plant Investment Fee for that property is charged by the City.

## The Former Park Avenue Domestic Water System

This private water system, also-known-as Maynard Water District entered into an agreement with the City of Cañon City. Effective October 1, 1980, the City agreed to purchase the entire water distribution system, and thereafter be the water system for those users. The City agreed to pay $500.00 to Frank and Violet Maynard for each of eight lots at the time water service was commenced to those lots within 21 years [all eight have been paid]. Prior to this agreement the City was selling potable water to the district, which was distributed by the district through the district's system to its 90 users.

Until September 30, 1983 there were some additional transitional considerations for district water users. It was agreed after September 30, 1983 the district area would be serviced, administered and charged without special consideration, excepting the payment of $500.00 for initiated water service to each of eight specific lots. There was one Tap Fee paid and untapped at the time of the transfer of the private system to the City.

## The Former Sherman Avenue Domestic Water System, Inc.

This incorporated domestic water distribution system entered into an agreement with the City of Cañon City April 27, 1984, that effective June 1, 1984 the City would acquire the district's assets, and thereafter be the water system for those users. Prior to this agreement the City was selling potable water to the district, which was distributed by the district through the district's system to its 145 users.

Until June 1, 1987 there were some transitional considerations for district water users. It was agreed after June 1, 1987 the district area would be serviced, administered and charged without special consideration.

There were 10 Taps fees paid for and untapped at the time of the transfer of the district to the City. The district surrendered its records to the City. When a claim that the Tap Fee within the former district has been paid is presented to the City, and research of the former district's records confirm it, no further Plant Investment Fee for that property is charged by the City.

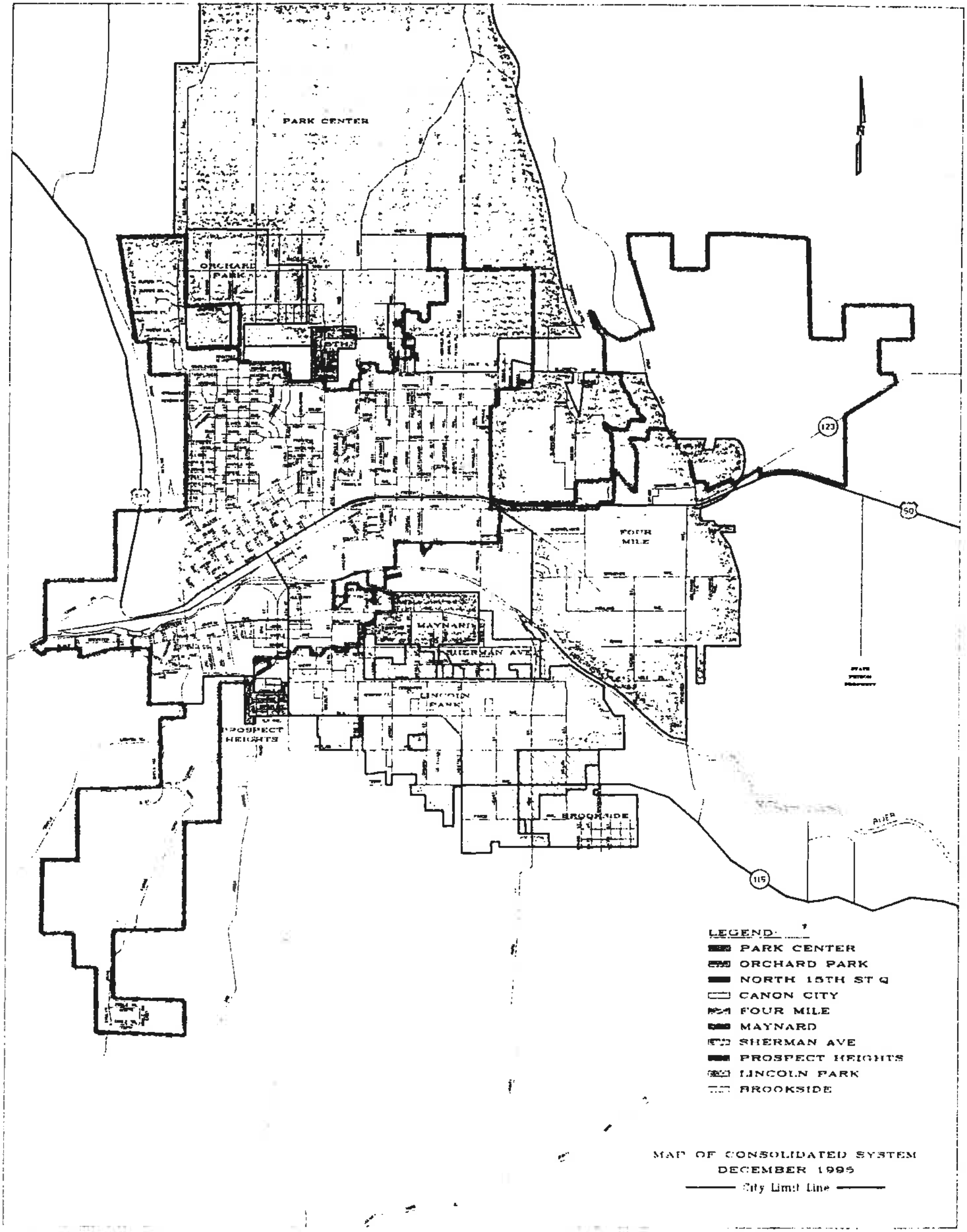
## The Former North 15th Street Water District

This unincorporated association entered into an agreement with the City of Cañon City October 31, 1985 for its domestic water distribution system. Effective November 1, 1985, the City would acquire the entire water distribution system, and thereafter be the water system for those users. Until November 1, 1988 there were some transitional considerations for district water users. It was agreed after November 1, 1988 the district area would be serviced, administered and charged without special consideration. Prior to this agreement the City was selling potable water to the district, which was distributed by this water system to its 20 users.

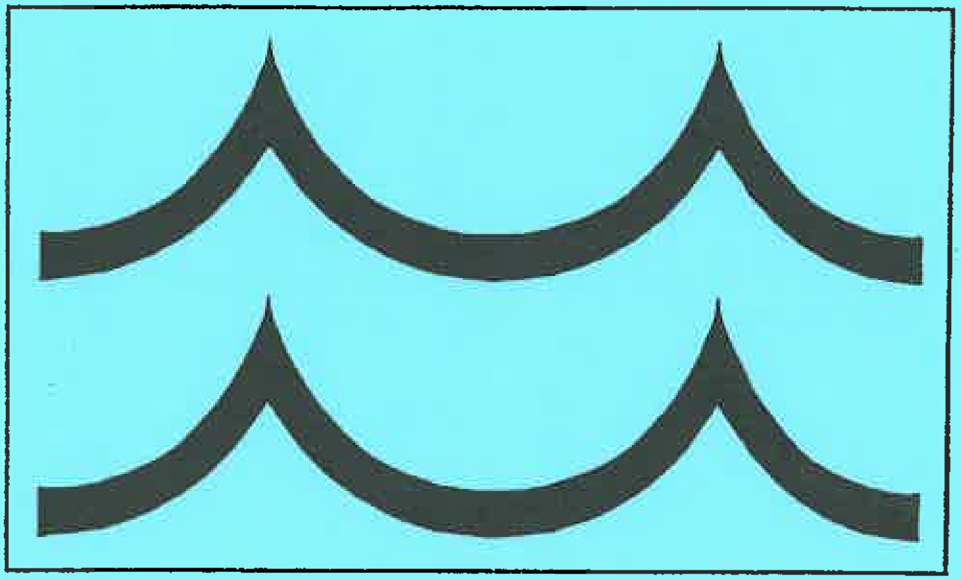
There was one Tap Fee paid and untapped at the time of the transfer of the private system to the City.

## Prospect Heights Water System

The Mildred C. Pierce Water System, which served 60 to 65 water users in the Town of Prospect Heights was approved to be abandoned by the Public Utilities Commission March 25, 1992. The City of Cañon City in agreement with the former owner of the water system and its users began discussions and negotiations in 1988. Each water user or customer of the Mildred C. Pierce Water System entered into written agreements consenting to the assumption of ownership of the system on the part of the City of Cañon City. In 1990/1991 the City of Cañon City built a new water system and assumed responsibility for it. The Town of Prospect Heights dissolved, and is now part of the unincorporated portion of Fremont County.


PARK CENTER
ORCHARD PARK
FOUR MILE
MAYNARD
SHERMAN AVE
LINCOLN PARK
PROSPECT HEIGHTS
BROOKSIDE
123
50
115
RIVER
STATE PRISON PROPERTY
LEGEND:
PARK CENTER
ORCHARD PARK
NORTH 15TH ST Q
CANON CITY
FOUR MILE
MAYNARD
SHERMAN AVE
PROSPECT HEIGHTS
LINCOLN PARK
BROOKSIDE
MAP OF CONSOLIDATED SYSTEM
DECEMBER 1995
City Limit Line

# THE CITY OF
# CAÑON CITY
# WATER SYSTEM



# APPENDIX 'B'

[Cumulative river miles beginning at gaging station Arkansas River near Leadville, Co]

| Gaging Station | Miles |
|---|---|
| Arkansas River Near Leadville, Co | 0 |
| Arkansas River at Granite, Co | 18.1 |
| Arkansas River at Nathrop, Co | 51.9 |
| Arkanssas River at Wellsville, Co | 69.1 |
| Arkansas River at Parkdale, Co | 112.4 |
| Arkansas River at Canyon City, Co | 120.9 |

[Discharges and appoximate mean velocities for selected sites on the Upper Arkansas River.]

| Arkansas River near Leadville, Co | | Arkansas River at Granite, Co | | Arkansas River at Nathrop, Co | |
|---|---|---|---|---|---|
| Discharge (cubic feet sec) | Mean Velocity (feet/second) | Discharge (cubic feet sec) | Mean Velocity (feet/second) | Discharge (cubic feet sec) | Mean Velocity (feet/second) |
| 200 | 3.1 | 200 | 2.3 | 200 | 1.1 |
| 500 | 4.1 | 500 | 3.4 | 500 | 2.5 |
| 1000 | 4.9 | 1000 | 4.3 | 1000 | 3.5 |
| 2000 | 5.6 | 2000 | 5.1 | 2000 | 4.5 |
| 3000 | 6.2 | 3000 | 5.6 | 3000 | 5.1 |
| 4000 | 6.4 | 4000 | 6.0 | 4000 | 5.5 |
| 5000 | 6.6 | 5000 | 6.3 | 5000 | 5.9 |
| 6000 | 6.8 | 6000 | 6.5 | 6000 | 6.1 |

| Arkansas River near Wellsville, Co | | Arkansas River at Parkdale, Co | | Arkansas River at Canyon City, Co | |
|---|---|---|---|---|---|
| Discharge (cubic feet sec) | Mean Velocity (feet/second) | Discharge (cubic feet sec) | Mean Velocity (feet/second) | Discharge (cubic feet sec) | Mean Velocity (feet/second) |
| 200 | 1.0 | 200 | 1.7 | 200 | 1.5 |
| 500 | 2.3 | 500 | 3.2 | 500 | 3.0 |
| 1000 | 3.2 | 1000 | 4.3 | 1000 | 4.0 |
| 2000 | 4.2 | 2000 | 5.4 | 2000 | 5.1 |
| 3000 | 4.8 | 3000 | 6.0 | 3000 | 5.8 |
| 4000 | 5.2 | 4000 | 6.5 | 4000 | 6.2 |
| 5000 | 5.5 | 5000 | 6..8 | 5000 | 6.6 |
| 6000 | 5.8 | 6000 | 7.1 | 6000 | 6.8 |

UNITED STATES DEPARTMENT OF THE INTERIOR - GEOLOGICAL SURVEY - CO DATA 10/27/95

STATION NUMBER 07096000 ARKANSAS RIVER AT CANON CITY, CO. STREAM SOURCE AGENCY USGS
LATITUDE 382602 LONGITUDE 1051524 DRAINAGE AREA 3117.00 DATUM 5342.13 STATE 08 COUNTY 043

DISCHARGE, CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1993 TO SEPTEMBER 1994
DAILY MEAN VALUES

| DAY | OCT | NOV | DEC | JAN | FEB | MAR | APR | MAY | JUN | JUL | AUG | SEP |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 504 | 429 | 504 | 561 | 430 | 557 | 407 | 600 | 3070 | 876 | 650 | 294 |
| 2 | 500 | 447 | 500 | 558 | 440 | 550 | 481 | 642 | 3600 | 862 | 701 | 285 |
| 3 | 458 | 420 | 490 | 554 | 445 | 553 | 506 | 563 | 3260 | 918 | 678 | 269 |
| 4 | 447 | 401 | 480 | 553 | 460 | 548 | 552 | 459 | 3080 | 911 | 648 | 302 |
| 5 | 431 | 419 | 513 | 541 | 470 | 551 | 629 | 414 | 2900 | 883 | 628 | 307 |
| 6 | 431 | 418 | 508 | 540 | 480 | 552 | 549 | 387 | 2750 | 785 | 649 | 300 |
| 7 | 411 | 407 | 507 | 501 | 490 | 553 | 495 | 399 | 2570 | 626 | 586 | 246 |
| 8 | 405 | 408 | 508 | 508 | 485 | 555 | 530 | 475 | 2480 | 576 | 594 | 233 |
| 9 | 414 | 402 | 511 | 525 | 480 | 535 | 490 | 618 | 2740 | 581 | 628 | 216 |
| 10 | 422 | 410 | 514 | 521 | 475 | 523 | 520 | 976 | 2780 | 613 | 648 | 206 |
| 11 | 423 | 479 | 504 | 510 | 460 | 524 | 517 | 927 | 2600 | 634 | 748 | 213 |
| 12 | 426 | 535 | 506 | 505 | 460 | 505 | 486 | 849 | 2470 | 590 | 754 | 216 |
| 13 | 439 | 528 | 502 | 525 | 460 | 485 | 520 | 852 | 2460 | 577 | 657 | 219 |
| 14 | 442 | 527 | 462 | 544 | 470 | 493 | 569 | 956 | 2360 | 571 | 784 | 233 |
| 15 | 416 | 513 | 466 | 544 | 475 | 494 | 523 | 975 | 2180 | 557 | 719 | 292 |
| 16 | 426 | 455 | 482 | 545 | 484 | 493 | 456 | 947 | 2020 | 565 | 645 | 258 |
| 17 | 437 | 439 | 503 | 533 | 488 | 496 | 436 | 1020 | 1940 | 590 | 553 | 239 |
| 18 | 464 | 439 | 491 | 547 | 505 | 502 | 442 | 1170 | 1850 | 562 | 491 | 247 |
| 19 | 442 | 440 | 493 | 530 | 511 | 491 | 442 | 1360 | 1950 | 556 | 547 | 253 |
| 20 | 442 | 431 | 507 | 497 | 489 | 472 | 440 | 1520 | 1880 | 574 | 532 | 289 |
| 21 | 421 | 427 | 478 | 500 | 493 | 471 | 429 | 1530 | 2050 | 568 | 393 | 309 |
| 22 | 388 | 436 | 510 | 501 | 499 | 439 | 450 | 1500 | 2240 | 533 | 376 | 313 |
| 23 | 393 | 459 | 490 | 497 | 476 | 433 | 483 | 1500 | 2230 | 536 | 358 | 310 |
| 24 | 387 | 514 | 501 | 499 | 480 | 429 | 511 | 1530 | 2280 | 561 | 331 | 289 |
| 25 | 380 | 481 | 513 | 498 | 490 | 455 | 563 | 1510 | 1980 | 561 | 289 | 282 |
| 26 | 391 | 431 | 537 | 519 | 540 | 464 | 586 | 2080 | 1750 | 562 | 278 | 277 |
| 27 | 379 | 449 | 566 | 513 | 540 | 444 | 581 | 2040 | 1620 | 576 | 233 | 272 |
| 28 | 367 | 475 | 546 | 490 | 540 | 411 | 585 | 1830 | 1640 | 584 | 208 | 258 |
| 29 | 413 | 508 | 538 | 476 | --- | 409 | 581 | 1930 | 1450 | 592 | 234 | 253 |
| 30 | 428 | 522 | 516 | 460 | --- | 409 | 628 | 2150 | 1070 | 592 | 246 | 245 |
| 31 | 412 | --- | 536 | 440 | --- | 398 | --- | 2400 | --- | 596 | 285 | --- |
| TOTAL | 13139 | 13649 | 15682 | 16035 | 13515 | 15194 | 15387 | 36109 | 69250 | 19668 | 16071 | 7925 |
| MEAN | 424 | 455 | 506 | 517 | 483 | 490 | 513 | 1165 | 2308 | 634 | 518 | 264 |
| MAX | 504 | 535 | 566 | 561 | 540 | 557 | 629 | 2400 | 3600 | 918 | 784 | 313 |
| MIN | 367 | 401 | 462 | 440 | 430 | 398 | 407 | 387 | 1070 | 533 | 208 | 206 |
| AC-FT | 26060 | 27070 | 31110 | 31810 | 26810 | 30140 | 30520 | 71620 | 137400 | 39010 | 31880 | 15720 |

UNITED STATES DEPARTMENT OF THE INTERIOR - GEOLOGICAL SURVEY - CO DATA 10/27/95

STATION NUMBER 07096000 ARKANSAS RIVER AT CANON CITY, CO. STREAM SOURCE AGENCY USGS
LATITUDE 382602 LONGITUDE 1051524 DRAINAGE AREA 3117.00 DATUM 5342.13 STATE 08 COUNTY 043

DISCHARGE, CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1992 TO SEPTEMBER 1993
DAILY MEAN VALUES

| DAY | OCT | NOV | DEC | JAN | FEB | MAR | APR | MAY | JUN | JUL | AUG | SEP |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 240 | 312 | 399 | 442 | 474 | 632 | 599 | 462 | 2850 | 2830 | 729 | 596 |
| 2 | 237 | 296 | 458 | 464 | 464 | 649 | 491 | 458 | 3000 | 2820 | 708 | 543 |
| 3 | 236 | 323 | 474 | 469 | 452 | 644 | 426 | 430 | 3040 | 2550 | 674 | 543 |
| 4 | 230 | 285 | 442 | 426 | 464 | 638 | 416 | 440 | 2750 | 2550 | 674 | 496 |
| 5 | 227 | 301 | 469 | 400 | 437 | 638 | 418 | 421 | 2410 | 2390 | 632 | 474 |
| 6 | 230 | 349 | 464 | 421 | 442 | 650 | 461 | 446 | 2190 | 2080 | 668 | 464 |
| 7 | 230 | 373 | 442 | 430 | 458 | 652 | 450 | 419 | 2050 | 1770 | 645 | 474 |
| 8 | 230 | 392 | 426 | 445 | 469 | 650 | 441 | 427 | 1910 | 1500 | 662 | 514 |
| 9 | 234 | 393 | 464 | 450 | 480 | 685 | 420 | 564 | 1660 | 1760 | 693 | 531 |
| 10 | 234 | 393 | 442 | 460 | 502 | 691 | 407 | 657 | 1510 | 1940 | 736 | 442 |
| 11 | 242 | 425 | 452 | 480 | 525 | 694 | 337 | 644 | 1320 | 1990 | 680 | 447 |
| 12 | 237 | 425 | 447 | 470 | 514 | 694 | 350 | 648 | 1340 | 2050 | 668 | 464 |
| 13 | 240 | 375 | 452 | 460 | 491 | 674 | 335 | 752 | 1590 | 2220 | 674 | 487 |
| 14 | 245 | 418 | 426 | 485 | 488 | 688 | 255 | 918 | 2160 | 2270 | 719 | 554 |
| 15 | 250 | 425 | 390 | 485 | 480 | 735 | 229 | 1130 | 3060 | 2230 | 723 | 517 |
| 16 | 256 | 418 | 447 | 490 | 465 | 722 | 294 | 1380 | 3920 | 2010 | 707 | 442 |
| 17 | 257 | 393 | 411 | 500 | 470 | 709 | 289 | 1570 | 3920 | 1890 | 656 | 447 |
| 18 | 265 | 383 | 437 | 490 | 486 | 701 | 336 | 1970 | 3920 | 1850 | 650 | 453 |
| 19 | 265 | 378 | 476 | 490 | 474 | 699 | 307 | 1990 | 3640 | 1800 | 638 | 478 |
| 20 | 265 | 374 | 437 | 480 | 474 | 695 | 259 | 2000 | 3340 | 1700 | 634 | 502 |
| 21 | 265 | 385 | 442 | 470 | 474 | 695 | 291 | 2120 | 3010 | 1480 | 561 | 452 |
| 22 | 255 | 363 | 461 | 460 | 502 | 692 | 282 | 2220 | 3100 | 1800 | 565 | 447 |
| 23 | 265 | 370 | 452 | 450 | 519 | 649 | 324 | 2310 | 3340 | 1910 | 578 | 476 |
| 24 | 265 | 380 | 452 | 450 | 596 | 649 | 397 | 2320 | 3400 | 1820 | 508 | 467 |
| 25 | 265 | 365 | 452 | 445 | 627 | 651 | 430 | 2300 | 3260 | 1800 | 452 | 461 |
| 26 | 290 | 365 | 438 | 455 | 627 | 656 | 400 | 2400 | 2990 | 1640 | 428 | 500 |
| 27 | 340 | 365 | 435 | 469 | 654 | 693 | 390 | 2730 | 2900 | 1200 | 491 | 480 |
| 28 | 334 | 370 | 462 | 450 | 652 | 719 | 379 | 2990 | 2940 | 855 | 599 | 474 |
| 29 | 306 | 395 | 514 | 468 | --- | 695 | 387 | 2740 | 2870 | 715 | 549 | 486 |
| 30 | 306 | 395 | 491 | 464 | --- | 689 | 404 | 2490 | 2860 | 694 | 574 | 502 |
| 31 | 303 | --- | 464 | 458 | --- | 677 | --- | 2560 | --- | 701 | 602 | --- |
| TOTAL | 8044 | 11184 | 13918 | 14276 | 14160 | 21005 | 11204 | 44906 | 82250 | 56815 | 19477 | 14613 |
| MEAN | 259 | 373 | 449 | 461 | 506 | 678 | 373 | 1449 | 2742 | 1833 | 628 | 487 |
| MAX | 340 | 425 | 514 | 500 | 654 | 735 | 599 | 2990 | 3920 | 2830 | 736 | 596 |
| MIN | 227 | 285 | 390 | 400 | 437 | 632 | 229 | 419 | 1320 | 694 | 428 | 442 |
| AC-FT | 15960 | 22180 | 27610 | 28320 | 28090 | 41660 | 22220 | 89070 | 163100 | 112700 | 38630 | 28980 |

UNITED STATES DEPARTMENT OF THE INTERIOR - GEOLOGICAL SURVEY - CO DATA 10/27/95

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DISCHARGE, CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1991 TO SEPTEMBER 1992
DAILY MEAN VALUES

| DAY | OCT | NOV | DEC | JAN | FEB | MAR | APR | MAY | JUN | JUL | AUG | SEP |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 218 | 399 | 470 | 485 | 489 | 518 | 500 | 293 | 1100 | 1200 | 679 | 647 |
| 2 | 213 | 430 | 456 | 471 | 504 | 502 | 490 | 334 | 1030 | 1140 | 679 | 623 |
| 3 | 216 | 408 | 460 | 461 | 509 | 531 | 488 | 340 | 928 | 1040 | 671 | 600 |
| 4 | 221 | 427 | 489 | 505 | 498 | 735 | 477 | 341 | 813 | 890 | 695 | 548 |
| 5 | 230 | 442 | 505 | 512 | 512 | 713 | 462 | 399 | 841 | 850 | 687 | 526 |
| 6 | 227 | 512 | 511 | 512 | 475 | 585 | 435 | 582 | 1020 | 800 | 664 | 498 |
| 7 | 206 | 579 | 509 | 527 | 472 | 571 | 410 | 622 | 1040 | 792 | 663 | 505 |
| 8 | 201 | 541 | 506 | 487 | 498 | 563 | 440 | 682 | 1060 | 860 | 671 | 556 |
| 9 | 199 | 509 | 498 | 476 | 499 | 588 | 376 | 761 | 992 | 977 | 668 | 540 |
| 10 | 199 | 500 | 481 | 462 | 488 | 513 | 267 | 813 | 1020 | 1060 | 679 | 527 |
| 11 | 221 | 494 | 484 | 493 | 477 | 497 | 274 | 711 | 924 | 1020 | 776 | 505 |
| 12 | 232 | 487 | 481 | 517 | 470 | 476 | 308 | 524 | 1030 | 914 | 767 | 449 |
| 13 | 210 | 462 | 444 | 470 | 470 | 484 | 300 | 499 | 1150 | 950 | 743 | 439 |
| 14 | 206 | 458 | 431 | 470 | 464 | 483 | 296 | 485 | 1240 | 923 | 740 | 365 |
| 15 | 211 | 495 | 507 | 470 | 464 | 491 | 405 | 509 | 1330 | 759 | 784 | 345 |
| 16 | 208 | 512 | 519 | 465 | 457 | 502 | 451 | 572 | 1350 | 719 | 784 | 320 |
| 17 | 207 | 563 | 515 | 465 | 451 | 527 | 426 | 649 | 1280 | 759 | 767 | 315 |
| 18 | 207 | 561 | 517 | 465 | 446 | 531 | 416 | 779 | 1140 | 700 | 639 | 306 |
| 19 | 211 | 561 | 554 | 455 | 433 | 558 | 386 | 831 | 1060 | 644 | 604 | 312 |
| 20 | 209 | 487 | 555 | 455 | 469 | 533 | 344 | 965 | 1180 | 695 | 542 | 318 |
| 21 | 210 | 488 | 510 | 450 | 473 | 555 | 321 | 1240 | 1310 | 727 | 488 | 306 |
| 22 | 210 | 516 | 506 | 495 | 495 | 615 | 298 | 1410 | 1380 | 703 | 456 | 322 |
| 23 | 212 | 466 | 495 | 464 | 486 | 584 | 280 | 1530 | 1370 | 694 | 603 | 300 |
| 24 | 218 | 448 | 485 | 535 | 484 | 564 | 267 | 1480 | 1370 | 735 | 957 | 289 |
| 25 | 223 | 465 | 480 | 533 | 475 | 512 | 246 | 1380 | 1440 | 759 | 1740 | 277 |
| 26 | 230 | 475 | 475 | 534 | 485 | 510 | 225 | 1270 | 1530 | 887 | 1200 | 278 |
| 27 | 235 | 473 | 470 | 510 | 476 | 510 | 218 | 1280 | 1690 | 878 | 957 | 282 |
| 28 | 234 | 470 | 460 | 490 | 496 | 515 | 208 | 1420 | 1800 | 717 | 822 | 251 |
| 29 | 245 | 476 | 460 | 508 | 498 | 515 | 224 | 1330 | 1620 | 658 | 695 | 250 |
| 30 | 265 | 475 | 460 | 507 | --- | 505 | 266 | 1170 | 1500 | 711 | 661 | 245 |
| 31 | 357 | --- | 470 | 501 | --- | 510 | --- | 1160 | --- | 695 | 695 | --- |
| TOTAL | 6891 | 14579 | 15163 | 15150 | 13913 | 16796 | 10504 | 26361 | 36538 | 25856 | 23176 | 12044 |
| MEAN | 222 | 486 | 489 | 489 | 480 | 542 | 350 | 850 | 1218 | 834 | 748 | 401 |
| MAX | 357 | 579 | 555 | 535 | 512 | 735 | 500 | 1530 | 1800 | 1200 | 1740 | 647 |
| MIN | 199 | 399 | 431 | 450 | 433 | 476 | 208 | 293 | 813 | 644 | 456 | 245 |
| AC-FT | 13670 | 28920 | 30080 | 30050 | 27600 | 33310 | 20830 | 52290 | 72470 | 51290 | 45970 | 23890 |

UNITED STATES DEPARTMENT OF THE INTERIOR - GEOLOGICAL SURVEY - CO DATA 10/27/95

STATION NUMBER 07096000 ARKANSAS RIVER AT CANON CITY, CO. STREAM SOURCE AGENCY USGS
LATITUDE 382602 LONGITUDE 1051524 DRAINAGE AREA 3117.00 DATUM 5342.13 STATE 08 COUNTY 043

DISCHARGE, CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1990 TO SEPTEMBER 1991
DAILY MEAN VALUES

| DAY | OCT | NOV | DEC | JAN | FEB | MAR | APR | MAY | JUN | JUL | AUG | SEP |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 375 | 408 | 406 | 580 | 521 | 508 | 348 | 330 | 1390 | 1150 | 643 | 308 |
| 2 | 328 | 410 | 409 | 570 | 527 | 515 | 358 | 440 | 1290 | 1050 | 653 | 306 |
| 3 | 375 | 506 | 398 | 560 | 538 | 435 | 344 | 447 | 1160 | 974 | 717 | 305 |
| 4 | 375 | 448 | 364 | 640 | 541 | 421 | 326 | 496 | 984 | 911 | 891 | 311 |
| 5 | 351 | 436 | 410 | 670 | 536 | 437 | 312 | 522 | 822 | 858 | 953 | 301 |
| 6 | 334 | 484 | 432 | 640 | 543 | 359 | 354 | 463 | 920 | 768 | 844 | 292 |
| 7 | 318 | 492 | 404 | 608 | 552 | 333 | 481 | 406 | 1250 | 663 | 844 | 273 |
| 8 | 351 | 487 | 406 | 550 | 552 | 311 | 497 | 400 | 1420 | 666 | 823 | 272 |
| 9 | 375 | 517 | 414 | 559 | 552 | 373 | 466 | 418 | 1490 | 856 | 796 | 280 |
| 10 | 351 | 539 | 412 | 549 | 531 | 408 | 428 | 546 | 1820 | 890 | 836 | 292 |
| 11 | 363 | 543 | 414 | 597 | 517 | 420 | 418 | 592 | 2040 | 880 | 798 | 294 |
| 12 | 375 | 534 | 415 | 596 | 497 | 419 | 407 | 588 | 2170 | 846 | 747 | 290 |
| 13 | 363 | 551 | 434 | 596 | 479 | 406 | 369 | 673 | 2460 | 680 | 744 | 284 |
| 14 | 345 | 592 | 438 | 625 | 478 | 408 | 363 | 710 | 2230 | 639 | 668 | 298 |
| 15 | 334 | 601 | 388 | 592 | 484 | 410 | 363 | 776 | 2140 | 640 | 656 | 294 |
| 16 | 318 | 586 | 394 | 578 | 493 | 420 | 345 | 743 | 2310 | 631 | 600 | 278 |
| 17 | 312 | 526 | 431 | 557 | 521 | 429 | 340 | 662 | 2190 | 605 | 557 | 279 |
| 18 | 306 | 528 | 406 | 556 | 531 | 422 | 351 | 568 | 1940 | 653 | 522 | 294 |
| 19 | 306 | 533 | 391 | 549 | 516 | 414 | 376 | 527 | 1880 | 695 | 519 | 304 |
| 20 | 375 | 539 | 373 | 551 | 517 | 414 | 345 | 755 | 1770 | 696 | 470 | 296 |
| 21 | 425 | 548 | 290 | 545 | 527 | 406 | 314 | 1060 | 1660 | 666 | 477 | 292 |
| 22 | 425 | 492 | 240 | 526 | 528 | 399 | 314 | 1110 | 1700 | 717 | 451 | 278 |
| 23 | 431 | 451 | 280 | 500 | 529 | 388 | 318 | 1290 | 1750 | 836 | 431 | 243 |
| 24 | 451 | 442 | 310 | 504 | 529 | 381 | 323 | 1400 | 1590 | 827 | 431 | 226 |
| 25 | 464 | 447 | 330 | 518 | 515 | 383 | 310 | 1110 | 1390 | 825 | 400 | 217 |
| 26 | 457 | 444 | 360 | 500 | 508 | 377 | 288 | 1040 | 1300 | 930 | 403 | 215 |
| 27 | 451 | 459 | 420 | 523 | 506 | 379 | 291 | 1200 | 1220 | 851 | 369 | 211 |
| 28 | 451 | 430 | 490 | 524 | 505 | 365 | 290 | 1400 | 1030 | 786 | 346 | 212 |
| 29 | 431 | 376 | 520 | 510 | --- | 358 | 310 | 1480 | 947 | 741 | 330 | 211 |
| 30 | 425 | 379 | 540 | 484 | --- | 367 | 285 | 1440 | 1050 | 649 | 322 | 211 |
| 31 | 412 | --- | 560 | 517 | --- | 345 | --- | 1490 | --- | 636 | 310 | --- |
| TOTAL | 11753 | 14728 | 12479 | 17374 | 14573 | 12410 | 10634 | 25082 | 47313 | 24215 | 18551 | 8167 |
| MEAN | 379 | 491 | 403 | 560 | 520 | 400 | 354 | 809 | 1577 | 781 | 598 | 272 |
| MAX | 464 | 601 | 560 | 670 | 552 | 515 | 497 | 1490 | 2460 | 1150 | 953 | 311 |
| MIN | 306 | 376 | 240 | 484 | 478 | 311 | 285 | 330 | 822 | 605 | 310 | 211 |
| AC-FT | 23310 | 29210 | 24750 | 34460 | 28910 | 24620 | 21090 | 49750 | 93850 | 48030 | 36800 | 16200 |

UNITED STATES DEPARTMENT OF THE INTERIOR - GEOLOGICAL SURVEY - CO DATA 10/27/95

STATION NUMBER 07096000 ARKANSAS RIVER AT CANON CITY, CO. STREAM SOURCE AGENCY USGS
LATITUDE 382602 LONGITUDE 1051524 DRAINAGE AREA 3117.00 DATUM 5342.13 STATE 08 COUNTY 043

DISCHARGE, CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1989 TO SEPTEMBER 1990
DAILY MEAN VALUES

| DAY | OCT | NOV | DEC | JAN | FEB | MAR | APR | MAY | JUN | JUL | AUG | SEP |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 240 | 306 | 345 | 301 | 290 | 323 | 290 | 265 | 767 | 1070 | 695 | 234 |
| 2 | 237 | 318 | 345 | 312 | 280 | 318 | 296 | 250 | 801 | 1000 | 671 | 224 |
| 3 | 234 | 312 | 340 | 318 | 270 | 318 | 270 | 290 | 719 | 923 | 671 | 218 |
| 4 | 224 | 323 | 351 | 301 | 245 | 318 | 250 | 328 | 687 | 887 | 679 | 214 |
| 5 | 227 | 340 | 345 | 275 | 260 | 323 | 250 | 425 | 1270 | 977 | 687 | 221 |
| 6 | 234 | 340 | 375 | 270 | 255 | 357 | 255 | 655 | 2420 | 1250 | 719 | 245 |
| 7 | 230 | 334 | 369 | 301 | 255 | 351 | 255 | 860 | 2820 | 1450 | 647 | 250 |
| 8 | 227 | 345 | 340 | 328 | 250 | 328 | 245 | 585 | 3030 | 1290 | 600 | 250 |
| 9 | 218 | 425 | 345 | 340 | 250 | 318 | 234 | 412 | 3260 | 1320 | 623 | 237 |
| 10 | 214 | 444 | 363 | 328 | 250 | 328 | 237 | 387 | 3280 | 1330 | 639 | 227 |
| 11 | 214 | 464 | 363 | 328 | 250 | 334 | 230 | 318 | 3580 | 1240 | 647 | 224 |
| 12 | 208 | 505 | 312 | 334 | 265 | 334 | 224 | 275 | 3540 | 986 | 703 | 218 |
| 13 | 211 | 498 | 290 | 318 | 270 | 334 | 218 | 290 | 3310 | 860 | 751 | 211 |
| 14 | 211 | 498 | 323 | 312 | 275 | 312 | 204 | 280 | 2680 | 835 | 759 | 208 |
| 15 | 214 | 444 | 328 | 301 | 270 | 285 | 199 | 260 | 2320 | 852 | 775 | 208 |
| 16 | 227 | 290 | 340 | 296 | 312 | 280 | 195 | 245 | 2070 | 826 | 792 | 203 |
| 17 | 270 | 265 | 318 | 275 | 306 | 285 | 197 | 245 | 1810 | 932 | 759 | 206 |
| 18 | 270 | 280 | 318 | 275 | 296 | 290 | 201 | 230 | 1540 | 995 | 727 | 221 |
| 19 | 270 | 275 | 318 | 290 | 301 | 296 | 206 | 218 | 1480 | 887 | 671 | 250 |
| 20 | 265 | 275 | 340 | 296 | 285 | 280 | 234 | 221 | 1560 | 932 | 639 | 260 |
| 21 | 270 | 275 | 340 | 290 | 280 | 265 | 227 | 208 | 1640 | 914 | 578 | 240 |
| 22 | 290 | 265 | 318 | 280 | 290 | 255 | 214 | 211 | 1580 | 950 | 505 | 230 |
| 23 | 290 | 260 | 369 | 290 | 285 | 255 | 199 | 294 | 1550 | 932 | 491 | 227 |
| 24 | 285 | 255 | 381 | 290 | 296 | 255 | 192 | 585 | 1510 | 878 | 464 | 227 |
| 25 | 285 | 260 | 381 | 265 | 301 | 255 | 194 | 869 | 1400 | 852 | 425 | 221 |
| 26 | 296 | 260 | 363 | 280 | 306 | 260 | 211 | 1090 | 1330 | 792 | 369 | 224 |
| 27 | 285 | 250 | 357 | 290 | 318 | 260 | 208 | 1200 | 1200 | 711 | 328 | 224 |
| 28 | 275 | 240 | 345 | 255 | 323 | 255 | 218 | 1080 | 1210 | 711 | 301 | 269 |
| 29 | 285 | 275 | 340 | 240 | --- | 275 | 211 | 1090 | 1220 | 727 | 290 | 393 |
| 30 | 290 | 323 | 357 | 275 | --- | 275 | 240 | 1160 | 1180 | 727 | 280 | 418 |
| 31 | 290 | --- | 334 | 285 | --- | 270 | --- | 869 | --- | 711 | 255 | --- |
| TOTAL | 7786 | 9944 | 10653 | 9139 | 7834 | 9192 | 6804 | 15695 | 56764 | 29747 | 18140 | 7202 |
| MEAN | 251 | 331 | 344 | 295 | 280 | 297 | 227 | 506 | 1892 | 960 | 585 | 240 |
| MAX | 296 | 505 | 381 | 340 | 323 | 357 | 296 | 1200 | 3580 | 1450 | 792 | 418 |
| MIN | 208 | 240 | 290 | 240 | 245 | 255 | 192 | 208 | 687 | 711 | 255 | 203 |
| AC-FT | 15440 | 19720 | 21130 | 18130 | 15540 | 18230 | 13500 | 31130 | 112600 | 59000 | 35980 | 14290 |

UNITED STATES DEPARTMENT OF THE INTERIOR - GEOLOGICAL SURVEY - CO DATA 10/27/95

STATION NUMBER 07096000 ARKANSAS RIVER AT CANON CITY, CO. STREAM SOURCE AGENCY USGS
LATITUDE 382602 LONGITUDE 1051524 DRAINAGE AREA 3117.00 DATUM 5342.13 STATE 08 COUNTY 043

DISCHARGE, CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1988 TO SEPTEMBER 1989
DAILY MEAN VALUES

| DAY | OCT | NOV | DEC | JAN | FEB | MAR | APR | MAY | JUN | JUL | AUG | SEP |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 230 | 255 | 387 | 369 | 301 | 363 | 639 | 592 | 1590 | 1080 | 1310 | 230 |
| 2 | 221 | 237 | 393 | 375 | 306 | 369 | 639 | 540 | 1400 | 1120 | 1410 | 245 |
| 3 | 237 | 260 | 381 | 363 | 275 | 387 | 600 | 405 | 1350 | 1110 | 1450 | 237 |
| 4 | 240 | 265 | 381 | 357 | 220 | 369 | 570 | 340 | 1300 | 1090 | 1360 | 230 |
| 5 | 237 | 265 | 375 | 357 | 190 | 498 | 526 | 237 | 1150 | 1070 | 1250 | 234 |
| 6 | 240 | 270 | 375 | 363 | 190 | 526 | 519 | 255 | 986 | 1050 | 1180 | 227 |
| 7 | 275 | 270 | 381 | 334 | 180 | 592 | 519 | 255 | 986 | 1040 | 1140 | 214 |
| 8 | 275 | 275 | 387 | 245 | 220 | 655 | 533 | 270 | 1100 | 1060 | 1010 | 208 |
| 9 | 270 | 285 | 363 | 234 | 210 | 743 | 585 | 296 | 1190 | 1080 | 905 | 208 |
| 10 | 270 | 285 | 357 | 351 | 260 | 914 | 592 | 438 | 1140 | 1080 | 896 | 211 |
| 11 | 260 | 285 | 363 | 375 | 300 | 950 | 563 | 663 | 1030 | 995 | 950 | 208 |
| 12 | 260 | 296 | 357 | 357 | 320 | 1000 | 570 | 835 | 1030 | 1020 | 1010 | 224 |
| 13 | 250 | 301 | 369 | 270 | 387 | 959 | 570 | 896 | 1240 | 1440 | 1100 | 318 |
| 14 | 245 | 296 | 375 | 275 | 340 | 968 | 592 | 835 | 1250 | 1380 | 1010 | 369 |
| 15 | 255 | 323 | 381 | 328 | 323 | 835 | 679 | 735 | 1110 | 1290 | 995 | 306 |
| 16 | 255 | 340 | 357 | 318 | 328 | 767 | 687 | 695 | 1150 | 1200 | 995 | 265 |
| 17 | 240 | 323 | 345 | 323 | 328 | 767 | 695 | 751 | 1530 | 1150 | 995 | 255 |
| 18 | 240 | 312 | 345 | 318 | 323 | 759 | 703 | 526 | 1710 | 1070 | 932 | 250 |
| 19 | 240 | 312 | 363 | 306 | 357 | 727 | 727 | 340 | 1680 | 959 | 835 | 237 |
| 20 | 237 | 301 | 369 | 301 | 357 | 743 | 801 | 381 | 1660 | 869 | 775 | 280 |
| 21 | 230 | 323 | 345 | 296 | 312 | 687 | 809 | 512 | 1550 | 869 | 743 | 328 |
| 22 | 240 | 328 | 345 | 290 | 285 | 695 | 852 | 735 | 1500 | 968 | 703 | 296 |
| 23 | 245 | 340 | 340 | 290 | 296 | 759 | 887 | 905 | 1300 | 995 | 679 | 296 |
| 24 | 245 | 363 | 334 | 296 | 334 | 818 | 835 | 1100 | 1080 | 1090 | 679 | 280 |
| 25 | 250 | 375 | 351 | 290 | 357 | 818 | 792 | 1260 | 932 | 1300 | 615 | 245 |
| 26 | 250 | 357 | 363 | 290 | 431 | 809 | 751 | 1180 | 869 | 1510 | 555 | 240 |
| 27 | 245 | 357 | 318 | 280 | 464 | 801 | 801 | 932 | 923 | 1610 | 533 | 255 |
| 28 | 245 | 375 | 270 | 275 | 393 | 743 | 743 | 809 | 923 | 1540 | 519 | 260 |
| 29 | 250 | 393 | 260 | 285 | --- | 687 | 631 | 941 | 887 | 1340 | 470 | 260 |
| 30 | 250 | 393 | 280 | 280 | --- | 687 | 608 | 1420 | 932 | 1360 | 296 | 250 |
| 31 | 255 | --- | 340 | 296 | --- | 655 | --- | 1660 | --- | 1420 | 250 | --- |
| TOTAL | 7682 | 9360 | 10950 | 9687 | 8587 | 22050 | 20018 | 21739 | 36478 | 36155 | 27550 | 7666 |
| MEAN | 248 | 312 | 353 | 312 | 307 | 711 | 667 | 701 | 1216 | 1166 | 889 | 256 |
| MAX | 275 | 393 | 393 | 375 | 464 | 1000 | 887 | 1660 | 1710 | 1610 | 1450 | 369 |
| MIN | 221 | 237 | 260 | 234 | 180 | 363 | 519 | 237 | 869 | 869 | 250 | 208 |
| AC-FT | 15240 | 18570 | 21720 | 19210 | 17030 | 43740 | 39710 | 43120 | 72350 | 71710 | 54650 | 15210 |

UNITED STATES DEPARTMENT OF THE INTERIOR - GEOLOGICAL SURVEY - CO DATA 10/27/95

STATION NUMBER 07096000 ARKANSAS RIVER AT CANON CITY, CO. STREAM SOURCE AGENCY USGS
LATITUDE 382602 LONGITUDE 1051524 DRAINAGE AREA 3117.00 DATUM 5342.13 STATE 08 COUNTY 043

DISCHARGE, CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1987 TO SEPTEMBER 1988
DAILY MEAN VALUES

| DAY | OCT | NOV | DEC | JAN | FEB | MAR | APR | MAY | JUN | JUL | AUG | SEP |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 363 | 375 | 405 | 328 | 363 | 399 | 323 | 318 | 986 | 1890 | 1070 | 381 |
| 2 | 351 | 369 | 418 | 315 | 363 | 418 | 323 | 381 | 852 | 1460 | 818 | 431 |
| 3 | 328 | 369 | 420 | 330 | 375 | 412 | 328 | 363 | 727 | 1250 | 740 | 399 |
| 4 | 328 | 357 | 444 | 380 | 381 | 399 | 375 | 345 | 923 | 1090 | 679 | 363 |
| 5 | 323 | 351 | 444 | 405 | 387 | 393 | 464 | 328 | 1770 | 995 | 618 | 334 |
| 6 | 318 | 340 | 444 | 385 | 387 | 381 | 412 | 328 | 2350 | 896 | 498 | 328 |
| 7 | 312 | 345 | 431 | 356 | 392 | 394 | 381 | 328 | 2280 | 852 | 529 | 306 |
| 8 | 306 | 351 | 419 | 385 | 405 | 375 | 369 | 345 | 2130 | 818 | 512 | 296 |
| 9 | 312 | 340 | 405 | 385 | 405 | 334 | 351 | 340 | 2100 | 759 | 487 | 285 |
| 10 | 306 | 340 | 405 | 390 | 381 | 357 | 334 | 334 | 2110 | 711 | 477 | 265 |
| 11 | 312 | 345 | 424 | 390 | 357 | 351 | 296 | 345 | 2040 | 695 | 402 | 240 |
| 12 | 306 | 351 | 431 | 380 | 363 | 328 | 265 | 418 | 2080 | 655 | 393 | 290 |
| 13 | 312 | 345 | 387 | 350 | 369 | 318 | 255 | 438 | 1890 | 600 | 390 | 548 |
| 14 | 334 | 351 | 380 | 360 | 351 | 345 | 264 | 532 | 1660 | 570 | 387 | 470 |
| 15 | 351 | 363 | 351 | 390 | 334 | 477 | 275 | 735 | 1350 | 512 | 366 | 424 |
| 16 | 369 | 369 | 328 | 390 | 351 | 491 | 280 | 941 | 1250 | 484 | 357 | 393 |
| 17 | 368 | 345 | 375 | 400 | 363 | 375 | 418 | 1090 | 1270 | 498 | 399 | 381 |
| 18 | 363 | 347 | 407 | 400 | 328 | 323 | 505 | 1190 | 1300 | 484 | 477 | 323 |
| 19 | 363 | 357 | 412 | 400 | 328 | 316 | 477 | 1250 | 1230 | 464 | 519 | 296 |
| 20 | 366 | 387 | 405 | 360 | 345 | 334 | 444 | 1230 | 1320 | 444 | 578 | 296 |
| 21 | 363 | 399 | 375 | 351 | 340 | 381 | 425 | 1100 | 1510 | 412 | 404 | 290 |
| 22 | 357 | 412 | 371 | 357 | 345 | 399 | 393 | 968 | 1600 | 375 | 405 | 280 |
| 23 | 366 | 412 | 375 | 380 | 351 | 405 | 369 | 818 | 1750 | 363 | 498 | 284 |
| 24 | 357 | 405 | 375 | 390 | 345 | 399 | 457 | 663 | 1700 | 340 | 470 | 270 |
| 25 | 363 | 399 | 357 | 400 | 345 | 375 | 477 | 592 | 1510 | 328 | 450 | 260 |
| 26 | 370 | 399 | 336 | 399 | 351 | 363 | 345 | 743 | 1370 | 328 | 563 | 259 |
| 27 | 369 | 412 | 334 | 412 | 357 | 387 | 328 | 923 | 1390 | 470 | 570 | 240 |
| 28 | 375 | 409 | 328 | 393 | 381 | 399 | 312 | 1060 | 1420 | 399 | 548 | 234 |
| 29 | 388 | 412 | 328 | 381 | 399 | 375 | 280 | 1170 | 1740 | 451 | 521 | 227 |
| 30 | 387 | 418 | 353 | 375 | --- | 328 | 270 | 1250 | 2100 | 615 | 484 | 224 |
| 31 | 381 | --- | 332 | 375 | --- | 347 | --- | 1220 | --- | 1220 | 405 | --- |
| TOTAL | 10767 | 11174 | 11999 | 11692 | 10542 | 11678 | 10795 | 22086 | 47708 | 21428 | 16014 | 9617 |
| MEAN | 347 | 372 | 387 | 377 | 364 | 377 | 360 | 712 | 1590 | 691 | 517 | 321 |
| MAX | 388 | 418 | 444 | 412 | 405 | 491 | 505 | 1250 | 2350 | 1890 | 1070 | 548 |
| MIN | 306 | 340 | 328 | 315 | 328 | 316 | 255 | 318 | 727 | 328 | 357 | 224 |
| AC-FT | 21360 | 22160 | 23800 | 23190 | 20910 | 23160 | 21410 | 43810 | 94630 | 42500 | 31760 | 19080 |

UNITED STATES DEPARTMENT OF THE INTERIOR - GEOLOGICAL SURVEY - CO DATA 10/27/95

STATION NUMBER 07096000 ARKANSAS RIVER AT CANON CITY, CO. STREAM SOURCE AGENCY USGS
LATITUDE 382602 LONGITUDE 1051524 DRAINAGE AREA 3117.00 DATUM 5342.13 STATE 08 COUNTY 043

DISCHARGE, CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1986 TO SEPTEMBER 1987
DAILY MEAN VALUES

| DAY | OCT | NOV | DEC | JAN | FEB | MAR | APR | MAY | JUN | JUL | AUG | SEP |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 477 | 570 | 548 | 440 | 390 | 387 | 519 | 1830 | 1420 | 1900 | 794 | 512 |
| 2 | 450 | 533 | 512 | 450 | 400 | 399 | 555 | 1820 | 1620 | 1700 | 860 | 505 |
| 3 | 438 | 540 | 519 | 440 | 400 | 405 | 512 | 1830 | 1920 | 1510 | 843 | 548 |
| 4 | 450 | 578 | 526 | 440 | 400 | 414 | 513 | 1830 | 2220 | 1420 | 834 | 519 |
| 5 | 450 | 608 | 505 | 460 | 410 | 431 | 525 | 1620 | 2530 | 1300 | 751 | 548 |
| 6 | 438 | 592 | 498 | 460 | 387 | 450 | 505 | 1540 | 2710 | 1230 | 684 | 558 |
| 7 | 431 | 587 | 519 | 460 | 381 | 470 | 529 | 1480 | 2900 | 1060 | 610 | 548 |
| 8 | 418 | 592 | 505 | 440 | 399 | 531 | 555 | 1310 | 3380 | 977 | 580 | 555 |
| 9 | 405 | 548 | 505 | 440 | 405 | 548 | 601 | 1360 | 4810 | 998 | 751 | 533 |
| 10 | 399 | 548 | 490 | 400 | 405 | 526 | 661 | 1450 | 5460 | 995 | 647 | 479 |
| 11 | 482 | 563 | 418 | 400 | 412 | 513 | 711 | 1560 | 4610 | 952 | 578 | 470 |
| 12 | 526 | 569 | 457 | 400 | 425 | 498 | 1060 | 1720 | 3960 | 900 | 592 | 457 |
| 13 | 498 | 563 | 484 | 400 | 425 | 491 | 959 | 2040 | 3650 | 900 | 623 | 431 |
| 14 | 516 | 583 | 477 | 420 | 431 | 526 | 800 | 2290 | 3550 | 860 | 608 | 414 |
| 15 | 548 | 600 | 484 | 400 | 431 | 533 | 797 | 2930 | 3550 | 840 | 570 | 412 |
| 16 | 533 | 611 | 498 | 340 | 412 | 562 | 959 | 3360 | 3690 | 848 | 540 | 418 |
| 17 | 514 | 615 | 512 | 290 | 412 | 533 | 1380 | 4630 | 3630 | 878 | 555 | 425 |
| 18 | 512 | 631 | 498 | 280 | 405 | 512 | 1800 | 4890 | 3330 | 862 | 563 | 425 |
| 19 | 519 | 639 | 491 | 285 | 412 | 519 | 1790 | 4490 | 3010 | 860 | 639 | 425 |
| 20 | 563 | 655 | 498 | 323 | 393 | 578 | 1790 | 4100 | 2710 | 850 | 578 | 418 |
| 21 | 592 | 611 | 491 | 323 | 369 | 555 | 1280 | 3490 | 2500 | 850 | 540 | 418 |
| 22 | 562 | 615 | 484 | 312 | 357 | 562 | 1080 | 3090 | 2340 | 870 | 585 | 431 |
| 23 | 533 | 615 | 457 | 405 | 375 | 555 | 1040 | 2830 | 2210 | 960 | 671 | 405 |
| 24 | 526 | 548 | 457 | 420 | 387 | 533 | 1180 | 2460 | 2180 | 930 | 719 | 393 |
| 25 | 512 | 555 | 457 | 400 | 402 | 526 | 1260 | 2310 | 2080 | 900 | 719 | 375 |
| 26 | 498 | 578 | 431 | 390 | 431 | 526 | 1290 | 2090 | 1920 | 870 | 735 | 369 |
| 27 | 484 | 563 | 425 | 390 | 418 | 533 | 1290 | 1880 | 1860 | 850 | 759 | 369 |
| 28 | 491 | 548 | 438 | 390 | 375 | 512 | 1380 | 1690 | 1770 | 860 | 689 | 375 |
| 29 | 526 | 562 | 438 | 400 | --- | 491 | 1590 | 1550 | 1780 | 1010 | 608 | 375 |
| 30 | 526 | 563 | 460 | 390 | --- | 484 | 1740 | 1450 | 1970 | 1050 | 570 | 369 |
| 31 | 491 | --- | 450 | 380 | --- | 491 | --- | 1370 | --- | 818 | 548 | --- |
| TOTAL | 15308 | 17483 | 14932 | 12168 | 11249 | 15594 | 30651 | 72290 | 85270 | 31808 | 20343 | 13479 |
| MEAN | 494 | 583 | 482 | 393 | 402 | 503 | 1022 | 2332 | 2842 | 1026 | 656 | 449 |
| MAX | 592 | 655 | 548 | 460 | 431 | 578 | 1800 | 4890 | 5460 | 1900 | 860 | 558 |
| MIN | 399 | 533 | 418 | 280 | 357 | 387 | 505 | 1310 | 1420 | 818 | 540 | 369 |
| AC-FT | 30360 | 34680 | 29620 | 24140 | 22310 | 30930 | 60800 | 143400 | 169100 | 63090 | 40350 | 26740 |

UNITED STATES DEPARTMENT OF THE INTERIOR - GEOLOGICAL SURVEY - CO DATA 10/27/95

STATION NUMBER 07096000 ARKANSAS RIVER AT CANON CITY, CO. STREAM SOURCE AGENCY USGS
LATITUDE 382602 LONGITUDE 1051524 DRAINAGE AREA 3117.00 DATUM 5342.13 STATE 08 COUNTY 043

DISCHARGE, CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1985 TO SEPTEMBER 1986
DAILY MEAN VALUES

| DAY | OCT | NOV | DEC | JAN | FEB | MAR | APR | MAY | JUN | JUL | AUG | SEP |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 484 | 570 | 555 | 387 | 370 | 340 | 334 | 387 | 1770 | 3720 | 950 | 687 |
| 2 | 464 | 526 | 533 | 381 | 370 | 340 | 351 | 444 | 1920 | 3230 | 932 | 687 |
| 3 | 451 | 512 | 540 | 387 | 360 | 350 | 357 | 585 | 2180 | 3110 | 932 | 655 |
| 4 | 444 | 519 | 540 | 375 | 350 | 350 | 369 | 923 | 2740 | 3000 | 914 | 631 |
| 5 | 457 | 519 | 526 | 369 | 350 | 340 | 345 | 1040 | 3230 | 3010 | 914 | 671 |
| 6 | 425 | 519 | 505 | 387 | 340 | 340 | 340 | 1360 | 3700 | 3330 | 869 | 600 |
| 7 | 412 | 505 | 505 | 375 | 340 | 330 | 375 | 1120 | 4430 | 3450 | 887 | 578 |
| 8 | 431 | 470 | 512 | 387 | 330 | 330 | 405 | 800 | 4850 | 3470 | 860 | 578 |
| 9 | 484 | 451 | 512 | 393 | 330 | 330 | 405 | 1090 | 4940 | 3280 | 843 | 600 |
| 10 | 491 | 451 | 512 | 399 | 320 | 340 | 363 | 1280 | 4510 | 2980 | 809 | 623 |
| 11 | 491 | 451 | 464 | 387 | 310 | 350 | 318 | 1140 | 3500 | 2700 | 784 | 679 |
| 12 | 512 | 477 | 381 | 375 | 300 | 345 | 290 | 1040 | 2950 | 2550 | 751 | 679 |
| 13 | 526 | 484 | 363 | 369 | 310 | 357 | 280 | 959 | 2740 | 2320 | 735 | 655 |
| 14 | 548 | 484 | 393 | 375 | 310 | 345 | 270 | 1140 | 2900 | 2220 | 695 | 639 |
| 15 | 555 | 477 | 451 | 381 | 320 | 345 | 240 | 1410 | 3110 | 2180 | 695 | 608 |
| 16 | 548 | 491 | 438 | 369 | 330 | 345 | 369 | 1570 | 3310 | 1920 | 639 | 563 |
| 17 | 600 | 491 | 444 | 369 | 340 | 329 | 498 | 1750 | 3670 | 1790 | 593 | 540 |
| 18 | 615 | 519 | 464 | 369 | 340 | 345 | 498 | 1700 | 3920 | 1860 | 803 | 512 |
| 19 | 585 | 526 | 512 | 369 | 350 | 345 | 498 | 1550 | 4250 | 1970 | 639 | 498 |
| 20 | 563 | 484 | 548 | 375 | 360 | 345 | 498 | 1450 | 4650 | 2110 | 585 | 470 |
| 21 | 548 | 491 | 533 | 360 | 350 | 351 | 505 | 1760 | 4490 | 2200 | 631 | 444 |
| 22 | 540 | 512 | 519 | 335 | 350 | 345 | 519 | 1850 | 4230 | 2140 | 695 | 425 |
| 23 | 548 | 526 | 491 | 340 | 360 | 340 | 548 | 1920 | 3980 | 1930 | 929 | 418 |
| 24 | 563 | 533 | 491 | 350 | 360 | 334 | 570 | 1920 | 3870 | 1810 | 923 | 405 |
| 25 | 555 | 563 | 464 | 340 | 360 | 318 | 425 | 1890 | 3770 | 1760 | 800 | 418 |
| 26 | 548 | 578 | 438 | 325 | 370 | 307 | 399 | 1930 | 3740 | 1600 | 860 | 438 |
| 27 | 533 | 585 | 438 | 330 | 360 | 301 | 451 | 2150 | 3980 | 1460 | 834 | 470 |
| 28 | 526 | 563 | 425 | 350 | 350 | 301 | 438 | 2180 | 4100 | 1360 | 735 | 526 |
| 29 | 519 | 555 | 405 | 360 | --- | 301 | 393 | 2080 | 4040 | 1270 | 687 | 540 |
| 30 | 519 | 570 | 412 | 360 | --- | 318 | 369 | 1930 | 3890 | 1130 | 727 | 570 |
| 31 | 526 | --- | 405 | 370 | --- | 329 | --- | 1770 | --- | 1000 | 703 | --- |
| TOTAL | 16011 | 15402 | 14719 | 11398 | 9590 | 10386 | 12020 | 44118 | 109360 | 71860 | 24353 | 16807 |
| MEAN | 516 | 513 | 475 | 368 | 342 | 335 | 401 | 1423 | 3645 | 2318 | 786 | 560 |
| MAX | 615 | 585 | 555 | 399 | 370 | 357 | 570 | 2180 | 4940 | 3720 | 950 | 687 |
| MIN | 412 | 451 | 363 | 325 | 300 | 301 | 240 | 387 | 1770 | 1000 | 585 | 405 |
| AC-FT | 31760 | 30550 | 29200 | 22610 | 19020 | 20600 | 23840 | 87510 | 216900 | 142500 | 48300 | 33340 |

UNITED STATES DEPARTMENT OF THE INTERIOR - GEOLOGICAL SURVEY - CO DATA 10/27/95

STATION NUMBER 07096000 ARKANSAS RIVER AT CANON CITY, CO. STREAM SOURCE AGENCY USGS
LATITUDE 382602 LONGITUDE 1051524 DRAINAGE AREA 3117.00 DATUM 5342.13 STATE 08 COUNTY 043

DISCHARGE, CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1984 TO SEPTEMBER 1985
DAILY MEAN VALUES

| DAY | OCT | NOV | DEC | JAN | FEB | MAR | APR | MAY | JUN | JUL | AUG | SEP |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 470 | 860 | 484 | 457 | 759 | 687 | 843 | 1350 | 2610 | 2000 | 1380 | 470 |
| 2 | 451 | 711 | 491 | 393 | 727 | 679 | 878 | 1400 | 2410 | 1930 | 1290 | 451 |
| 3 | 444 | 671 | 477 | 351 | 818 | 655 | 959 | 1470 | 2280 | 1840 | 1320 | 438 |
| 4 | 743 | 711 | 477 | 381 | 834 | 631 | 1010 | 1610 | 2340 | 1770 | 1270 | 405 |
| 5 | 826 | 695 | 484 | 399 | 834 | 608 | 663 | 1860 | 2550 | 1750 | 1160 | 387 |
| 6 | 735 | 679 | 457 | 418 | 826 | 431 | 519 | 2170 | 3080 | 1790 | 1070 | 387 |
| 7 | 809 | 687 | 451 | 431 | 818 | 351 | 484 | 2220 | 3890 | 1920 | 950 | 381 |
| 8 | 860 | 639 | 464 | 431 | 818 | 345 | 585 | 2240 | 5270 | 1960 | 887 | 381 |
| 9 | 834 | 608 | 505 | 457 | 852 | 340 | 655 | 2310 | 6810 | 1850 | 843 | 381 |
| 10 | 809 | 593 | 519 | 444 | 826 | 345 | 655 | 2340 | 7580 | 1790 | 800 | 381 |
| 11 | 751 | 593 | 519 | 412 | 826 | 375 | 585 | 2280 | 6670 | 1770 | 932 | 381 |
| 12 | 727 | 608 | 519 | 387 | 826 | 412 | 585 | 2200 | 5190 | 1670 | 775 | 484 |
| 13 | 679 | 608 | 519 | 369 | 719 | 412 | 578 | 1860 | 4730 | 1620 | 719 | 505 |
| 14 | 600 | 600 | 491 | 387 | 735 | 375 | 593 | 1550 | 4510 | 1710 | 671 | 484 |
| 15 | 671 | 593 | 491 | 399 | 784 | 363 | 593 | 1330 | 4510 | 1720 | 671 | 484 |
| 16 | 727 | 548 | 505 | 405 | 809 | 431 | 647 | 1180 | 4510 | 1750 | 655 | 464 |
| 17 | 767 | 585 | 491 | 399 | 809 | 784 | 663 | 1150 | 4470 | 1700 | 608 | 405 |
| 18 | 818 | 585 | 491 | 425 | 809 | 826 | 671 | 1290 | 4290 | 1720 | 578 | 363 |
| 19 | 932 | 578 | 477 | 451 | 792 | 860 | 703 | 1480 | 4150 | 1830 | 563 | 363 |
| 20 | 1050 | 555 | 470 | 451 | 784 | 869 | 719 | 1510 | 3940 | 2150 | 563 | 375 |
| 21 | 1040 | 540 | 464 | 418 | 784 | 860 | 600 | 1600 | 3580 | 2220 | 548 | 418 |
| 22 | 1040 | 526 | 444 | 431 | 767 | 860 | 540 | 1660 | 3420 | 2730 | 563 | 418 |
| 23 | 995 | 533 | 425 | 775 | 784 | 809 | 505 | 1520 | 3280 | 2950 | 563 | 387 |
| 24 | 809 | 563 | 431 | 735 | 711 | 809 | 464 | 1460 | 3050 | 2760 | 615 | 393 |
| 25 | 759 | 570 | 418 | 759 | 703 | 818 | 451 | 1430 | 3000 | 2360 | 743 | 405 |
| 26 | 751 | 563 | 425 | 826 | 711 | 809 | 655 | 1560 | 3080 | 2150 | 663 | 418 |
| 27 | 775 | 519 | 438 | 843 | 695 | 792 | 923 | 1960 | 2700 | 1900 | 498 | 418 |
| 28 | 818 | 491 | 470 | 860 | 695 | 800 | 1040 | 2150 | 2340 | 1740 | 491 | 399 |
| 29 | 800 | 526 | 484 | 834 | --- | 852 | 1350 | 2920 | 2220 | 1860 | 519 | 425 |
| 30 | 843 | 498 | 470 | 809 | --- | 809 | 1430 | 3030 | 2150 | 1800 | 498 | 477 |
| 31 | 959 | --- | 451 | 767 | --- | 818 | --- | 2890 | --- | 1550 | 464 | --- |
| TOTAL | 24292 | 18036 | 14702 | 16304 | 21855 | 19815 | 21546 | 56980 | 114610 | 60260 | 23870 | 12528 |
| MEAN | 784 | 601 | 474 | 526 | 781 | 639 | 718 | 1838 | 3820 | 1944 | 770 | 418 |
| MAX | 1050 | 860 | 519 | 860 | 852 | 869 | 1430 | 3030 | 7580 | 2950 | 1380 | 505 |
| MIN | 444 | 491 | 418 | 351 | 695 | 340 | 451 | 1150 | 2150 | 1550 | 464 | 363 |
| AC-FT | 48180 | 35770 | 29160 | 32340 | 43350 | 39300 | 42740 | 113000 | 227300 | 119500 | 47350 | 24850 |

# INITIATING WATER SERVICE

Initiating Water Service:
An application for initiating water service to a property may be submitted to the City Engineer's Office on the main floor of the City Hall of the City of Cañon City at 6th and Royal Gorge Blvd. in Cañon City, Colorado. Initiation of water service will be permitted in accord with the water regulations and fees as published in the Charter and Code of The City of Cañon City, Colorado. Some of the basic requirements to initiate service are paraphrased below:

1) An approved, completed and accepted application for: a) water service to a property for which water service is available, or b) for water service to a property for which no water service is available and the City agrees to permit service to.
2) Determination that the proper size water main is available to the property to be serviced, or applicant will be required to provide the proper size water main and extension.

   If the water main fronting or abutting the property to be served is less than four inches (4") the applicant shall pay for and install a six inch (6") water main across the full length of the real property - or eight inch (8") if the City's Master Plan for water mains require the larger water main. If a water main larger than eight inches (8") is required, the City will reimburse the applicant for cost of materials only, for the cost of materials in excess of an eight inch water main.

   Alternately, applicant with City's approval may pay to the City an amount equal to the cost of required water main installation, in lieu of making the installation.
3) If the water main available to the applicant property is subject to a non-expired Water Line Rebate Agreement, the applicant shall pay the pro-rated cost of the water main per the Rebate Agreement to permit a tap into that water main.
4) A water service agreement may be required, which addresses other development issues.
5) Payment of the applicable Raw Water and Plant Investment Fee, and any water main costs.
6) If property to be serviced is outside the City, owners shall tender a fully executed annexation agreement as permitted under Section 31-21-121, CRS.
7) An appropriate size meter purchased from the City.
8) The costs of and the installation of all connections to the City water main, all service line connections and installed meter.

The Base Raw Water and Plant Investment Fee for the initial privilege of being furnished city water through a new connection at a particular property shall be as follows (effective 2/1/94):

| Connection Size | Amount-Inside City | Amount-Outside City |
|---|---|---|
| 3/4 inch or under | $2,200.00 | $2,750.00 |
| 1 inch | $3,674.00 | $4,592.50 |
| 1 1/4 inch | $5,126.00 | $6,407.50 |
| 1 1/2 inch | $7,326.00 | $9,157.50 |
| 2 inch | $11,726.00 | $14,657.50 |
| 3 inch | $23,474.00 | $29,342.50 |
| 4 inch | $36,674.00 | $45,842.50 |
| 6 inch | $73,326.00 | $91,657.50 |
| 8 inch | $117,326.00 | $146,657.50 |

In cases where a public purpose would be accomplished, the City will negotiate the Raw Water and Plant Investment Fee for water taps of three inches or larger for a commercial or industrial user.

Fees for increase in Tap Size:

> For any increase in the size of an existing tap by removal of an old tap and installation of a new tap in its place, the user shall pay the difference in tap size fee per the then current fee schedule.

Condominiums and Townhouses shall pay a sum equal to the amount of a three-fourth-inch tap, multiplied by the number of units in the condominium or townhouse.

Fire Protection:

> A tap, solely and exclusively for water for fire protection purposes, shall not be charged a Raw Water and Plant Investment Fee. This connection must remain exclusively for fire protection, or the then appropriate Raw Water and Plant Investment Fee will be due.

More complete and current information regarding initiation of water service will be as published in the Charter and Code of The City of Cañon City, Colorado.

SECWCD Information Request - August 11, 1997

Average Monthly Water Usage in Cañon City shown as a percentage of annual use

| | 1987 | 1988 | 1989 | 1990 | 1991 | 1992 | 1993 | 1994 | 1995 | 1996 |
|---|---|---|---|---|---|---|---|---|---|---|
| January | 4.6 | 4.7 | 4.7 | 5.2 | 5.3 | 5.6 | 5.0 | 5.2 | 5.8 | 5.3 |
| February | 4.2 | 4.6 | 4.1 | 4.6 | 4.7 | 5.3 | 4.4 | 4.5 | 5.5 | 5.1 |
| March | 5.6 | 5.1 | 5.5 | 5.6 | 6.0 | 5.5 | 5.6 | 5.5 | 5.6 | 5.7 |
| April | 6.7 | 8.0 | 9.3 | 6.9 | 8.5 | 8.4 | 7.4 | 6.6 | 5.7 | 8.6 |
| May | 9.0 | 10.7 | 9.6 | 9.9 | 11.3 | 11.0 | 9.6 | 9.1 | 7.0 | 12.2 |
| June | 13.5 | 11.4 | 11.1 | 16.0 | 12.3 | 10.6 | 13.1 | 14.6 | 10.2 | 12.3 |
| July | 15.0 | 13.6 | 14.8 | 11.8 | 12.6 | 13.0 | 15.9 | 15.7 | 14.3 | 14.2 |
| August | 11.9 | 12.7 | 12.2 | 10.9 | 9.9 | 9.9 | 12.4 | 11.1 | 15.0 | 10.7 |
| September | 9.6 | 9.4 | 9.4 | 10.8 | 9.7 | 10.4 | 8.6 | 10.1 | 9.7 | 8.3 |
| October | 8.8 | 7.9 | 8.3 | 6.9 | 9.1 | 9.9 | 7.0 | 7.0 | 8.8 | 7.7 |
| November | 6.1 | 5.5 | 5.9 | 5.6 | 5.1 | 5.2 | 5.3 | 5.2 | 6.2 | 4.9 |
| December | 5.0 | 6.4 | 5.1 | 5.8 | 5.5 | 5.2 | 5.7 | 5.4 | 6.2 | 5.0 |

# PARK CENTER

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# SOUTHEASTERN COLORADO WATER CONSERVANCY DISTRICT

## Arkansas River Basin Water Storage and Future Needs Assessment

WATER SYSTEM SURVEY (Compiled by BWR)

### 1. General Information

**Entity** PARK CENTER WATER DISTRICT

**Contact Name/District Manager** DREW MARSICANO

**Address** 107 SOUTH 9TH STREET
CANON CITY, CO 81212

**Phone No.** (719)275-2055

**Fax No.** (719)275-0268

**Primary Use** [✓ Municipal] Agricultural Industrial Recreational Other

**Master Plan or other Water Resource Planning Documents?** Y [✓ N]
(If yes we must obtain it)
**Prepared by:**

**Geographic Location of Service Area** (obtain service area map)

### 2. Demographics/Water Use

*Historic Water Use*

| Year | Population | Water Use, af | $^3/_4$-in Domestic Taps (optional) |
|---|---|---|---|
| 1987 | 1500 ? | | ~500 |
| 1988 | | | |
| 1989 | | | |
| 1990 | | | |
| 1991 | | | |
| 1992 | | | |
| 1993 | | | |
| 1994 | | | |
| 1995 | | | |
| 1996 | 3000 ? | ~430 | ~1000 |

*Projected Water Use*

| Year | Population | Water Use, af | $^3/_4$-in Domestic Taps (optional) |
|---|---|---|---|
| 2000 | 4500 ? | | |
| 2010 | | | |
| 2020 | | | |
| 2040 | | | |

**Major industrial or other uses other than domestic**

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# SOUTHEASTERN COLORADO WATER CONSERVANCY DISTRICT

## Arkansas River Basin Water Storage and Future Needs Assessment

WATER SYSTEM SURVEY (Compiled by B W R )

| 3. Estimated Monthly Water Use | |
|---|---|
| | as a percent of total annual use,% |
| | |
| JAN | |
| FEB | |
| MAR | |
| APR | |
| MAY | |
| JUN | |
| JUL | |
| AUG | |
| SEP | |
| OCT | |
| NOV | |
| DEC | |
| TOTAL | 100% |

Notes:

- "PEAKING" PROBLEMS PRESENT UNTIL NEW WATER TREATMENT PLANT WAS BUILT
- DID NOT RECEIVE AN SECOND SURVEY
- DUAL SYSTEM IRRIGATION FROM LOCAL DITCHES AND LATERALS

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# SOUTHEASTERN COLORADO WATER CONSERVANCY DISTRICT

## Arkansas River Basin Water Storage and Future Needs Assessment

WATER SYSTEM SURVEY (Compiled by BWR)

### 4. Sources of Water

*Surface Water*

**Sources**

**Point of Diversion** (for larger municipalities attach map, if available)

Location FOURMILE CREEK – IRRIGATION RIGHT

Capacity 1 AF/SHARE /YR. at 189 SHARES = 189 AF/YR

*Ground Water*

**Sources**

Tributary ARTESIAN WELL BLM 1131 AF/YR (HIGH ESTIMATE)

Nontributary

Number of Wells

**Combined Annual Flow Rate** (from decrees or based on conveyance capacity)

(May only be available as an annual total)

| | gpm | cfs | af |
|---|---|---|---|
| JAN | | | |
| FEB | | | |
| MAR | | | |
| APR | | | |
| MAY | | | |
| JUN | | | |
| JUL | | | |
| AUG | | | |
| SEP | | | |
| OCT | | | |
| NOV | | | |
| DEC | | | |
| **TOTAL ANNUAL** | | | |

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# SOUTHEASTERN COLORADO WATER CONSERVANCY DISTRICT
## Arkansas River Basin Water Storage and Future Needs Assessment
WATER SYSTEM SURVEY (Compiled by BWR)

### 5. Firm Yield

**District Managers may not have this information, attorneys and/ or consulting engineers may need to be contacted**

| **Monthly Average Firm Yield for 1966-1995** | **af** |
|---|---|
| JAN | |
| FEB | |
| MAR | |
| APR | |
| MAY | |
| JUN | |
| JUL | |
| AUG | |
| SEP | |
| OCT | |
| NOV | |
| DEC | |
| TOTAL ANNUAL<br>1200 AF/YR | |

Firm yield can estimated from:

Response of water rights during critical dry year
Potential volume limitation per decree or well permit
Ability to augment out of priority depletions

Consulting Engineer or Attorney

### 6. Future Water Planning

Estimated future yield of existing water rights ____________af/yr

Conditional Water Rights
Direct flow/wells

Storage PIGSAH RESERVOIR NOT USED YET STORAGE BY OWNERSHIP OF 189 SHARES

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# SOUTHEASTERN COLORADO WATER CONSERVANCY DISTRICT

## Arkansas River Basin Water Storage and Future Needs Assessment

WATER SYSTEM SURVEY (Compiled by BWR)

### 7. Raw Water Storage

Total Vol. in af

Type:

Fry-Ark 200 AF RESERVE CONTRACT THROUGH SECWCD

If and When

Shared

Owned

### 8. Raw Water Conveyance

Type:

Pipeline

Canal

Estimated Raw Water Conveyance Losses

### 9. Treatment Plant Capacity

Type

Capacity

Also:

1. Attach copies of relevant tables and text from master plans, or water resource planning documents.
2. Compare data found in reports to data obtained from contacting entity via telephone or previous survey.

Notes:

# FLORENCE

RECEIVED
SEP 27 1996
Southeastern Colorado Water
Conservancy District

# Survey of Water Users in the Southeastern Colorado Water Conservancy District

Please take a few minutes to fill out this important survey. It will assist the Southeastern Colorado Water Conservancy District in assessing the future demand for Fryingpan-Arkansas Project water and storage space. If you have questions or comments regarding this survey, you can call Steve Arveschoug (719-544-2040). **Please complete and return the survey to the District in the enclosed envelope before Monday, September 23, 1996.** Your cooperation is appreciated.

Name of Organization City of Florence
Contact Person Steven G. Rabe Phone (719) 784-4848

User Group—Municipal X Agricultural ____ Industrial ____
Recreation ____ Other ____

What is your primary source of supply? (surface water rights, ground water rights, or leased water, please describe)

Surface

Do you have a raw-water storage system? Yes X No ____
(Please describe your existing water storage system, rights.)

Most raw water storage for the Florence Regional Water System is provided by the 384 AF of storage rights decreed to Florence Reservoirs 1,2,3 in Case No. 2637 in 1916. These reservoirs currently provide an estimated 210 AF of storage.

Do you currently request Fryingpan-Arkansas Project Water? (If yes, please describe your existing use, amount and purpose, of Project Water) Yes

Florence recently requested 21 AF of project water to cover replacement requirements for 1996 for Florence Municipal Well No. 2. This well irrigates 8.23 acres of landscaping at a school in Florence.

Have you used Fry-Ark Project IF-and-When storage space for the storage of your own water rights? Yes ____ No X

## Municipal Population and Irr. Acreage Water/Storage Demand Projections

List your projected use of water and Project water (acre-feet).

| Year | Population | Irr. acreage | Water Use | Storage Use | Proj. Water Use |
|---|---|---|---|---|---|
| 1995 ~~Current~~ | 4782* | - | 1666 | 0 | 21 |
| 2000 | 5775 | - | 1826 | - | - |
| 2010 | 8720 | - | 2700 | - | - |
| 2020 | 13730 | - | 3999 | - | - |

*Includes Florence Regional Water System also provides water to FCC

Please describe your projected future demand for Fry-Ark Project Water and Storage (include copies of any reports or studies which provide the basis for your projections).

Florence is considering the use of District Storage for the storage of Florence's water rights.

## Water Resource Planning Efforts

Do you currently have a water resource plan to meet future water/storage demands? Yes X No______ If yes, do your plans include the construction of raw-water storage facilities? Yes X No______

Please describe your current water resource planning efforts and any construction plans.

Florence is in the last stages of preparing a Regional Water System Master Plan. In its plan, Florence is considering the construction of the decreed 2,250 AF Florence-Williamsburg-Coal Creek Reservoir on Oak Creek (case No. 80CW92)

Would you be willing to participate in a cooperative effort to assess the future demands for water and storage in the Arkansas River Basin and the future need for Fry-Ark Project Water and storage.

Yes X No________ Need more information X

Comments________

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# SOUTHEASTERN COLORADO WATER CONSERVANCY DISTRICT

## Arkansas River Basin Water Storage and Future Needs Assessment

WATER SYSTEM SURVEY (Compiled by BWR)

### 1. General Information

**Entity** CITY OF FLORENCE

**Contact Name/District Manager** STEVEN G. RABE

**Address** 300 WEST MAIN
FLORENCE, CO 81226

**Phone No.** (719)784-4848

**Fax No.** ( ) -

**Primary Use** [✓ Municipal] Agricultural Industrial Recreational Other

**Master Plan or other Water Resource Planning Documents?** [✓ Y] N
(If yes we must obtain it) FINAL STAGE OF PREPARING A REGIONAL
**Prepared by:** WATER PLAN

**Geographic Location of Service Area** (obtain service area map)

### 2. Demographics/Water Use

*Historic Water Use*

| Year | Population | Water Use, af | ³/₄ -in Domestic Taps (optional) |
|---|---|---|---|
| 1987 | | | |
| 1988 | | | |
| 1989 | | | |
| 1990 | 3801 | 1108 | |
| 1991 | | | |
| 1992 | | | |
| 1993 | | | |
| 1994 | | | |
| 1995 | 5148 | 1504 | |
| 1996 | | | |

*Projected Water Use*

| Year | Population | Water Use, af | ³/₄ -in Domestic Taps (optional) |
|---|---|---|---|
| 2000 | 6927 | 2019 | |
| 2010 | 10095 | 2943 | |
| 2020 | 14431 | 4207 | |
| 2040 | | | |

**Major industrial or other uses other than domestic**

WATER SYSTEM SURVEY (Compiled by BWR )

## 3. Estimated Monthly Water Use

| | as a percent of total annual use,% |
|---|---|
| JAN | |
| FEB | |
| MAR | |
| APR | |
| MAY | |
| JUN | |
| JUL | |
| AUG | |
| SEP | |
| OCT | |
| NOV | |
| DEC | |
| **TOTAL** | **100%** |

Notes:

# SOUTHEASTERN COLORADO WATER CONSERVANCY DISTRICT

## Arkansas River Basin Water Storage and Future Needs Assessment

WATER SYSTEM SURVEY (Compiled by BWR)

## 4. Sources of Water

*Surface Water*

**Sources**

SURFACE WATER

**Point of Diversion** (for larger municipalities attach map, if available)

Location

Capacity

*Ground Water*

**Sources**

Tributary

Nontributary

Number of Wells

**Combined Annual Flow Rate** (from decrees or based on conveyance capacity)

(May only be available as an annual total)

| | gpm | cfs | af |
|---|---|---|---|
| JAN | | | |
| FEB | | | |
| MAR | | | |
| APR | | | |
| MAY | | | |
| JUN | | | |
| JUL | | | |
| AUG | | | |
| SEP | | | |
| OCT | | | |
| NOV | | | |
| DEC | | | |
| **TOTAL ANNUAL** | | | |

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# SOUTHEASTERN COLORADO WATER CONSERVANCY DISTRICT

## Arkansas River Basin Water Storage and Future Needs Assessment

WATER SYSTEM SURVEY (Compiled by BWR)

## 5. Firm Yield

**District Managers may not have this information, attorneys and/ or consulting engineers may need to be contacted**

| Monthly Average Firm Yield for 1966-1995 | af |
|---|---|
| JAN | |
| FEB | |
| MAR | |
| APR | |
| MAY | |
| JUN | |
| JUL | |
| AUG | |
| SEP | |
| OCT | |
| NOV | |
| DEC | |
| TOTAL ANNUAL | 4835 AF/YR |

Firm yield can estimated from:

- Response of water rights during critical dry year
- Potential volume limitation per decree or well permit
- Ability to augment out of priority depletions

Consulting Engineer or Attorney

## 6. Future Water Planning

Estimated future yield of existing water rights ____________ af/yr

Conditional Water Rights

Direct flow/wells

Storage CONSIDERING CONSTRUCTION OF 2250 AF FLORENCE, WILLIAMSBURG - COAL CREEK RESERVOIR ON OAK CREEK

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# SOUTHEASTERN COLORADO WATER CONSERVANCY DISTRICT

## Arkansas River Basin Water Storage and Future Needs Assessment

WATER SYSTEM SURVEY (Compiled by BWR)

### 7. Raw Water Storage

Total Vol. in af 384 AF RIGHTS
210 AF USEABLE

Type:
Fry-Ark

If and When

Shared

Owned FLORENCE REGIONAL WATER SYSTEM

### 8. Raw Water Conveyance

Type:
Pipeline

Canal

Estimated Raw Water Conveyance Losses

### 9. Treatment Plant Capacity

Type

Capacity

Also:

1. Attach copies of relevant tables and text from master plans, or water resource planning documents.
2. Compare data found in reports to data obtained from contacting entity via telephone or previous survey.

Notes:

# *SOUTHEASTERN COLORADO WATER CONSERVANCY DISTRICT*

## FACSIMILE TRANSMITTAL SHEET

**PHONE 719-544-2040 . PO BOX 440 . 905 HIWAY 50 WEST**
**PUEBLO, CO 81002**

**FAX NUMBER (719) 543-8467**

DATE: 3-2-98

TIME: 9:55

TO FAX#: 303-662-8757

TO: Dick Westmore

FROM: Tom Simpson

SUBJECT:

COMMENTS:

Total number of pages transmitted (including cover sheet): 2

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City of Florence 300 W. Main Street, Florence, CO 81226

# FAX

3-2

Tom, Please take care of this. SA

Date: 02/19/98

Number of pages including cover sheet: 1

**To:**

Steve Arveschoug

SECWCD

Phone: 544-2040

Fax phone: 543-8467

CC:

**From:**

Steven G. Rabe

City of Florence

Email sgrabe@ris.net

Phone: (719) 784-4848

Fax phone: (719) 784-0228

**REMARKS:** ☐ Urgent ☒ For your review ☐ Reply ASAP ☐ Please comment

Steve - Reviewed Revised Draft Report, Section 2-5, and found one error. Section 2.2.1.5 dealing with descriptions of City of Florence's water system, inaccurately identified that we had 5 raw water reservoirs. Actually, we currently have two sites, the North Raw Water Reservoirs and the South Raw Water Reservoirs. Each has two cells. Please pass this info on to GEI/Helton. Thanks.

✓ Incorporated by RAW 3/3/98

Table II-3 is a summary of the population projections for each of the communities in the Regional Water System. The total population projection for the year 2020 is 14,431 people.

**Table II-3**
**Projected Population**

| Year | Florence | Williamsburg | Rockvale | Coal Creek | Total |
|---|---|---|---|---|---|
| 1980* | 2,990 | 102 | 275 | 258 | 3,625 |
| 1985* | 2,990 | 123 | 287 | 312 | 3,712 |
| 1990* | 2,990 | 145 | 300 | 366 | 3,801 |
| 1995* | 3,791 | 812 | 375 | 170 | 5,148 |
| 2000 | 4,612 | 1,600 | 525 | 190 | 6,927 |
| 2005 | 5,612 | 1,900 | 675 | 216 | 8,403 |
| 2010 | 6,827 | 2,200 | 825 | 243 | 10,095 |
| 2015 | 8,307 | 2,400 | 975 | 260 | 11,942 |
| 2020 | 10,106 | 2,900 | 1,125 | 300 | 14,431 |

* Populations are based on records of past population provided by the City of Florence and the individual communities.

Figure 1 is a graph of the projected population in the City of Florence and the adjacent towns.

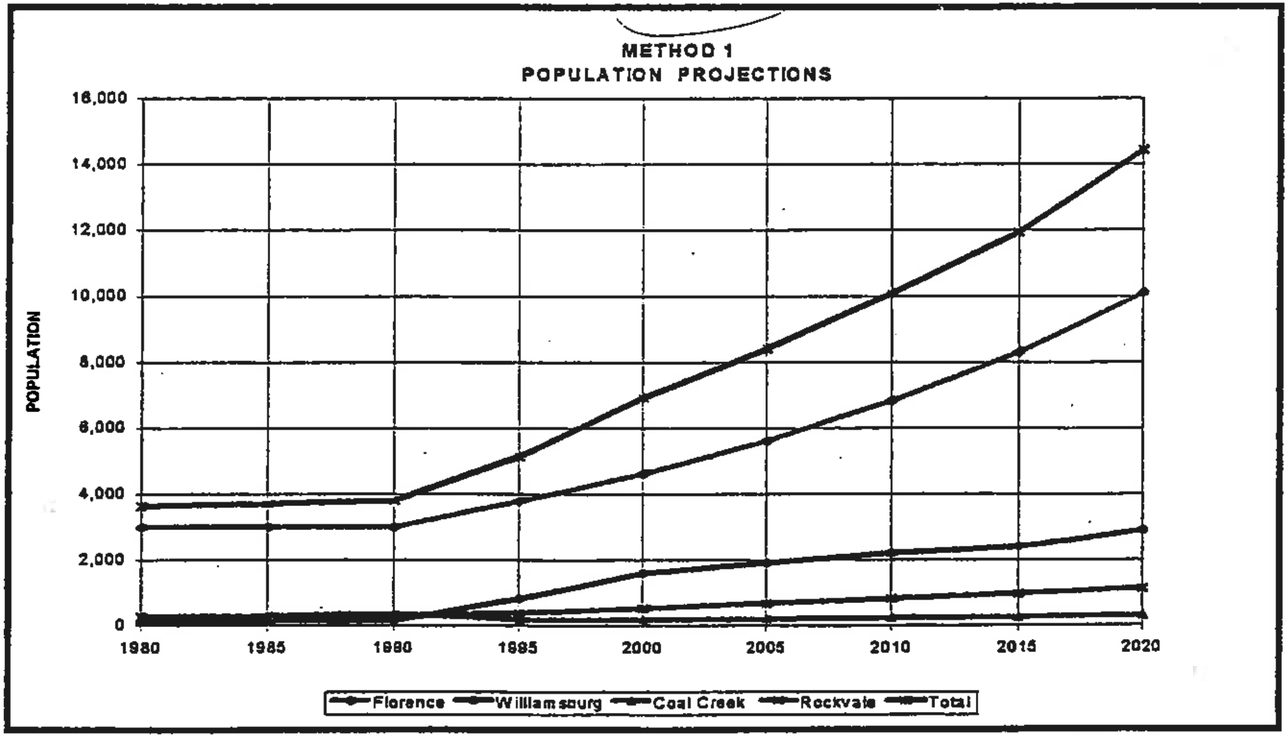

Figure 1

## D. Future Demands

The projected maximum-day demands for the Regional Water System are summarized in Table II-8 through the year 2020. These projections are based on the population projections in Table II-3. Average annual water demands in acre-feet/year were determined for their impact on the water resources. Maximum-daily demands were based on a ratio of 2.5 times average-daily demand, and peak-hourly demands were based on the ratios of 1.5 times maximum-daily demands.

**Table II-8**
**Projected Water Demands**

| Year | Population | Average-Daily Demand (MGD) | Annual Usage (acre-feet/year) | Maximum-Daily Demands (MGD) | Peak-Hourly Demands (MGD) |
|---|---|---|---|---|---|
| 1980* | 3,625 | 0.94 | 1,057 | 2.36 | 3.54 |
| 1985* | 3,712 | 0.97 | 1,082 | 2.42 | 3.62 |
| 1990* | 3,801 | 0.99 | 1,108 | 2.47 | 3.71 |
| 1995* | 5,148 | 1.34 | 1,504 | 3.35 | 5.03 |
| 2000 | 6,927 | 1.8 | 2,019 | 4.51 | 6.76 |
| 2005 | 8,403 | 2.19 | 2,500 | 5.47 | 8.20 |
| 2010 | 10,095 | 2.63 | 2,943 | 6.57 | 9.85 |
| 2015 | 11,942 | 3.11 | 3,482 | 7.77 | 11.66 |
| 2020 | 14,431 | 3.76 | 4,207 | 9.39 | 14.09 |

* Populations are based on records of past population provided by the City of Florence and the individual communities.

As indicated in Section I, the City of Florence has received requests for service from a number of significant developments. The largest request has been from the Bear Paw development which includes approximately 600 acres southeast of Florence. The developer projects that this area will eventually serve 2,400 residential taps.

It is not clear what impact these large developments will have on the population projections for the system. If they generate more interest in the area than anticipated, the projections may have to be revised. If they do not, the projected build-out schedules are probably too optimistic on the part of the developers.

In addition to the above demands, previous discussions have considered the possibility of serving the Brewster area. Projection of the future demands for the district as a whole (as indicated above) is based, to a large extent, upon the historical growth in the area. It is very difficult, however, to predict the location or the magnitude of the future demands. Obviously, the demands are dependent upon the location of future developments and the development of new industries. Given the uncertainty of these factors, an estimate of the future distribution of

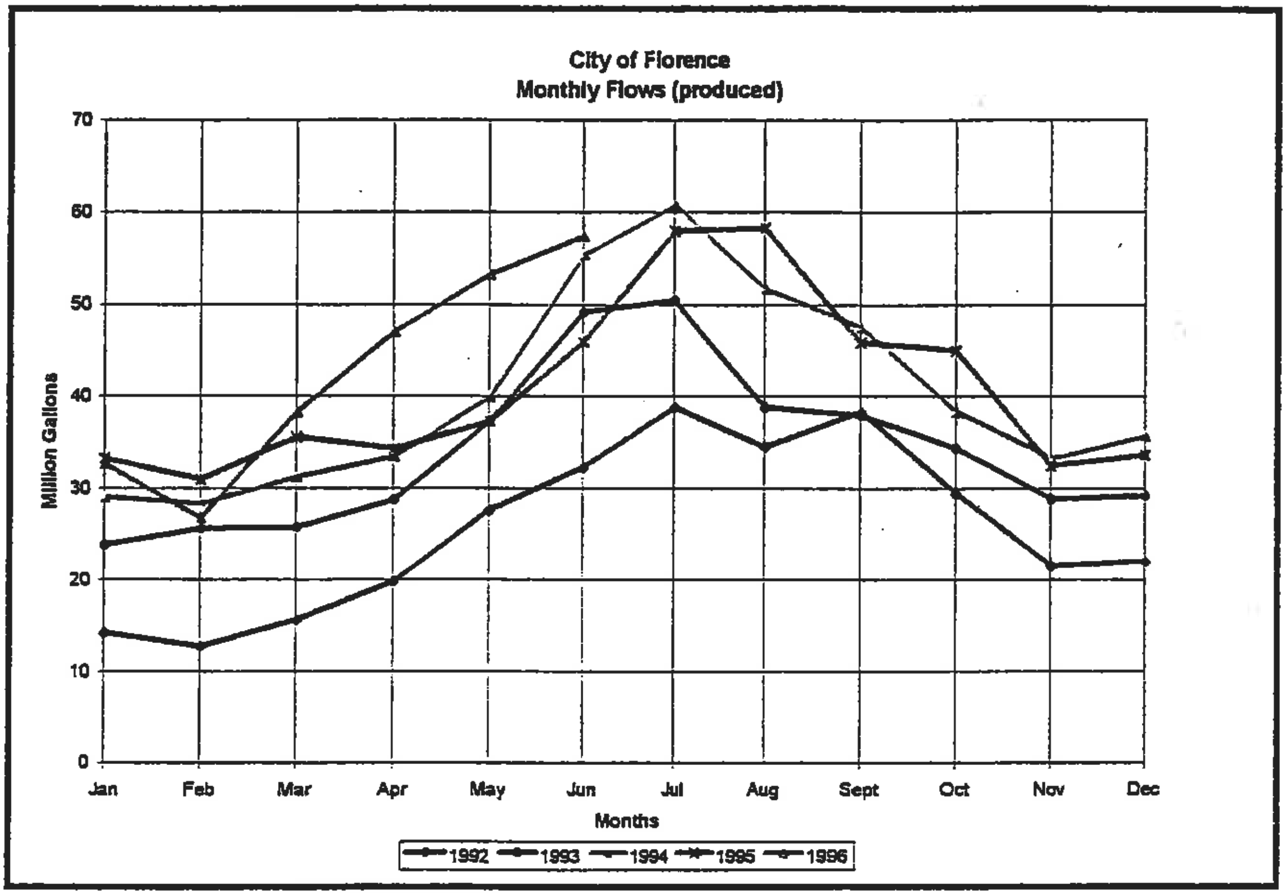

Figure 3

Table II-6 reflects the annual usage on a monthly basis for the communities served. The flows were developed from meter records for the individual communities.

### Table II- 6
### 1995 Monthly Meter Readings
### for Individual Communities

| Entity | Jan | Feb | Mar | Apr | May | June | July | Aug | Sept | Oct | Nov | Dec | Total | Avg. Annual* |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Coal Creek | .29 | .25 | .25 | .36 | .49 | .66 | .79 | .83 | .59 | .56 | .32 | .32 | 5.72 | 0.016 |
| Williamsburg | .97 | .78 | .81 | .77 | 1.07 | 1.72 | 20.68 | 2.27 | 1.51 | 1.42 | 1.00 | 1.01 | 15.41 | 0.042 |
| Rockvale | .50 | .53 | .53 | .58 | .59 | .88 | 1.23 | 1.77 | 1.11 | .83 | .69 | .62 | 9.87 | 0.027 |
| Prison | 12.20 | 11.60 | 13.80 | 12.70 | 14.30 | 17.10 | 20.20 | 22.10 | 16.60 | 17.30 | 14.80 | 14.10 | 186.80 | 0.510 |
| EFWA | .56 | .52 | .49 | .52 | .51 | .64 | .91 | .80 | .61 | .57 | .49 | .60 | 7.22 | 0.020 |
| Florence | 25.59 | 24.72 | 26.88 | 26.06 | 30.00 | 36.96 | 49.68 | 54.17 | 37.46 | 35.42 | 27.57 | 27.19 | 271.32 | 0.740 |
| Total | 40.12 | 38.42 | 42.76 | 41.00 | 46.98 | 57.97 | 74.83 | 81.95 | 57.90 | 56.10 | 44.89 | 43.83 | 496.35 | 1.360 |

* Average Annual Demand is the total yearly demand divided by 365 days.

The peak-hour demands are estimated assuming a ratio of 1:5 between the average demand on the maximum-day and the peak-hour demand. This ratio has been confirmed in a number of different systems and is the generally-accepted figure used where actual rates are not available.

### Table II-7
### Water Consumption Comparison
### (Based on Plant Production)

| | Florence* | Williamsburg | Rockvale | Coal Creek | Prison |
|---|---|---|---|---|---|
| Population 1995 | 3,791 | 812 | 375 | 170 | -- |
| No. of Taps | 1,395 | 172 | 163 | 102 | -- |
| Avg. Pop./Tap | 2.72 | 4.7 | 2.3 | 1.7 | -- |
| **Annual Consumption** | | | | | |
| 1995 Use (MG) | 278.5 | 15.4 | 10.6 | 6.1 | 186.8 |
| Gal/Tap/Month | 16,639 | 7,478 | 5,435 | 4,983 | -- |
| Per Capita Use (gal/day) | 201 | 52 | 72 | 98 | -- |
| **Maximum-Day Consumption** | | | | | |
| Max-Day (MGD) | 1.91 | 0.11 | 0.07 | 0.04 | 1.27 |
| Avg. Max-Day (gpm/tap) | 0.95 | 0.43 | 0.31 | 0.29 | -- |
| Per Capita Use (gal/day) | 502 | 130 | 180 | 245 | -- |
| **Peak-Hour Consumption** | | | | | |
| Peak-Hour (MGD) | 2.87 | 0.16 | 0.11 | 0.07 | 1.17 |
| Avg. Peak-Hour (gpm/tap) | 1.43 | 0.64 | 0.47 | 0.50 | -- |
| Per Capita Use ( gal/day) | 753 | 195 | 270 | 367 | -- |

* Includes East Florence Water Association

As shown in Table II-7, the per capita water consumption for the City of Florence is considerably higher than that in the other communities. This is attributed to Florence historically using more water for lawn irrigation and larger commercial users.

COPY

# WATER PURCHASE CONTRACT

This contract for the sale and purchase of water is entered into as of the 1st day of December, 1997, between the City of Florence, Colorado (the "City"), and the East Florence Water Association, Inc., a Colorado non-profit corporation (the "Association").

## WITNESSETH:

WHEREAS, the Association is a Colorado non-profit corporation established for the purpose of construction and operation of a water distribution system serving water users within a certain area located outside the municipal limits of the City of Florence: and

WHEREAS, the City owns and operates a water supply distribution system with a capacity currently capable of serving the present customers of the City and the present number of water users to be served by the Association; and

WHEREAS, the City has been providing water to the Association pursuant to a contract entered into between the City and the Association on July 6, 1987; which contract has been modified by addenda executed April 18, 1988, October 2, 1989, and June 4, 1990; and

WHEREAS, the City is willing to continue to provide water to the Association.

NOW, THEREFORE, in consideration of the mutual promises, covenants and agreements set forth in this agreement, it is agreed as follows:

A. THE CITY AGREES:

1. To furnish the Association during the term of this agreement or any renewal or extension thereof, potable, treated water meeting applicable purity standards of the Colorado State Board of Health, and all other applicable federal, state, and local laws, ordinances, rules and regulations. Notwithstanding this agreement to provide water to the Association, the City may, at any time, when in the judgment of the City Council, a shortage of water as supplied by the City waterworks of the City of Florence shall seem imminent or likely, restrict the quantity of water to be provided to the Association and the hours and manner of its use.

2. That water will be furnished at a reasonably constant pressure for a six inch main supply at a point located within the City limits. Emergency failures of pressure or supply due to main supply line breaks, power failure, flood, fire and use of water to fight fire, earthquake or other circumstances beyond the control of the City shall excuse the City from this provision for such reasonable period of time as may be necessary to restore service.

3. The City, at the expense of the Association, shall operate and maintain metering equipment to measure the quantity of water delivered to the Association. In the event that it is necessary to replace the metering equipment which is currently in place, the City will purchase and install such replacement equipment, at the sole expense of the Association. Any replacement

equipment will be comparable to the metering equipment which is now in place. The City shall calibrate such metering equipment upon written request by the Association, but not more frequently than once every twelve (12) months. If any meter fails to register for any period, the amount of water furnished during such period shall be deemed to be the amount of water delivered in the corresponding period immediately prior to the failure, unless City and Association shall agree upon a different amount. The metering equipment shall be read on the last day of each month. A bypass of a meter shall not be allowed.

4. To furnish the Secretary of the Association, at Florence, Colorado, not later than the fifth day of each month, with an itemized statement of the amount of water furnished the Association during the preceding month.

5. To perform, on behalf of the Association, routine bacteriological sampling and all other water quality testing, as may be required by the Colorado State Department of Health, or any other federal, state, or local regulatory or administrative agency, or which may be necessary or desirable, in the sole discretion of the City, to insure the quality of the water being delivered to the Association, or to protect the City's water system from damage or contamination, and to provide copies of such testing results to the Association.

6. To grant to the Association an non-exclusive easement for the term of this Agreement , at a location selected by the City, at the north edge of the property owed by the City and commonly known as Wilcox Park for the maintenance of its water pipe line which is located within the park. In the event that such maintenance is needed, the Association will restore any disturbed area within the easement to the condition in which it was found prior to the maintenance activities.

7. Subject to the other provisions of this Agreement, to provide the first twelve (12) million gallons of water pursuant to this Agreement, as measured from January 1 until December 31 each calendar year at the rates stated in this Agreement. If the Association uses more than twelve (12) million gallons of water within a calendar year, then a penalty shall be added to the rate otherwise charged for water used in excess of that amount, so that the Association shall pay 150% of the rate otherwise charged per 1,000 gallons of water, or any fraction thereof. This penalty shall be added to the next monthly billing following the month in which the maximum annual usage provided herein is exceeded. The penalty provided for in this paragraph shall apply only to the water usage in excess of twelve (12) million gallons per calendar year.

B. THE ASSOCIATION AGREES:

1. To pay the City, not later than the fifteenth day of each month, for water delivered during the preceding month, according to the following rate schedule:

(a) As of May 1, 1997, pursuant to City of Florence Resolution No. 8-97, the sum of $1.45 per 1,000 gallons of water, or fraction thereof, as reflected by the metering equipment, or if not functioning then as provided in Section A.(3). The rate charged for water pursuant to this provision shall be reviewed annually, based on the water cost computation performed by the City and shall be established annually by resolution of the Florence City Council.

(b) As of May 1, 1997, pursuant to City of Florence Resolution 8-97, $5.68 per month for each tap physically installed by the Association, active or inactive, as payment for Farmers' Home Administration debt retirement. The rate charged for debt retirement pursuant to this provision shall be reviewed annually, based on the water cost computation performed by the City and shall be established annually by resolution of the Florence City Council.

(c) Any charges assessed pursuant to Section A.(3), above.

2. To provide the City with a current written list of all customers currently served with water, upon the execution of this Agreement, which list shall be attached to this Agreement as Exhibit "A" and to update such list on a continuous basis. In the event that a new customer, or customers, are to be added the system and provided with water by the Association, the Association shall provide the City with the name, address, and telephone number of each customer, and the physical location of the proposed water tap serving that location, not less than 10 days prior to the proposed installation of such tap.

3. The Association shall be subject to the same restrictions as the City of Florence as provided in Resolution 4-92 and the Association shall not provide water service to any new building, structure or other property which is partly or entirely within an area designated as a flood plain, according to the Federal Emergency Management Agency map which is in existence from time-to-time during the term of this Agreement; except in cases in which a flood plain development permit has been issued by the City of Florence in accordance with the City of Florence Flood Damage Resolution No. 7-90.

4. To provide the City with a plat or map of the Association's water delivery system, including the size and location of all pipes, taps, and water metering devices, which plat or map shall be attached to this Agreement as Exhibit "B"; and which plat or map shall be kept current as additional equipment is added to the system, or additional users provided with water service. The Association shall not extend or expand its water system without the prior, written approval of the City of Florence; and shall provide the City with all necessary drawings, engineering information and other relevant data concerning any proposed extension or expansion of the water system prior to undertaking such extension or expansion of the system.

5. All equipment currently installed in the master metering pits, or which may hereafter be installed in the master metering pits, including the metering devices, pressure control devices, fire flow devices and backflow regulators, shall be the sole property of the City; which shall provide maintenance and/or any necessary replacement of such devices and equipment at the sole cost of the Association.

6. To comply with all applicable federal, state, local and municipal laws, ordinances, rules and regulations concerning the construction, maintenance and operation of the Association's water system, and specifically to comply with any municipal ordinances or Colorado State health laws, rules or regulations relative to backflow and cross connections.

7. To pay to the City a penalty as provided in paragraph A(8) herein in the event the annual water usage of the Association exceeds twelve (12) million gallons.

8. To operate and maintain the Association's system, equipment and accessories to the system in a reasonable and prudent manner which will not cause injury, damage, contamination or other loss of any kind to the City's water system, including all pipes, fittings, meters, or other devices associated with the system, and including the water which passes through the system. If the City becomes aware of a condition in the Association's system which the City reasonably believes to be a threat to the City's system or water supply, the Association will, within 48 hours of receiving written notice of such condition, correct the condition to the satisfaction of the City. If the Association does not take the appropriate corrective action within the time provided, the City may terminate water service to the Association upon the expiration of 48 hours from the time of notice to the Association; or, at the City's option, the City may take the necessary corrective action relative to the Association's system, at the sole expense of the Association.

9. To indemnify and hold the City harmless from any and all claims or demands for injuries, losses, or damages of whatever nature which are made against the City as the result of this Agreement or the operation of the Association's water system; and to defend the City against any such claims, demands, lawsuits or other legal actions taken by any person seeking damages or other compensation from the City as a result of this Agreement or the operation of the Association's water system. In the event that it becomes necessary to defend the City pursuant to this paragraph, the City shall be entitled to select and to retain an attorney of its own choosing to provide its defense; with the cost of that attorney being the sole responsibility of the Association.

10. To maintain during the term of this Agreement, a policy of general public liability insurance in an amount not less than $1,000,000 per occurrence, with an insurance carrier reasonably acceptable to the City, naming the City as an additional insured; and to provide the City with a certificate of such insurance contemporaneously with the execution of this Agreement.

11. To execute and deliver to the City, contemporaneously with the execution of this Agreement, any and all documents deemed necessary by the City to transfer and convey to the City the master metering pits, together with all pipes, meters, devices and equipment located within the master metering pits, free from any further claim on the part of the Association.

12. To charge sufficient fees for new water taps which are approved and become a part of the Association's water system to provide for adequate maintenance and replacement of the water system and its various elements and components, as such maintenance and replacement becomes reasonably necessary to insure the continued integrity and proper operation of the system.

13. On of before January 30 of each year during the term of this agreement, to provide the City with a certificate issued by the Secretary of State of Colorado certifying that the Association remains in good standing with the State of Colorado.

C. IT IS FURTHER MUTUALLY AGREED BETWEEN THE CITY AND THE ASSOCIATION AS FOLLOWS:

1. This agreement is specifically subject to the terms and conditions of all other agreements or relationships in which the City is a party (including regional water agreements and Farmers' Home Administration agreements). If the terms and conditions of this Agreement are in conflict with any provisions of such other agreements and relationships to which the City is a party, or if the operation of this Agreement would expose the City to fine, penalty, or loss of any kind by virtue of its other agreements and relationships, then this Agreement shall, at the sole option of the City, be null and void.

2. Water service to the Association may, in the sole discretion of the City, be terminated for failure to pay the water rates or any other charge imposed by the City pursuant to the terms of this Agreement. Further, the City may, at any time, in its sole discretion, terminate or diminish water service to the Association if, in the sole discretion of the City, the further provision of water to the Association threatens the integrity or quality of the City's water system or water supply; or if, in the sole discretion of the City, the continued provision of water to the Association would impair or threaten to impair the City's ability to provide water to its other users.

3. The provisions of this contract pertaining to the schedule of rates to be paid by the Association for water delivered and for the payment of capital improvements are subject to the water cost computation performed by the City on May 1 of each year. Any increase or decrease in rates shall be based on demonstrable increase or decrease in the costs of providing water. In the event that the actual cost of providing water exceeds the cost assessed when adjustment is made on May 1 of any year, any such excess shall be billed to the account of the Association at the rate of one-twelfth (1/12) of the excess each month for the next twelve months with no interest assessed. In the event that the actual cost of providing water is less than the cost assessed when the adjustment is made on May 1 of any year, any overpayment which has been made by the Association shall be credited to the Association at the rate of 1/12th of such overpayment each month for the next twelve months.

4. This contract shall extend for a period of five years and thereafter may be renewed or extended for such term as may be agreed between the City and the Association.

5. This contract is subject to such federal, state and local laws, ordinances, rules, and regulations as may be applicable to similar agreements in the State of Colorado, and the City and Association will collaborate in obtaining such permits, certificates, or the like, as may be required to comply therewith.

6. This Agreement has been drawn and executed in the State of Colorado. The Agreement shall be interpreted in accordance with the laws of the State of Colorado.

7. In the event that it becomes necessary to enforce any term or provision of this Agreement be legal action, the prevailing party in such action shall be entitled to recover reasonable attorney's fees and costs, including costs and fees on appeal.

8. This Agreement constitutes the entire agreement of the parties. All prior

agreements or negotiations between the parties are merged into this agreement. This Agreement may not be amended or modified except by written document executed by both parties and making specific reference to this Agreement.

9. Whenever the context requires, the use of any gender shall include all genders, the use of the singular shall include the plural, and vice versa.

10. In the event that any provision of this Agreement is held to be invalid or unenforceable by any court of law having jurisdiction to do so, all other provisions of this agreement shall remain in full force and effect and the agreement shall continue to be interpreted and performed by the parties in the manner best suited to carry out the original intent of the parties. If the invalidity of any provision makes the further performance of the agreement impossible, the agreement shall be null and void.

Dated: December 1, 1997.

The City of Florence, a Colorado municipal
Corporation

By: Merle Strickland
Mayor

ATTEST:

Dan E Williams
City Clerk

East Florence Water Association, a Colorado
non-profit corporation

By: Dean E. Corning
President

ATTEST:

Alfred R Lopez
Secretary

# DRAFT INTERIM REPORT ON
# THE FLORENCE REGIONAL WATER SYSTEM'S
# WATER SUPPLY AND WATER DEMAND

Prepared For:

The Engineering Company

By:

Martin and Wood
Water Consultants, Inc.
602 Park Point Drive
Suite 275
Golden, Colorado 80401

Job No. 398.1
January 6, 1998

## Table of Contents

## TABLES

## FLORENCE REGIONAL SYSTEM SUPPLIES AND DEMANDS

## FIGURES

FIGURES (CONTINUED) PAGE TWO

## I. GENERAL

This report describes the existing water supplies of the Florence Regional Water System ("Regional System" or "System") and their ability to satisfy the System's existing and future demands for water. The report describes the System's decreed water rights and their calculated yields over the selected 24-year study period of 1971 through 1994. The report also discusses the need for the as-yet-unbuilt Florence-Coal Creek-Williamsburg Reservoir on Oak Creek.

## II. THE REGIONAL SYSTEM'S EXISTING WATER SUPPLIES

### A. General

This section of the report lists and describes the decreed water rights owned by each present member of the Regional System. The members of the Regional System include the City of Florence, the Town of Coal Creek, the Town of Williamsburg, and the Town of Rockvale. Figure 1 - Map of the Raw Water Supply System - provides locations for the System's present points of diversion, raw water storage reservoirs, raw water pipelines, and treatment plants.

### B. Water Rights Owned by the City of Florence

The City of Florence owns three decreed water rights in its own name and, together with the Towns of Coal Creek and Williamsburg, owns the Florence Treatment Plant Diversion Works and the Florence-Coal Creek-Williamsburg Reservoir. Solely for the sake of convenience, the two latter and jointly owned water rights are listed herein under the City of Florence. In addition, the City of Florence owns three decreed storage rights and two decreed groundwater rights.

#### 1. Florence Adobe Creek Pipe and Florence Mineral Creek Pipe

The Water Court's decree entered in 1982 in Case No. 80CW93 changed numerous water rights on Adobe and Mineral Creeks to these newly named structures. The 80CW93 decree provided that the Adobe Creek Pipe and Mineral Creek Pipe water rights should be administered together for all municipal uses with the following priorities under the original adjudication in Water District No.

12.

| Priority Date | Amount<br>Cubic Feet Per Second |
|---|---|
| May 31, 1866 | 1.0 |
| May 31, 1867 | 0.5 |
| May 31, 1870 | 0.5 |
| Sep 30, 1870 | 0.5 |
| Total | 2.5 |

The decree further found that any call against these water rights from the Arkansas River or from Hardscrabble Creek would be futile.

This report henceforth refers to these jointly administered rights as the "Florence Adobe/Mineral Creek Pipe."

## 2. Florence Newlin Creek Pipe

The decree entered in Case No. 80CW93 also changed several water rights owned by Florence on Newlin Creek (aka Newland Creek) to one set of water rights called the Florence Newlin Creek Pipe.

| Appropriation Date | Amount | Adjudication Date |
|---|---|---|
| April 29, 1873 | 0.5 | February 2, 1899 |
| June 1, 1873 | 0.5 | February 2, 1899 |
| March 31, 1883 | 0.5 | February 2, 1899 |
| June 21, 1870 | 3.5 (spring and summer) | February 14, 1916 |
| February 23, 1898 | 3.5 (fall and winter) | February 14, 1916 |
| Total | 5.0 CFS | |

The 80CW93 decree allowed all of these water rights to be used for all municipal uses and further stated that any call on these rights from the Arkansas River or from Hardscrabble Creek would be futile.

### 3. Union Ditch

The decree entered in 1982 in Case No. 80CW93 formally changed Florence's then-total interest of 2,793.1 Union Ditch shares to all municipal purposes. Florence's proportional interest in the total 48 cfs Union Ditch priority of November 30, 1861, is calculated to be 4.47 cfs (48 cfs x 2,793.1 shares/29998 shares). The Union Ditch diverts from the Arkansas River at the headworks of the Minnequa Canal.

### 4. Florence Treatment Plant Diversion Works

In Case No. 80CW91 in 1982 the Water Court awarded a 100 cfs direct flow priority from the Arkansas River to the City of Florence and the Towns of Coal Creek and Williamsburg. This water right, named Florence Treatment Plant Diversion Works, bears a priority date of August 26, 1980, for irrigation, domestic, municipal and all other beneficial uses. Upon remand from the Colorado Supreme Court, the Water Court entered its final decree in 1985, reducing the maximum rate of diversion from 100 cfs to 7.6 cfs.

In 1987 in the decree entered in Case No. 86CW120, the Water Court added the Minnequa Canal as an alternate point of diversion for the Florence Treatment Plant Diversion Works.

## 5. Augmented Florence Treatment Plant Diversion Works

The decree in Case No. 80CW93 allowed an augmentation credit based on the actual extent of municipal use of Florence's changed Union Ditch water rights. Beyond the threshold of 2.00 cfs of municipal use of the Union Ditch, the decree provided for an augmentation credit of 7% of the Union Ditch usage. Then, based on the finding that the municipal use of water was only 25% consumptive, the decree allowed an out-of-priority diversion under the augmented Florence Treatment Plant Diversion Works right at a rate of four times the calculated augmentation credit. For example, if 3.00 cfs of Florence's Union Ditch rights were being diverted and used for municipal purposes, the augmentation credit would be calculated as 0.07 cfs (= 7% x (3.00 cfs - 2.00 cfs)). The permissible rate of diversion of the augmented out-of-priority Florence Treatment Plant Diversion Works right would then be 0.28 cfs (= 4 x 0.07 cfs).

### 6. Florence-Coal Creek-Williamsburg Reservoir

The decree entered in 1982 in Case No. 80CW92 awarded Florence, Coal Creek, and Williamsburg a 2,250-acre-foot storage priority for municipal purposes. The reservoir, to be located on Oak Creek approximately one mile west of Florence, may store water from the Arkansas River via the Florence Treatment Plant Diversion Works at a maximum rate of 100 cfs, or from Oak Creek.

In 1987 in the decree entered in Case No. 86CW120, the Water Court added the Minnequa Canal as an alternate point of diversion for the Florence-Coal Creek-Williamsburg Reservoir.

### 7. Augmented Florence-Coal Creek-Williamsburg Reservoir

The decree in Case No. 80CW93 also allowed the Union Ditch augmentation credit to be diverted into storage in the Florence-Coal Creek-Williamsburg Reservoir. Alternatively to the direct flow usage of the augmentation credit described in Paragraph II B5 herein, such augmentation credit, calculated as 7% of the difference between the Union Ditch usage and the threshold usage of 2.00 cfs, may be stored in the Florence-Coal Creek-Williamsburg Reservoir. Thus, at the maximum Union Ditch usage of 4.47 cfs, the augmentation credit which may be stored is calculated to be 0.17 cfs (= 7% x (4.47 cfs - 2.00 cfs)). However, pursuant to another provision of the decree in 80CW93, only 50% of this augmentation credit may be stored in the Florence-Coal Creek-Williamsburg Reservoir.

Similarly, the decree in 80CW93 also provided that 50% of any of the diversions from the Adobe/Mineral Creek Pipe, the Newlin Creek Pipe, the Coal Creek Pipe (subsequently described), and the Williamsburg Pipe (subsequently described), not used for direct municipal purposes, could be stored in the Florence-Coal Creek-Williamsburg Reservoir.

### 8. Florence Reservoirs 1, 2, and 3

The decree entered in 1916 in Case No. 2637 by the District Court for Fremont County awarded Florence the right to fill and refill three reservoirs from various sources along Newlin Creek and to use such stored waters for domestic, culinary, stock watering, sprinkling of streets, irrigation, fire fighting, steam, power, manufacturing, heating and all other purposes usually connected with and used as a part of a city water supply. The decree later entered by the Water Court in Case No. 80CW93 authorized the continued use of Florence Reservoirs 1, 2, and 3 to store any or all of the water diverted under the rights of the Florence Adobe Creek Pipe, the Florence Mineral Creek Pipe, and the Florence Newlin Creek Pipe, for municipal purposes, up to the capacities previously decreed in Case No. 2637: Reservoir 1 - 154 acre-feet; Reservoir 2 - 92 acre-feet; and Reservoir 3 - 138 acre-feet. (The embankment separating Reservoir 1 and Reservoir 2 has been removed, and Reservoir 1 and Reservoir 2 now constitute one reservoir.)

### 9. Florence Municipal Wells No. 1 and No. 2

The Water Court in 1971 entered its decree in Case No. W-147 awarding a September 25, 1911, priority for 0.668 cfs to Florence Municipal Well No. 1 and a December 31, 1950, priority for 0.668 cfs to Florence Municipal Well No. 2, both priorities to be used for municipal purposes. Because these wells are reportedly leased to the Fremont-Custer County School District, this report will no longer consider them as a part of the Regional System. However, because Florence Municipal Well No. 2 has a post-1948 priority date, it is noted that either the Town of Florence or the school district is obligated to provide augmentation water for its continued use under the new rules for use of ground water promulgated by the Colorado State Engineer.

### C. Water Rights Owned by Town of Coal Creek

The decree entered by the Water Court in Case No. 80CW93 changed several water rights owned by Coal Creek into one newly named water right - the Coal Creek Pipe. This water right carries a priority date of March 5, 1884, for 1.0 cfs for all municipal uses. The point of diversion was established as from the Arkansas River at the Florence Treatment Plant Diversion Works. The decree also imposed monthly diversion limits of 10 acre-feet for June through November, and 5 acre-feet for December through May.

In 1987 in the decree entered in Case No. 86CW120, the Water Court added the Minnequa Canal as an alternate point of diversion for the Coal Creek Pipe.

### D. Water Rights Owned by Town of Williamsburg

The decree in Case No. 80CW93 likewise changed several water rights owned by Williamsburg into one new water right - the Williamsburg Pipe. This water right is to divert its 0.665 cfs for all municipal purposes from the Arkansas River at the Florence Treatment Plant Diversion Works. This water right carries a December 31, 1890, priority. The decree limited its monthly diversions to 7 acre-feet from June through November and 4 acre-feet from December through May.

In 1987 in the decree entered in Case No. 86CW120, the Water Court added the Minnequa Canal as an alternate point of diversion for the Williamsburg Pipe.

### E. Water Rights Owned by Town of Rockvale

In 1884 in the original adjudication of water rights in Water District No. 12 and in 1916 in Case No. 2637, the District Court for Fremont County entered its decrees approving water rights for the Town of Rockvale. These water rights include a 2.96 cfs priority of May 31, 1867, and a 1.60 cfs priority of December 30, 1875, "for domestic purposes, including the watering of stock, the sprinkling of lawns, the irrigation of ornamental trees, and all other purposes usually connected with and used as a part of a town water supply." The decree provided that these priorities may be diverted from Oak Creek by the W.H. May Ditch or by wells situated on Oak Creek. The decree further provides for the filling and refilling of two small reservoirs (0.33 acre-feet and 3.11 acre-feet) to be used for domestic purposes.

Later, in the decree entered in 1974 in Case No. W-1566, the Water Court changed the point of diversion for 0.4 cfs of the Town's senior, 1867 priority of 2.96 cfs, to six wells lying upstream from the Town on Oak Creek, located on Figure 1.

In 1991 in Case No. 90CW33, the Water Court approved the changes in location to two of the six wells decreed in Case No. W-1566.

## III. YIELDS OF EXISTING WATER SUPPLIES

### A. Methodology

Yields for the Regional System's decreed sources of water described above were calculated on a daily basis for the 1971-1994 study period. The 1971-1994 study period provides a sufficiently long period, having both dry years (1977, 1978) and wet years (1985, 1987), upon which to evaluate the System's water supply.

### B. Direct Flow Supplies

#### 1. Florence Adobe/Mineral Pipe

Historic daily diversion records maintained by the State Engineer's Office ("SEO") were used to represent the water supply available from the Florence Adobe/Mineral Creek Pipe. For water years (November 1 - October 31) for which no such diversion records were available (1984, 1987, 1988, and 1991), a linear correlation technique using diversion records for the Florence Newlin Creek Pipe were used to generate diversions for the Adobe/Mineral Creek Pipe. For water years for which the SEO diversion records indicated that no diversions were made, zero diversions were used in the yield analyses described herein. In any and all events where either recorded diversions or correlated diversions exceeded the maximum rate of diversion of 2.5 cfs decreed in Case No. 80CW93, a value of 2.5 cfs was used for the yield analyses. Because the decree in Case No. 80CW93 found that any call on these rights from the Arkansas River or from Hardscrabble Creek would be futile, diversions as described above were used without any reduction for historic senior calls.

Table 1 provides a summary of monthly diversions in acre-feet for the Florence Adobe/Mineral Creek Pipe as computed from annual files of daily diversions. This report uses a conversion factor of 1.98347 to calculate acre-feet from cfs-days.

Direct flow yields from the Florence Adobe/Mineral Creek Pipe average 216 acre-feet per year during the 1971-1994 study period. Also, to the extent that water diverted under this water right is not immediately used within the Regional System, fifty percent of such diversions not immediately used may be stored in the Florence-Coal Creek-Williamsburg Reservoir on Oak Creek.

The zero or near-zero yields for 1984, 1985, 1986, and 1989 are difficult to believe and may be due to operational practices or problems with diversion structures or pipelines at the time. The present practice of operating the Regional System is to divert <u>all</u> available water from the Florence Adobe/Mineral Creek Pipe, and from the Florence Newlin Creek Pipe as well, at <u>all</u> times. It is difficult to believe that Adobe and Mineral Creeks dried up all year long for such extended periods of time, but the yield analyses herein rely on <u>recorded</u> diversions.

It is also noted that the Adobe/Mineral Creek Pipe yields over the 1987-1994 period are generally quite a bit larger than those from earlier years. These increases are probably due to many factors, including the fairly recent reconstruction of the pipe, a greater demand for water occasioned principally by the extension of the Regional System's service area to include the State Prison, and a higher degree of diligence in operating this diversion facility.

### 2. Florence Newlin Creek Pipe

Historic daily diversion records, limited to the maximum rate of diversion of 5.0 cfs under the decree in Case No. 80CW93, were used for yield analyses. Because of the futile call language contained in 80CW93, no further reductions were made.

Table 2 summarizes monthly availability of direct flow yield from the Florence Newlin Creek Pipe.

Direct flow yields from the Florence Newlin Creek Pipe averaged 372 acre-feet per year. Fifty percent of the diversions from this water right not immediately used may be stored in the Florence-Coal Creek-Williamsburg Reservoir on Oak Creek.

Once again, the zero or near-zero yields for 1983, 1984, 1985, 1986, and 1989 are difficult to accept, but such diversions were reported to the State Engineer's Office. Some of these low yields are clearly attributable to a breakage in the Newlin Creek Pipe in the late 1980's.

It is also noted that yields recorded for the Newlin Creek Pipe over recent years have increased over those reported in the earlier period, as was mentioned in regard to the yields from the Adobe/Mineral Creek Pipe. These increases are likely due to the same reasons as those given for the Adobe/Mineral Creek Pipe - reconstruction of the pipe, greater demand, and a higher degree of diligence in operating this diversion facility.

No yields have been calculated independently for the three Florence reservoirs. This report will largely treat these reservoirs as regulatory or operational reservoirs whereby day-to-day variations of supply and demand may be moderated, although they could be operated for annual or longer term carryover storage. This report in the main will not treat these reservoirs as having independent yield.

### 3. Union Ditch

Florence's proportional interest in the senior, 1861 Union Ditch priority, which was changed in Case No. 80CW93, amounts to 4.47 cfs. Because of this ditch's historic practice of diverting on a year-round basis, the seniority of the 1861 Union Ditch priority, and the streamflow physically present in the Arkansas River at the point of diversion of the Union Ditch, the daily yield of Florence's Union Ditch rights was taken to be 4.47 cfs each day throughout the 1971-1994 study period. However, to reflect down time for maintenance of the Minnequa Canal, through which the Union Ditch is diverted, yields for the ten-day period of February 1 through February 10 were taken to be zero.

Table 3 summarizes monthly direct flow yields available from Florence's Union Ditch water rights changed in Case No. 80CW93. (Florence owns an additional 736.63 shares of Union Ditch which have not yet been judicially changed to municipal use. The present study described in this report does not address nor incorporate the yield from these 736.63 shares.) The direct flow yield from Florence's 4.47 cfs of the senior, 1861 Union Ditch right averages 3,149 acre-feet per year, and year-to-year yields do not deviate from the average yield due to the seniority of this water right. Like the Adobe/Mineral Creek Pipe and the Newlin Creek Pipe, fifty percent of the augmentation credit from this water right may be stored in the Florence-Coal Creek-Williamsburg Reservoir on Oak Creek.

### 4. Florence Treatment Plant Diversion Works

The in-priority yield from this 1980 priority for 7.6 cfs will be severely restricted in the future due to its junior date. For purposes of calculating its yield in this study, the full 7.6 cfs was assumed to be divertable from the Arkansas River at any time for which historic call records, maintained by the Division Engineer's Office, indicated that a free river was present. Due to the Water Court's approval of a basin-wide winter storage program in Case No. 84CW179, a river call of March 1, 1910, has been superimposed on historic call records for the period November 15 through March 14 of each year for the yield analyses described herein. As Table 4 indicates, such in-priority periods during which yield would be expected to be present during the selected study period include only the years 1985 and 1987.

Table 4 summarizes monthly yields available for the Florence Treatment Plant Diversion Works water right, based on daily calculations. Yields of approximately 500 acre-feet and 1,500 acre-feet would be expected to be available in the wet years of 1985 and 1987, with no yield being the norm in most years.

## 5. Augmented Florence Treatment Plant Diversion Works

Wherever the Regional System diverts Florence's Union Ditch water rights in excess of 2.00 cfs for direct municipal use, the Florence Treatment Plant Diversion Works water right can produce an additional increment of supply by augmentation from the municipal use of the Union Ditch diversion. The full rate of such augmented use of the Florence Treatment Plant Diversion Works water right is calculated to be 0.68 cfs, as previously described. This augmented use must be distinguished from the augmented exercise of the Florence-Coal Creek-Williamsburg Reservoir water right. That is, the full measure of augmentation credit from municipal use of Union Ditch diversions can not be applied at the same instant to augment both the Florence Treatment Plant Diversion Works water right and the Florence-Coal Creek-Williamsburg Reservoir water right. Any given portion of the Union Ditch augmentation credit may augment only the Florence Treatment Plant Diversion Works water right or the Florence-Coal Creek-Williamsburg Reservoir water right at one time. However, the decree in Case No. 80CW93 does not prohibit the use of one portion of the Union Ditch augmentation credit to augment the Florence Treatment Plant Diversion Works water right while at the same time using a different portion of the augmentation credit to augment the reservoir.

Table 5 summarizes the full measure of yield of the augmented Florence Treatment Plant Diversion Works water right, assuming full municipal use of the 4.47 cfs Union Ditch water right each day of the year, except for February 1 through 10, and assuming no use of the Union Ditch augmentation credit for storage. If the full measure of Florence's 4.47 cfs of Union Ditch rights were diverted and used for municipal purposes each day of the year (excepting ten days in February), this water right could yield a dependable supply of 472 acre-feet annually.

### 6. Florence-Coal Creek-Williamsburg Reservoir

The yield from the Florence-Coal Creek-Williamsburg Reservoir under its own 1980 storage priorities from the Arkansas River and from Oak Creek will also be expected to be severely limited in the future due to demands from senior water rights along the Arkansas River. The yield available from the Arkansas River was calculated at the maximum decreed rate of diversion of 100 cfs for each day for which historic call records indicated that a free river was present. Table 6 summarizes the yields calculated to be available from the Arkansas River. Tremendous yields would be expected to be available in the wet years of 1985 and 1987, but this water right would produce no yield in normal to dry years.

The yields from Oak Creek were calculated by use of daily calculations of streamflow for Oak Creek based on recorded streamflows from the USGS gaging station on Fourmile Creek near Canon City (#07096500). Although the drainage area above the Fourmile Creek gage, 434 square miles, is much larger than the Oak Creek Reservoir's 72 square mile drainage area, the two drainage basins are similar in several respects. Maximum elevations at their upstream divides are between 10,000 and 11,000 feet, and elevations at the gaging station on Fourmile Creek and at the Oak Creek damsite are approximately 5,200 feet. Slopes of the main stream courses are comparable. Precipitation upon the Oak Creek watershed appears to be approximately 16% greater than that for the Fourmile Creek basin, suggesting that streamflow per unit area would be somewhat greater for Oak Creek. For purposes of creating daily flows for Oak Creek in the vicinity of the damsite for Oak Creek Reservoir, however, this report adopts a drainage area based factor of 17% (72 square miles/434 square miles) to be multiplied against daily Fourmile Creek gaged flows to obtain daily Oak Creek streamflows.

In-priority yields available to the Oak Creek Reservoir from Oak Creek were then taken to be the calculated daily Oak Creek streamflows whenever historic call records indicated that a free river was present. During the selected 1971-1994 study period, in-priority yields from Oak Creek would occur only in 1985 and 1987.

Table 7 summarizes the in-priority yields from Oak Creek calculated to be available to Oak Creek Reservoir. This water right could produce significant yields of around 2,000 to 3,000 acre-feet in wet years, such as 1985 and 1987, but normally it could produce no yield.

### 7. Augmented Florence-Coal Creek-Williamsburg Reservoir

If the full measure of the Union Ditch augmentation credit were utilized to augment the Florence-Coal Creek-Williamsburg Reservoir, augmented diversions from either the Arkansas River or from Oak Creek could be made at a rate of approximately 0.086 cfs into storage in the Florence-Coal Creek-Williamsburg Reservoir. (Also, fifty percent of the diversions from the Adobe/Mineral Creek Pipe, the Newlin Creek Pipe, the Coal Creek Pipe, and the Williamsburg Pipe which are not immediately used within the Regional System may be stored in the Florence-Coal Creek-Williamsburg Reservoir on Oak Creek.)

Table 8 summarizes the full measure of the yield of the augmented Oak Creek Reservoir water right. If the full measure of Florence's 4.47 cfs of Union Ditch were to be used to augment the Oak Creek Reservoir (as opposed to the use of the Union Ditch credit to augment the direct flow Florence Treatment Plant Diversion Works water right), the augmented Oak Creek Reservoir water right would produce a dependable yield into storage of 63 acre-feet annually.

### 8. Coal Creek Pipe

The daily yield of the Coal Creek Pipe was calculated as its maximum decreed rate of diversion of 1.0 cfs for each day for which historic call records indicate that its March 5, 1884, priority would not be called out. However, whenever the monthly diversion limit was reached (10 acre-feet for June through November, and 5 acre-feet for December through May), no further in-priority yields for the given month were calculated.

Table 9 summarizes the monthly direct flow yields of the Coal Creek Pipe, based on daily calculations of yield. This 1884 water right is senior enough to produce a direct flow yield of 90 acre-feet each year in the 1971-1994 study period, except for a slight decline to 85 acre-feet in the drought year of 1978. Fifty percent of any diversions of this water right not immediately used may be stored in the Florence-Coal Creek-Williamsburg Reservoir on Oak Creek.

### 9. Williamsburg Pipe

The daily yield of the Williamsburg Pipe was calculated as its maximum decreed rate of diversion of 0.665 cfs for each day for which historic call records indicate that its December 31, 1890, priority would not be called out. However, whenever the monthly diversion limit was reached (7 acre-feet for June through November, and 4 acre-feet for December through May), no further in-priority yields for the given month were calculated.

Table 10 summarizes the monthly direct flow yields of the Williamsburg Pipe, based on daily calculations of yield. Yields average 37 acre-feet per year due to the effect of senior calls curtailing the diversion of this moderately junior water right. However, due to continued imposition of a March 1, 1910, call from November 15 through March 14 as a result of the decreed basin-wide winter storage program, this water right can produce a dependable supply of 23 acre-feet each winter. Fifty percent of the diversions not immediately used within the Regional System may be stored in the Florence-Coal Creek-Williamsburg Reservoir on Oak Creek.

### 10. W.H. May Ditch

The senior, 1867 W.H. May Ditch water right is the most senior priority on Oak Creek, according to the SEO's 1994 tabulations of water rights. Also, the junior, 1875 W.H. May Ditch water right is the third-most senior priority on Oak Creek. In between these priorities is the House Ditch domestic priority for 0.5 cfs. Due to the lack of any recent diversion records for the House Ditch which might indicate its activity, and due to its relatively small decreed rate of diversion, this report calculates the daily yield of Rockvale's two W.H. May Ditch priorities as the previously described calculated daily streamflow for Oak Creek, up to the limits of the in-priority flow rates for the W.H. May Ditch, i.e., up to 2.96 cfs for the senior, May 31, 1867, priority, and up to 1.60 cfs for the junior, December 30, 1875, priority. The small decreases in the drainage area of Oak Creek either at the headgate of the W.H. May Ditch or at Rockvale's wells further upstream along Oak Creek, as compared with the 72-square mile drainage area of Oak Creek Reservoir, does not justify a reduction in the calculated daily Oak Creek streamflows. Also, it is noted that the 1916 decree in Case No. 2637 expressly authorizes the Town's "year round" diversion and use of these two priorities for domestic purposes.

Table 11 summarizes the total calculated in-priority direct flow yields available form the two W.H. May Ditch priorities. The total yield from these rights averages 2,273 acre-feet per year, with a minimum yield of 1,091 acre-feet (1989). According to the SEO's records of historic calls, no calls have ever curtailed the diversions under senior, 1867 W.H. May Ditch priority for 2.56 cfs. Thus, the monthly yields in Table 11 which are less than 150 acre-feet are attributable to low streamflows in Oak Creek. At other times the relatively senior, 1875 W.H. May Ditch is called out. The decrees for the W.H. May Ditch do not authorize storage of diversions made under its two priorities.

No yields have been independently calculated for the two small decreed Rockvale reservoirs (0.33 acre-feet and 3.11 acre-feet), because these reservoirs are very small and are considered to be regulatory or operational reservoirs.

### 11. Total Direct Flow Yield

Table 12 summarizes the total direct flow yield available from the Regional System's water rights. The total direct flow yield averages approximately 6,700 acre-feet per year, with a minimum annual yield of 4,835 acre-feet (1989) and a maximum annual yield of 9,524 acre-feet (1987). The average annual yield of 6,700 acre-feet includes the yields of all of the System's water rights when used in a direct flow mode, including the augmented Florence Treatment Plant Diversion Works direct flow right for 7.6 cfs. The 6,700 acre-foot per year average yield, however, does not include the Oak Creek Reservoir storage yields from the Arkansas River (Table 6) or from Oak Creek (Table 7), or the augmented storage yield available from municipal use of Florence's Union Ditch rights (Table 8).

Figure 2 depicts the average monthly supply of water during the 1971-1994 study period for the System's total direct flow yield. Average monthly yields reach almost to 700 acre-feet for May and decline somewhat flatly in other months. The dip in total yield in February results from the annual loss of Florence's Union Ditch rights for ten days each February.

Figure 3 depicts the average monthly supplies of water as percentages of the average annual supply.

## IV. WATER DEMANDS FROM REGIONAL SYSTEM

*Forward*

*The following presentations of existing water demand and future water demand are admittedly incomplete at this time. However, I'd like to present our preliminary analysis for the Regional System's existing demand and our preliminary analysis of the water supply capability of the Regional System in Section IV. I would intend to use the same structure of explaining the system's ability to meet demands as which follows herein, and I think there are some tentative benchmarks of water supply to establish for TEC and for Bob Krassa.*

Florence

The projected maximum-day demands for the Regional Water System are summarized in Table II-8 through the year 2020. These projections are based on the population projections in Table II-3. Average annual water demands in acre-feet/year were determined for their impact on the water resources. Maximum-daily demands were based on a ratio of 2.5 times average-daily demand, and peak-hourly demands were based on the ratios of 1.5 times maximum-daily demands.

**Table II-8**
**Projected Water Demands**

| Year | Population | Average-Daily Demand (MGD) | Annual Usage (acre-feet/year) | Maximum-Daily Demands (MGD) | Peak-Hourly Demands (MGD) |
|---|---|---|---|---|---|
| 1980* | 3,625 | 0.94 | 1,057 | 2.36 | 3.54 |
| 1985* | 3,712 | 0.97 | 1,082 | 2.42 | 3.62 |
| 1990* | 3,801 | 0.99 | 1,108 | 2.47 | 3.71 |
| 1995* | 5,148 | 1.34 | 1,504 | 3.35 | 5.03 |
| 2000 | 6,927 | 1.8 | 2,019 | 4.51 | 6.76 |
| 2005 | 8,403 | 2.19 | 2,500 | 5.47 | 8.20 |
| 2010 | 10,095 | 2.63 | 2,943 | 6.57 | 9.85 |
| 2015 | 11,942 | 3.11 | 3,482 | 7.77 | 11.66 |
| 2020 | 14,431 | 3.76 | 4,207 | 9.39 | 14.09 |

* Populations are based on records of past population provided by the City of Florence and the individual communities.

As indicated in Section I, the City of Florence has received requests for service from a number of significant developments. The largest request has been from the Bear Paw development which includes approximately 600 acres southeast of Florence. The developer projects that this area will eventually serve 2,400 residential taps.

It is not clear what impact these large developments will have on the population projections for the system. If they generate more interest in the area than anticipated, the projections may have to be revised. If they do not, the projected build-out schedules are probably too optimistic on the part of the developers.

In addition to the above demands, previous discussions have considered the possibility of serving the Brewster area. Projection of the future demands for the district as a whole (as indicated above) is based, to a large extent, upon the historical growth in the area. It is very difficult, however, to predict the location or the magnitude of the future demands. Obviously, the demands are dependent upon the location of future developments and the development of new industries. Given the uncertainty of these factors, an estimate of the future distribution of the demands is made by assuming that the future demands will be distributed uniformly throughout the system. The analysis of the distribution system will allow for evaluating alternative locations of development and determining the impact on the system.

# DRAFT INTERIM REPORT ON

# THE FLORENCE REGIONAL WATER SYSTEM'S

# WATER SUPPLY AND WATER DEMAND

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Job No. 398.1
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## TABLES

## FIGURES

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# I. GENERAL

This report describes the existing water supplies of the Florence Regional Water System ("Regional System" or "System") and their ability to satisfy the System's existing and future demands for water. The report describes the System's decreed water rights and their calculated yields over the selected 24-year study period of 1971 through 1994. The report also discusses the need for the as-yet-unbuilt Florence-Coal Creek-Williamsburg Reservoir on Oak Creek.

# II. THE REGIONAL SYSTEM'S EXISTING WATER SUPPLIES

## A. General

This section of the report lists and describes the decreed water rights owned by each present member of the Regional System. The members of the Regional System include the City of Florence, the Town of Coal Creek, the Town of Williamsburg, and the Town of Rockvale. Figure 1 - Map of the Raw Water Supply System - provides locations for the System's present points of diversion, raw water storage reservoirs, raw water pipelines, and treatment plants.

## B. Water Rights Owned by the City of Florence

The City of Florence owns three decreed water rights in its own name and, together with the Towns of Coal Creek and Williamsburg, owns the Florence Treatment Plant Diversion Works and the Florence-Coal Creek-Williamsburg Reservoir. Solely for the sake of convenience, the two latter and jointly owned water rights are listed herein under the City of Florence. In addition, the City of Florence owns three decreed storage rights and two decreed groundwater rights.

### 1. Florence Adobe Creek Pipe and Florence Mineral Creek Pipe

The Water Court's decree entered in 1982 in Case No. 80CW93 changed numerous water rights on Adobe and Mineral Creeks to these newly named structures. The 80CW93 decree provided that the Adobe Creek Pipe and Mineral Creek Pipe water rights should be administered together for all municipal uses with the following priorities under the original adjudication in Water District No. 12.

| Priority Date | Amount<br>Cubic Feet Per Second |
|---|---|
| May 31, 1866 | 1.0 |
| May 31, 1867 | 0.5 |
| May 31, 1870 | 0.5 |
| Sep 30, 1870 | 0.5 |
| Total | 2.5 |

The decree further found that any call against these water rights from the Arkansas River or from Hardscrabble Creek would be futile.

This report henceforth refers to these jointly administered rights as the "Florence Adobe/Mineral Creek Pipe."

### 2. Florence Newlin Creek Pipe

The decree entered in Case No. 80CW93 also changed several water rights owned by Florence on Newlin Creek (aka Newland Creek) to one set of water rights called the Florence Newlin Creek Pipe.

| Appropriation Date | Amount | Adjudication Date |
|---|---|---|
| April 29, 1873 | 0.5 | February 2, 1899 |
| June 1, 1873 | 0.5 | February 2, 1899 |
| March 31, 1883 | 0.5 | February 2, 1899 |
| June 21, 1870 | 3.5 (spring and summer) | February 14, 1916 |
| February 23, 1898 | 3.5 (fall and winter) | February 14, 1916 |
| Total | 5.0 CFS | |

The 80CW93 decree allowed all of these water rights to be used for all municipal uses and further stated that any call on these rights from the Arkansas River or from Hardscrabble Creek would be futile.

### 3. Union Ditch

The decree entered in 1982 in Case No. 80CW93 formally changed Florence's then-total interest of 2,793.1 Union Ditch shares to all municipal purposes. Florence's proportional interest in the total 48 cfs Union Ditch priority of November 30, 1861, is calculated to be 4.47 cfs (48 cfs x 2,793.1 shares/29998 shares). The Union Ditch diverts from the Arkansas River at the headworks of the Minnequa Canal.

### 4. Florence Treatment Plant Diversion Works

In Case No. 80CW91 in 1982 the Water Court awarded a 100 cfs direct flow priority from the Arkansas River to the City of Florence and the Towns of Coal Creek and Williamsburg. This water right, named Florence Treatment Plant Diversion Works, bears a priority date of August 26, 1980, for irrigation, domestic, municipal and all other beneficial uses. Upon remand from the Colorado Supreme Court, the Water Court entered its final decree in 1985, reducing the maximum rate of diversion from 100 cfs to 7.6 cfs.

In 1987 in the decree entered in Case No. 86CW120, the Water Court added the Minnequa Canal as an alternate point of diversion for the Florence Treatment Plant Diversion Works.

### 5. Augmented Florence Treatment Plant Diversion Works

The decree in Case No. 80CW93 allowed an augmentation credit based on the actual extent of municipal use of Florence's changed Union Ditch water rights. Beyond the threshold of 2.00 cfs of municipal use of the Union Ditch, the decree provided for an augmentation credit of 7% of the Union Ditch usage. Then, based on the finding that the municipal use of water was only 25% consumptive, the decree allowed an out-of-priority diversion under the augmented Florence Treatment Plant Diversion Works right at a rate of four times the calculated augmentation credit. For example, if 3.00 cfs of Florence's Union Ditch rights were being diverted and used for municipal purposes, the augmentation credit would be calculated as 0.07 cfs (= 7% x (3.00 cfs - 2.00 cfs)). The permissible rate of diversion of the augmented out-of-priority Florence Treatment Plant Diversion Works right would then be 0.28 cfs (= 4 x 0.07 cfs).

## 6. Florence-Coal Creek-Williamsburg Reservoir

The decree entered in 1982 in Case No. 80CW92 awarded Florence, Coal Creek, and Williamsburg a 2,250-acre-foot storage priority for municipal purposes. The reservoir, to be located on Oak Creek approximately one mile west of Florence, may store water from the Arkansas River via the Florence Treatment Plant Diversion Works at a maximum rate of 100 cfs, or from Oak Creek.

In 1987 in the decree entered in Case No. 86CW120, the Water Court added the Minnequa Canal as an alternate point of diversion for the Florence-Coal Creek-Williamsburg Reservoir.

## 7. Augmented Florence-Coal Creek-Williamsburg Reservoir

The decree in Case No. 80CW93 also allowed the Union Ditch augmentation credit to be diverted into storage in the Florence-Coal Creek-Williamsburg Reservoir. Alternatively to the direct flow usage of the augmentation credit described in Paragraph II B5 herein, such augmentation credit, calculated as 7% of the difference between the Union Ditch usage and the threshold usage of 2.00 cfs, may be stored in the Florence-Coal Creek-Williamsburg Reservoir. Thus, at the maximum Union Ditch usage of 4.47 cfs, the augmentation credit which may be stored is calculated to be 0.17 cfs (= 7% x (4.47 cfs - 2.00 cfs)). However, pursuant to another provision of the decree in 80CW93, only 50% of this augmentation credit may be stored in the Florence-Coal Creek-Williamsburg Reservoir.

Similarly, the decree in 80CW93 also provided that 50% of any of the diversions from the Adobe/Mineral Creek Pipe, the Newlin Creek Pipe, the Coal Creek Pipe (subsequently described), and the Williamsburg Pipe (subsequently described), not used for direct municipal purposes, could be stored in the Florence-Coal Creek-Williamsburg Reservoir.

### 8. Florence Reservoirs 1, 2, and 3

The decree entered in 1916 in Case No. 2637 by the District Court for Fremont County awarded Florence the right to fill and refill three reservoirs from various sources along Newlin Creek and to use such stored waters for domestic, culinary, stock watering, sprinkling of streets, irrigation, fire fighting, steam, power, manufacturing, heating and all other purposes usually connected with and used as a part of a city water supply. The decree later entered by the Water Court in Case No. 80CW93 authorized the continued use of Florence Reservoirs 1, 2, and 3 to store any or all of the water diverted under the rights of the Florence Adobe Creek Pipe, the Florence Mineral Creek Pipe, and the Florence Newlin Creek Pipe, for municipal purposes, up to the capacities previously decreed in Case No. 2637: Reservoir 1 - 154 acre-feet; Reservoir 2 - 92 acre-feet; and Reservoir 3 - 138 acre-feet. (The embankment separating Reservoir 1 and Reservoir 2 has been removed, and Reservoir 1 and Reservoir 2 now constitute one reservoir.)

### 9. Florence Municipal Wells No. 1 and No. 2

The Water Court in 1971 entered its decree in Case No. W-147 awarding a September 25, 1911, priority for 0.668 cfs to Florence Municipal Well No. 1 and a December 31, 1950, priority for 0.668 cfs to Florence Municipal Well No. 2, both priorities to be used for municipal purposes. Because these wells are reportedly leased to the Fremont-Custer County School District, this report will no longer consider them as a part of the Regional System. However, because Florence Municipal Well No. 2 has a post-1948 priority date, it is noted that either the Town of Florence or the school district is obligated to provide augmentation water for its continued use under the new rules for use of ground water promulgated by the Colorado State Engineer.

## C. Water Rights Owned by Town of Coal Creek

The decree entered by the Water Court in Case No. 80CW93 changed several water rights owned by Coal Creek into one newly named water right - the Coal Creek Pipe. This water right carries a priority date of March 5, 1884, for 1.0 cfs for all municipal uses. The point of diversion was established as from the Arkansas River at the Florence Treatment Plant Diversion Works. The decree also imposed monthly diversion limits of 10 acre-feet for June through November, and 5 acre-feet for December through May.

In 1987 in the decree entered in Case No. 86CW120, the Water Court added the Minnequa Canal as an alternate point of diversion for the Coal Creek Pipe.

## D. Water Rights Owned by Town of Williamsburg

The decree in Case No. 80CW93 likewise changed several water rights owned by Williamsburg into one new water right - the Williamsburg Pipe. This water right is to divert its 0.665 cfs for all municipal purposes from the Arkansas River at the Florence Treatment Plant Diversion Works. This water right carries a December 31, 1890, priority. The decree limited its monthly diversions to 7 acre-feet from June through November and 4 acre-feet from December through May.

In 1987 in the decree entered in Case No. 86CW120, the Water Court added the Minnequa Canal as an alternate point of diversion for the Williamsburg Pipe.

## E. Water Rights Owned by Town of Rockvale

In 1884 in the original adjudication of water rights in Water District No. 12 and in 1916 in Case No. 2637, the District Court for Fremont County entered its decrees approving water rights for the Town of Rockvale. These water rights include a 2.96 cfs priority of May 31, 1867, and a 1.60 cfs priority of December 30, 1875, "for domestic purposes, including the watering of stock, the sprinkling of lawns, the irrigation of ornamental trees, and all other purposes usually connected with and used as a part of a town water supply." The decree provided that these priorities may be diverted from Oak Creek by the W.H. May Ditch or by wells situated on Oak Creek. The decree further provides for the filling and refilling of two small reservoirs (0.33 acre-feet and 3.11 acre-feet) to be used for domestic purposes.

Later, in the decree entered in 1974 in Case No. W-1566, the Water Court changed the point of diversion for 0.4 cfs of the Town's senior, 1867 priority of 2.96 cfs, to six wells lying upstream from the Town on Oak Creek, located on Figure 1.

In 1991 in Case No. 90CW33, the Water Court approved the changes in location to two of the six wells decreed in Case No. W-1566.

## III. YIELDS OF EXISTING WATER SUPPLIES

### A. Methodology

Yields for the Regional System's decreed sources of water described above were calculated on a daily basis for the 1971-1994 study period. The 1971-1994 study period provides a sufficiently long period, having both dry years (1977, 1978) and wet years (1985, 1987), upon which to evaluate the System's water supply.

### B. Direct Flow Supplies

#### 1. Florence Adobe/Mineral Pipe

Historic daily diversion records maintained by the State Engineer's Office ("SEO") were used to represent the water supply available from the Florence Adobe/Mineral Creek Pipe. For water years (November 1 - October 31) for which no such diversion records were available (1984, 1987, 1988, and 1991), a linear correlation technique using diversion records for the Florence Newlin Creek Pipe were used to generate diversions for the Adobe/Mineral Creek Pipe. For water years for which the SEO diversion records indicated that no diversions were made, zero diversions were used in the yield analyses described herein. In any and all events where either recorded diversions or correlated diversions exceeded the maximum rate of diversion of 2.5 cfs decreed in Case No. 80CW93, a value of 2.5 cfs was used for the yield analyses. Because the decree in Case No. 80CW93 found that any call on these rights from the Arkansas River or from Hardscrabble Creek would be futile, diversions as described above were used without any reduction for historic senior calls.

Table 1 provides a summary of monthly diversions in acre-feet for the Florence Adobe/Mineral Creek Pipe as computed from annual files of daily diversions. This report uses a conversion factor of 1.98347 to calculate acre-feet from cfs-days.

Direct flow yields from the Florence Adobe/Mineral Creek Pipe average 216 acre-feet per year during the 1971-1994 study period. Also, to the extent that water diverted under this water right is not immediately used within the Regional System, fifty percent of such diversions not immediately used may be stored in the Florence-Coal Creek-Williamsburg Reservoir on Oak Creek.

The zero or near-zero yields for 1984, 1985, 1986, and 1989 are difficult to believe and may be due to operational practices or problems with diversion structures or pipelines at the time. The present practice of operating the Regional System is to divert <u>all</u> available water from the Florence Adobe/Mineral Creek Pipe, and from the Florence Newlin Creek Pipe as well, at <u>all</u> times. It is difficult to believe that Adobe and Mineral Creeks dried up all year long for such extended periods of time, but the yield analyses herein rely on <u>recorded</u> diversions.

It is also noted that the Adobe/Mineral Creek Pipe yields over the 1987-1994 period are generally quite a bit larger than those from earlier years. These increases are probably due to many factors, including the fairly recent reconstruction of the pipe, a greater demand for water occasioned principally by the extension of the Regional System's service area to include the State Prison, and a higher degree of diligence in operating this diversion facility.

### 2. Florence Newlin Creek Pipe

Historic daily diversion records, limited to the maximum rate of diversion of 5.0 cfs under the decree in Case No. 80CW93, were used for yield analyses. Because of the futile call language contained in 80CW93, no further reductions were made.

Table 2 summarizes monthly availability of direct flow yield from the Florence Newlin Creek Pipe.

Direct flow yields from the Florence Newlin Creek Pipe averaged 372 acre-feet per year. Fifty percent of the diversions from this water right not immediately used may be stored in the Florence-Coal Creek-Williamsburg Reservoir on Oak Creek.

Once again, the zero or near-zero yields for 1983, 1984, 1985, 1986, and 1989 are difficult to accept, but such diversions were reported to the State Engineer's Office. Some of these low yields are clearly attributable to a breakage in the Newlin Creek Pipe in the late 1980's.

It is also noted that yields recorded for the Newlin Creek Pipe over recent years have increased over those reported in the earlier period, as was mentioned in regard to the yields from the Adobe/Mineral Creek Pipe. These increases are likely due to the same reasons as those given for the Adobe/Mineral Creek Pipe - reconstruction of the pipe, greater demand, and a higher degree of diligence in operating this diversion facility.

No yields have been calculated independently for the three Florence reservoirs. This report will largely treat these reservoirs as regulatory or operational reservoirs whereby day-to-day variations of supply and demand may be moderated, although they could be operated for annual or longer term carryover storage. This report in the main will not treat these reservoirs as having independent yield.

### 3. Union Ditch

Florence's proportional interest in the senior, 1861 Union Ditch priority, which was changed in Case No. 80CW93, amounts to 4.47 cfs. Because of this ditch's historic practice of diverting on a year-round basis, the seniority of the 1861 Union Ditch priority, and the streamflow physically present in the Arkansas River at the point of diversion of the Union Ditch, the daily yield of Florence's Union Ditch rights was taken to be 4.47 cfs each day throughout the 1971-1994 study period. However, to reflect down time for maintenance of the Minnequa Canal, through which the Union Ditch is diverted, yields for the ten-day period of February 1 through February 10 were taken to be zero.

Table 3 summarizes monthly direct flow yields available from Florence's Union Ditch water rights changed in Case No. 80CW93. (Florence owns an additional 736.63 shares of Union Ditch which have not yet been judicially changed to municipal use. The present study described in this report does not address nor incorporate the yield from these 736.63 shares.) The direct flow yield from Florence's 4.47 cfs of the senior, 1861 Union Ditch right averages 3,149 acre-feet per year, and year-to-year yields do not deviate from the average yield due to the seniority of this water right. Like the Adobe/Mineral Creek Pipe and the Newlin Creek Pipe, fifty percent of the augmentation credit from this water right may be stored in the Florence-Coal Creek-Williamsburg Reservoir on Oak Creek.

### 4. Florence Treatment Plant Diversion Works

The in-priority yield from this 1980 priority for 7.6 cfs will be severely restricted in the future due to its junior date. For purposes of calculating its yield in this study, the full 7.6 cfs was assumed to be divertable from the Arkansas River at any time for which historic call records, maintained by the Division Engineer's Office, indicated that a free river was present. Due to the Water Court's approval of a basin-wide winter storage program in Case No. 84CW179, a river call of March 1, 1910, has been superimposed on historic call records for the period November 15 through March 14 of each year for the yield analyses described herein. As Table 4 indicates, such in-priority periods during which yield would be expected to be present during the selected study period include only the years 1985 and 1987.

Table 4 summarizes monthly yields available for the Florence Treatment Plant Diversion Works water right, based on daily calculations. Yields of approximately 500 acre-feet and 1,500 acre-feet would be expected to be available in the wet years of 1985 and 1987, with no yield being the norm in most years.

## 5. Augmented Florence Treatment Plant Diversion Works

Wherever the Regional System diverts Florence's Union Ditch water rights in excess of 2.00 cfs for direct municipal use, the Florence Treatment Plant Diversion Works water right can produce an additional increment of supply by augmentation from the municipal use of the Union Ditch diversion. The full rate of such augmented use of the Florence Treatment Plant Diversion Works water right is calculated to be 0.68 cfs, as previously described. This augmented use must be distinguished from the augmented exercise of the Florence-Coal Creek-Williamsburg Reservoir water right. That is, the full measure of augmentation credit from municipal use of Union Ditch diversions can not be applied at the same instant to augment both the Florence Treatment Plant Diversion Works water right and the Florence-Coal Creek-Williamsburg Reservoir water right. Any given portion of the Union Ditch augmentation credit may augment only the Florence Treatment Plant Diversion Works water right or the Florence-Coal Creek-Williamsburg Reservoir water right at one time. However, the decree in

Case No. 80CW93 does not prohibit the use of one portion of the Union Ditch augmentation credit to augment the Florence Treatment Plant Diversion Works water right while at the same time using a different portion of the augmentation credit to augment the reservoir.

Table 5 summarizes the full measure of yield of the augmented Florence Treatment Plant Diversion Works water right, assuming full municipal use of the 4.47 cfs Union Ditch water right each day of the year, except for February 1 through 10, and assuming no use of the Union Ditch augmentation credit for storage. If the full measure of Florence's 4.47 cfs of Union Ditch rights were diverted and used for municipal purposes each day of the year (excepting ten days in February), this water right could yield a dependable supply of 472 acre-feet annually.

## 6. Florence-Coal Creek-Williamsburg Reservoir

The yield from the Florence-Coal Creek-Williamsburg Reservoir under its own 1980 storage priorities from the Arkansas River and from Oak Creek will also be expected to be severely limited in the future due to demands from senior water rights along the Arkansas River. The yield available from the Arkansas River was calculated at the maximum decreed rate of diversion of 100 cfs for each day for which historic call records indicated that a free river was present. Table 6 summarizes the yields calculated to be available from the Arkansas River. Tremendous yields would be expected to be available in the wet years of 1985 and 1987, but this water right would produce no yield in normal to dry years.

The yields from Oak Creek were calculated by use of daily calculations of streamflow for Oak Creek based on recorded streamflows from the USGS gaging station on Fourmile Creek near Canon City (#07096500). Although the drainage area above the Fourmile Creek gage, 434 square miles, is much larger than the Oak Creek Reservoir's 72 square mile drainage area, the two drainage basins are similar in several respects. Maximum elevations at their upstream divides are between 10,000 and 11,000 feet, and elevations at the gaging station on Fourmile Creek and at the Oak Creek damsite are approximately 5,200 feet. Slopes of the main stream courses are comparable. Precipitation upon the Oak Creek watershed appears to be approximately 16% greater than that for the Fourmile Creek basin, suggesting that streamflow per unit area would be somewhat greater for Oak Creek. For purposes of creating daily flows for Oak Creek in the vicinity of the damsite for Oak Creek Reservoir, however, this report adopts a drainage area based factor of 17% (72 square miles/434 square miles) to be multiplied against daily Fourmile Creek gaged flows to obtain daily Oak Creek streamflows.

In-priority yields available to the Oak Creek Reservoir from Oak Creek were then taken to be the calculated daily Oak Creek streamflows whenever historic call records indicated that a free river was present. During the selected 1971-1994 study period, in-priority yields from Oak Creek would occur only in 1985 and 1987.

Table 7 summarizes the in-priority yields from Oak Creek calculated to be available to Oak Creek Reservoir. This water right could produce significant yields of around 2,000 to 3,000 acre-feet in wet years, such as 1985 and 1987, but normally it could produce no yield.

### 7. Augmented Florence-Coal Creek-Williamsburg Reservoir

If the full measure of the Union Ditch augmentation credit were utilized to augment the Florence-Coal Creek-Williamsburg Reservoir, augmented diversions from either the Arkansas River or from Oak Creek could be made at a rate of approximately 0.086 cfs into storage in the Florence-Coal Creek-Williamsburg Reservoir. (Also, fifty percent of the diversions from the Adobe/Mineral Creek Pipe, the Newlin Creek Pipe, the Coal Creek Pipe, and the Williamsburg Pipe which are not immediately used within the Regional System may be stored in the Florence-Coal Creek-Williamsburg Reservoir on Oak Creek.)

Table 8 summarizes the full measure of the yield of the augmented Oak Creek Reservoir water right. If the full measure of Florence's 4.47 cfs of Union Ditch were to be used to augment the Oak Creek Reservoir (as opposed to the use of the Union Ditch credit to augment the direct flow Florence Treatment Plant Diversion Works water right), the augmented Oak Creek Reservoir water right would produce a dependable yield into storage of 63 acre-feet annually.

### 8. Coal Creek Pipe

The daily yield of the Coal Creek Pipe was calculated as its maximum decreed rate of diversion of 1.0 cfs for each day for which historic call records indicate that its March 5, 1884, priority would not be called out. However, whenever the monthly diversion limit was reached (10 acre-feet for June through November, and 5 acre-feet for December through May), no further in-priority yields for the given month were calculated.

Table 9 summarizes the monthly direct flow yields of the Coal Creek Pipe, based on daily calculations of yield. This 1884 water right is senior enough to produce a direct flow yield of 90 acre-feet each year in the 1971-1994 study period, except for a slight decline to 85 acre-feet in the drought year of 1978. Fifty percent of any diversions of this water right not immediately used may be stored in the Florence-Coal Creek-Williamsburg Reservoir on Oak Creek.

### 9. Williamsburg Pipe

The daily yield of the Williamsburg Pipe was calculated as its maximum decreed rate of diversion of 0.665 cfs for each day for which historic call records indicate that its December 31, 1890, priority would not be called out. However, whenever the monthly diversion limit was reached (7 acre-feet for June through November, and 4 acre-feet for December through May), no further in-priority yields for the given month were calculated.

Table 10 summarizes the monthly direct flow yields of the Williamsburg Pipe, based on daily calculations of yield. Yields average 37 acre-feet per year due to the effect of senior calls curtailing the diversion of this moderately junior water right. However, due to continued imposition of a March 1, 1910, call from November 15 through March 14 as a result of the decreed basin-wide winter storage program, this water right can produce a dependable supply of 23 acre-feet each winter. Fifty percent of the diversions not immediately used within the Regional System may be stored in the Florence-Coal Creek-Williamsburg Reservoir on Oak Creek.

## 10. W.H. May Ditch

The senior, 1867 W.H. May Ditch water right is the most senior priority on Oak Creek, according to the SEO's 1994 tabulations of water rights. Also, the junior, 1875 W.H. May Ditch water right is the third-most senior priority on Oak Creek. In between these priorities is the House Ditch domestic priority for 0.5 cfs. Due to the lack of any recent diversion records for the House Ditch which might indicate its activity, and due to its relatively small decreed rate of diversion, this report calculates the daily yield of Rockvale's two W.H. May Ditch priorities as the previously described calculated daily streamflow for Oak Creek, up to the limits of the in-priority flow rates for the W.H. May Ditch, i.e., up to 2.96 cfs for the senior, May 31, 1867, priority, and up to 1.60 cfs for the junior, December 30, 1875, priority. The small decreases in the drainage area of Oak Creek either at the headgate of the W.H. May Ditch or at Rockvale's wells further upstream along Oak Creek, as compared with the 72-square mile drainage area of Oak Creek Reservoir, does not justify a reduction in the calculated daily Oak Creek streamflows. Also, it is noted that the 1916 decree in Case No. 2637 expressly authorizes the Town's "year round" diversion and use of these two priorities for domestic purposes.

Table 11 summarizes the total calculated in-priority direct flow yields available form the two W.H. May Ditch priorities. The total yield from these rights averages 2,273 acre-feet per year, with a minimum yield of 1,091 acre-feet (1989). According to the SEO's records of historic calls, no calls have ever curtailed the diversions under senior, 1867 W.H. May Ditch priority for 2.56 cfs. Thus, the monthly yields in Table 11 which are less than 150 acre-feet are attributable to low streamflows in Oak Creek. At other times the relatively senior, 1875 W.H. May Ditch is called out. The decrees for the W.H. May Ditch do not authorize storage of diversions made under its two priorities.

No yields have been independently calculated for the two small decreed Rockvale reservoirs (0.33 acre-feet and 3.11 acre-feet), because these reservoirs are very small and are considered to be regulatory or operational reservoirs.

## 11. Total Direct Flow Yield

Table 12 summarizes the total direct flow yield available from the Regional System's water rights. The total direct flow yield averages approximately 6,700 acre-feet per year, with a minimum annual yield of 4,835 acre-feet (1989) and a maximum annual yield of 9,524 acre-feet (1987). The average annual yield of 6,700 acre-feet includes the yields of all of the System's water rights when used in a direct flow mode, including the augmented Florence Treatment Plant Diversion Works direct flow right for 7.6 cfs. The 6,700 acre-foot per year average yield, however, does not include the Oak Creek Reservoir storage yields from the Arkansas River (Table 6) or from Oak Creek (Table 7), or the augmented storage yield available from municipal use of Florence's Union Ditch rights (Table 8).

Figure 2 depicts the average monthly supply of water during the 1971-1994 study period for the System's total direct flow yield. Average monthly yields reach almost to 700 acre-feet for May and decline somewhat flatly in other months. The dip in total yield in February results from the annual loss of Florence's Union Ditch rights for ten days each February.

Figure 3 depicts the average monthly supplies of water as percentages of the average annual supply.

## IV. WATER DEMANDS FROM REGIONAL SYSTEM

*Forward*

*The following presentations of existing water demand and future water demand are admittedly incomplete at this time. However, I'd like to present our preliminary analysis for the Regional System's existing demand and our preliminary analysis of the water supply capability of the Regional System in Section IV. I would intend to use the same structure of explaining the system's ability to meet demands as which follows herein, and I think there are some tentative benchmarks of water supply to establish for TEC and for Bob Krassa.*

### A. Existing Water Demands

At present, the Regional System provides water service to the City of Florence, to the Town of Coal Creek, to the Town of Williamsburg, and to the Town of Rockvale. Also, the Regional System provides treated water service to the State Prison and raw water to the Bear Paw Golf Course for irrigation.

Based on recent records of water production and water usage, Table 13 summarizes the estimated average demands from the System. Current (1995) annual requirements for raw water stand at 1,666 acre-feet.

Figure 4 depicts these existing average monthly demands for water from the Regional System in units of acre-feet, and Figure 5 depicts these average demands as percentages of annual demand.

### B. Future Water Demands

Based on maps delineating the future service areas of the members of the existing Regional System, on expected zoning, and on current water use patterns, Table 14 presents the projected future water demands for the Regional System. (*This work hasn't been done yet*.)

Figures 6 and 7 (*not done yet*) depict the average future monthly water demands from the Regional System in units of acre-feet and percent of annual demand, respectively.

## V. ASSESSMENT OF REGIONAL SYSTEM'S EXISTING WATER SUPPLY

### A. Existing Water Supply and Existing Water Demand

In the following discussions of the Regional System's existing water supplies and demands, the assessments assume that the previously described yields of the System's various supplies will be divertable and deliverable to the System's point of need. For example, to get storable water into a new reservoir on Oak Creek from Florence's Newlin Creek Pipe, the following assessments will assume that a pipe from Florence's existing raw water reservoirs near the south Treatment Plant to the new Oak Creek Reservoir will be in place.

A comparison of the Regional System's existing direct flow supply (Table 12 and Figure 2) with the Regional System's average existing demand (Table 13 and Figure 4) indicates that the Regional System should have an ample supply to meet its existing demands. The average annual direct flow supply is 6,700 acre-feet, and the average annual demand is 1,666 acre-feet. Minor monthly deficits of up to 17 acre-feet would result, but the raw water stored in the two Florence Reservoirs at the South and North treatment plants could easily provide for these deficits and then refill.

In order to assess the Regional System's water supply in a comprehensive manner, a FORTRAN computer program, named "DF" for direct flow, reads all of the daily supplies from all of the System's direct flow sources for each of the 24 years in the 1971-1994 study period and first compares each member's daily supply against each member's daily demands. The program asks the user for each member's annual demand (in acre-feet), and then the program calculates each member's daily demand based on a set of monthly percentages of annual demand which approximate those shown in the far-right column of Table 13. (*When we get additional water demand information from Rockvale and for the State Prison, we'll modify the monthly distribution of annual demand.*)

Table 15 presents a sample of the optional daily output from Program DF for the month of February, 1977.

On a daily basis Program DF calculates and prints out each member's supply from each of its sources and its total supply; its demand; its surplus; its deficit; and its net deficit. Then, after calculating and depicting each member's daily status, Program DF takes a fresh look at the Regional System operating as a system (and not operating as individual members), and it calculates and depicts, on a daily basis, the Regional System's total supply; its total demand; its total surplus; its total deficit; and its total net surplus. The "total net surplus" will be positive if there is a surplus on any given day, and it will be negative if there is a deficit on any given day.

Because Program DF calculates surpluses and deficits on a daily basis, it is possible that although a given member may have a net surplus for the month, it may also have deficits for certain days during the month. This is important to understand in evaluating Coal Creek's and Williamsburg's situations. Recalling that the yield methodologies for the Coal Creek Pipe and the Williamsburg Pipe calculated in-priority yield at the maximum decreed rate of diversion on a daily basis until the decreed monthly limit was reached, these yield procedures heavily load the yields for these two rights toward the beginning of the month, leaving no calculated yield for the remaining days of the month. This method of calculating yields for these two rights is consistent, however, with the operation of a regional system to obtain the maximum yield for the regional system, because if one does not divert his/her water on a given day when his/her water right is in priority, he/she takes the chance of losing the yield from such a right due to a subsequent call for a senior water right. Thus, for the most part, and due to the seniority of the Coal Creek Pipe priority, the deficits shown on Table 15 and elsewhere during the 1971-1994 study period for Coal Creek may be disregarded. The deficits for Williamsburg for those months having a yield from the Williamsburg Pipe may also largely be disregarded.

Taking another look at Table 15, one will note that Florence's supplies appear inadequate for its demands for the first 10 days of February of 1977. The shortage is largely due to the assumed shutdown of the Minnequa Canal for maintenance and the resultant unavailability of Florence's Union Ditch water. This "shortage" is very much not the norm for Florence's water supply and water demand. As will be shown later, Florence's water supplies provide a very large portion of the total supply for the Regional System. The operation of the Regional System shown in the five far-right columns of Table 15 indicates that the System's total supply would alleviate these shortages. Also, the use of a small amount of raw water storage in Florence's reservoirs would take care of this shortage.

Another option of Program DF is to skip the lengthy daily output depicted in Table 15 and to print out a parallel monthly summary of the operation of each member's supply and demand and the Regional System's supply and demand. Table 16 presents a portion of such a monthly summary for the Regional System's existing supply and existing demand for years 1977, 1978, and 1979. In Table 16 the status of each member's supply and demand and surplus/deficit is given, along with the status for the Regional System operating as a system.

A variation of Program DF is Program "DFTABLE." With the same demand information for each member inputted into Program DFTABLE, DFTABLE prepares a month-and-year summary table for each supply and for each member's demand, surplus, deficit, and net surplus. These tables are prepared in the same order as the headings from Table 16, i.e., the Adobe/Mineral Creek Pipe supply first, then the Newlin Creek Pipe supply, then the Union Ditch supply, and so on. Tables 17 through 46 comprise this set of tables, some of which are identical to previously described tables.

As discussed previously, the System's direct flow supply of 6,700 acre-feet per year, as an average, can adequately satisfy the System's average annual demand of 1,666 acre-feet, and only a few minor monthly deficits occur (Table 45). These deficits can be satisfied by use of Florence's raw water storage reservoirs located at the two existing treatment plants. There appears to be no immediate need to develop additional raw water storage on Oak Creek to satisfy the Regional System's existing water demands. The System's net surplus averaging 5,030 acre-feet (Table 46) is available to meet increases in water demand resulting from growth within the Regional System. However, it may be wise for the Regional System to consider initiation of acquisition of land and rights of way for this reservoir.

Table 47 summarizes the 24-year study period averages for each member's direct flow supply and for each member's demand, surplus, deficit, and net surplus, as well as the respective averages for the Regional System as a whole.

### B. Existing Water Supply and Future Water Demand

*(We will address this issue when we get projected water demands from TEC.)*

### C. Water Supply Capability of Existing System

*(I may combine this discussion into the previous discussion of future water demands, if the projected future water demand is so large, approximately 4,000 af/yr or more, as to stress the System's existing supplies.)*

The Regional System's total direct flow supply can service quite a large demand without the need for additional raw water storage, based on the analyses discussed previously herein and those to follow. At least three questions arise as a result of these analyses. First, at what level of demand would the Regional System require a new raw water reservoir on Oak Creek? Second, how large a reservoir should be constructed? Third, what steps should be taken (land acquisition, design, etc.) to develop a new raw water reservoir and when should such steps be taken? Before proceeding to answer these questions, it is important to note that other factors besides these water supply analyses may justify the development of some raw water storage on Oak Creek at the present time.

Among these would be simply the security of having a supplemental supply to take care of a more severe drought than those represented by the 1971-1994 study period relied upon herein. Also, unexpected failures of diversion facilities or even Florence's existing raw water storage reservoirs could obviously occur and disrupt the System's raw water supply. The threat of pollution from spills of hazardous materials upstream on the Arkansas River has also been noted in previous engineering studies for Florence, and such threats could be alleviated by having a supplemental supply of raw water in the Oak Creek Reservoir.

Figure 8 depicts the minimal monthly deficits in water supply resulting from the application of the Regional System's total direct flow supply to meet the System's existing demand of 1,666 acre-feet per year. Figures 9, 10, 11, 12, 13, and 14 depict the increasing monthly deficits that correspond to annual system water demands of 2,000, 3,000, 4,000, 5,000, 6,000, and 7,000 acre-feet, respectively.

Again, referring to the existing System demand of 1,666 acre-feet per year, the deficits from the System's direct flow supplies (Figure 8) are infrequent and minimal, and, therefore, tolerable from a water supply viewpoint. The monthly direct flow deficits shown in Figure 9 for an annual demand of 2,000 acre-feet, and in Figure 10 for an annual demand of 3,000 acre-feet, are also infrequent and are less than 50 acre-feet. These indicated deficits are probably tolerable. With an annual System demand of 4,000 acre-feet, however, monthly deficits of 50 acre-feet become more frequent, and monthly deficits of up to 80 acre-feet would be expected. Also, significant monthly deficits begin to occur consecutively over several months. For example, in 1989, a two-month deficit of 120 acre-feet occurs. When this two-month deficit of 120 acre-feet is compared with Florence's existing total raw water storage of ____ *(Brian Zick to furnish)* acre-feet, one would begin to become concerned over the desire and need to have additional raw water storage. With an annual demand of 5,000 acre-feet, direct flow deficits (Figure 12) would rise to over 150 acre-feet, and four-month deficits in 1989 would reach 450 acre-feet, which the existing raw water reservoirs simply could not support.

Recalling that the average direct flow supply is 6,700 acre-feet per year, graphs of monthly deficits from annual System demands of 6,000 and 7,000 acre-feet were also prepared (Figures 13 and 14, respectively). One can quickly conclude that the monthly deficits resulting from a System demand of 5,000 acre-feet or more would be completely intolerable.

Figure 15 summarizes these analyses of direct flow deficits and annual System demand. As discussed above, direct flow deficits resulting from annual demands of up to 3,000 or even 4,000 acre-feet appear quite acceptable, but at an annual demand in excess of approximately 4,000 acre-feet, direct flow deficits become unacceptable and lead toward the need to develop additional raw water storage.

## B. Description of Oak Creek Reservoir

The Water Court in 1982 in Case No. 80CW92 awarded Florence, Coal Creek, and Williamsburg a 2,250 acre-foot storage priority for a reservoir to be located on Oak Creek. The formal name for this water right is the Florence-Coal Creek-Williamsburg Reservoir, but for brevity this report hereinafter refers to it as the Oak Creek Reservoir.

Based on the decreed location of the dam on Oak Creek and by calculation of reservoir surface area from the 1:24,000 scale 7-1/2-minute USGS Canon City quadrangle map, a dam creating a depth of water of approximately 57 feet would be required to store 2,250 acre-feet. The location and the high water line at a depth of 57 feet are presented on Figure 16. This water surface level would correspond to an elevation of approximately 5,252 feet. Figure 17 graphically depicts the reservoir's water surface area and capacity up to an elevation of 5,260 feet.

For purposes of analyses of the role which Oak Creek Reservoir could serve relative to the Regional System's needs, monthly net evaporation data were developed using gross evaporation data from the State Engineer's Office. The average gross reservoir evaporation rate was taken to be 3.79 feet per year. After subtracting 70% of the average annual precipitation of 12.94 inches from the Canon City weather station, the net reservoir evaporation used in this study for Oak Creek Reservoir averages 3.04 feet per year for the 1971-1994 study period, as summarized in Table 49.

## C. The Need for Additional Raw Water Storage in Oak Creek Reservoir

Before getting into the water supply aspects of the current study, it is noted that Martin and Wood Water Consultants, Inc., has undertaken no evaluation of the engineering or geotechnical suitability of the decreed site for the dam or underlying bed of Oak Creek Reservoir. It is simply assumed that Oak Creek Reservoir may be constructed at its decreed site up to its decreed maximum storage of 2,250 acre-feet. Regardless of the actual suitability of the decreed site, however, the discussions which follow may be interpreted to describe, in general terms, the quantity of raw water storage needed to develop fully the existing water supplies of the Regional System even if the Oak Creek Reservoir site were eventually to be deemed unsuitable.

### 1. Utilization of the Full-Scale, 2,250 Acre-Foot Oak Creek Reservoir

This water supply discussion begins by recalling that the Regional System's existing direct flow supplies can adequately meet a System demand of approximately 4,000 acre-feet per year, with tolerable deficits. The question which then arises is: "By constructing Oak Creek Reservoir, how much water can the Regional System dependably supply?" The answer is that by constructing the Oak Creek Reservoir to its fully decreed size of 2,250 acre-feet, the calculated maximum dependable yield of the Regional System's existing supplies reaches up to 5,089 acre-feet per year, without deficits or shortages indicated by these analyses. The word dependable, as used in this report, simply means that no deficits or shortages of the supply of water needed to meet a given demand are calculated to occur, based on the evaluations described herein of the yields of all of the water rights involved.

Figure 18 depicts the behavior of a 2,250 acre-foot Oak Creek Reservoir operating in conjunction with the Regional System's existing supplies in order to produce a total System yield of 5,089 acre-feet per year with no shortages in supply. Due to its somewhat sparse supply of water to store in Oak Creek Reservoir, and due to its fully constructed size, the reservoir would only fill upon the availability of large quantities of in-priority water from the Arkansas River and from Oak Creek in the years 1985 and 1987. In all other years the reservoir's level would generally decline. Figure 19 depicts the direct flow deficits from the annual demand of 5,089 acre-feet, all of which would be eliminated by use of the 2,250 acre-foot reservoir.

The Regional System's use of an Oak Creek Reservoir, together with its existing direct flow supplies, is analyzed in this study by use of an additional computer program named "RES." Program RES asks the user for each member's annual water demand, the maximum capacity of the Oak Creek Reservoir to be used in the given analysis, and the amount of water in storage at the beginning of the study period, i.e., at the beginning of January, 1971. In a manner much like that of PROGRAMS DF and DFTABLE, PROGRAM RES first analyzes the Regional System's direct flow supplies and demands on a daily basis, and only on a system basis. RES utilizes the System's direct flow supplies in the following order to meet the System's demands. This order is predicated on maximization of storage of the System's water rights which in turn maximizes the overall yield of the System's water rights.

First, RES utilizes Rockvale's W.H. May Ditch rights, because these are solely direct flow rights which cannot be stored pursuant to any existing decree.

Second, RES utilizes Florence's Union Ditch rights changed in Case No. 80CW93.

Third, RES utilizes the in-priority Florence Treatment Plant Diversion Works water right even though it would seldom be in priority. This right can't be stored, and its use before the other four storable rights maximizes the System's storable inflow to the Oak Creek Reservoir.

Fourth, RES utilizes the augmented Florence Treatment Plant Diversion Works water right. Using this water right prior to the other four storable rights also maximizes the System's storable inflow to the Oak Creek Reservoir. For each one cfs of the System's direct use of Florence's Union Ditch rights in excess of the threshold of 2.00 cfs of use of such rights, 0.28 cfs of diversion of the augmented Florence Treatment Plant Diversion Works is generated. Alternatively, in the storage mode, each one cfs of use of the Union Ditch rights in excess of the threshold of 2.00 cfs of such use generates only 0.035 cfs of storable water. Thus, using the augmented Florence Treatment Plant Diversion Works water right, which necessarily reduces the storability of Union Ditch water, nevertheless increases the System's storability of its rights as well as the overall yield of the System.

RES then utilizes the last four rights which are storable under 80CW93 - the Adobe/Mineral Creek Pipe, the Newlin Creek Pipe, the Coal Creek Pipe, and the Williamsburg Pipe. Putting first the uses of the W.H. May Ditch, the changed Union Ditch, the Florence Treatment Plan Diversion Works and the augmentation thereof delays the use of these last four storable rights and thereby maximizes the inflow storable in Oak Creek Reservoir, resulting in maximization of the System's total dependable yield.

Table 50 summarizes the output from the operation of PROGRAM RES in its daily format for the month of February, 1977, for the System's existing supply, an annual System demand of 5,089 acre-feet, and in conjunction with the use of the full-scale 2,250 acre-foot reservoir on Oak Creek. The daily output option does not produce values for the far-right eight columns. These columns are used in the monthly output option.

Taking February 28 as an example, RES calculates the inflow storable under 80CW93 as follows.

| TOTAL SUPPLY AVAILABLE | 6.00 cfs |
|---|---|
| From W.H. May Ditch | 0.85 cfs |
| From Union Ditch | 4.47 |
| From Flor Trtmnt Plant Div Wrks | 0.00 |
| From Augmented Flor Trtmnt Plant Div Wrks | 0.68 |
| From Adobe/Mineral | |

| | |
|---|---|
| Creek Pipe | 0.00 |
| From Newlin Creek Pipe | 0.00 |
| From Coal Creek Pipe | 0.00 |
| From Williamsburg Pipe | 0.00 |
| TOTAL | 6.00 cfs |

| | |
|---|---|
| SYSTEM DAILY DEMAND | 5.40 cfs |
| From W.H. May Ditch | 0.85 cfs |
| From Union Ditch | 4.47 |
| From Augmented Flor Trtmnt Plant Div Wrks | 0.08 |
| TOTAL | 5.40 cfs |

| | |
|---|---|
| AMOUNT STORABLE UNDER 80CW93 | |
| From Union Ditch | 0.17 cfs |
| Total augmentation credit (7.0 x [4.47 cfs - 2.00 cfs]) | |
| Less augmentation credit needed for augmented Flor Trtmnt Plant Div Wrks (=25% x 0.08 cfs) | - 0.02 |
| Augmentation credit remaining | 0.15 cfs |
| Storable augmentation credit (50% x [0.17 cfs - 0.02 cfs]) | 0.07 cfs |
| From Adobe/Mineral Creek Pipe 0.00 cfs x 50% storable | 0.00 |
| From Newlin Creek Pipe 0.00 cfs x 50% storable | 0.00 |
| From Coal Creek Pipe 0.00 cfs x 50% storable | 0.00 |
| From Williamsburg Pipe 0.00 cfs x 50% storable | 0.00 |
| TOTAL | 0.07 cfs |

Table 51 provides an example of the monthly output from PROGRAM RES for years 1977, 1978, and 1979 for the existing System supply, a System demand of 5,089 acre-feet per year, and with the full-scale 2,250 acre-foot reservoir on Oak Creek.

PROGRAM "RSTABLE" is a variation of PROGRAM RES which prints out monthly summary tables for all of the System's supplies; the System demand; the System direct flow deficit; the System's storable inflows under the 80CW93 rights as well as under the two 80CW92 rights; the total inflow storable in Oak Creek Reservoir; end-of-month storage content in Oak Creek Reservoir; shortage of supply from Oak Creek Reservoir; and spills from Oak Creek Reservoir. Tables 52 through 62 provide these monthly summaries for those items not previously presented in this report. Tables 52 through 62 relate to the use of the System's existing supplies to provide for a System annual demand of 5,089 acre-feet in conjunction with the full-scale, 2,250 acre-foot Oak Creek Reservoir.

### 2. Utilization of A Smaller Oak Creek Reservoir

Rather than initially or ever constructing the full-scale, 2,250 acre-foot Oak Creek Reservoir, the Florence Regional System could elect to construct an Oak Creek Reservoir smaller than its decreed size of 2,250 acre-feet. Such an election would result in a System water supply operating in one of three different fashions. First, the System could operate less dependably at an annual demand of 5,089 acre-feet, and, over the long run, it would expect to encounter shortages from time to time, depending on the size of the Oak Creek Reservoir. Second, with an Oak Creek Reservoir of less than 2,250 acre-feet, the System could operate more dependably at annual demands of less than 5,089 acre-feet. Third, the System could operate at annual demands in excess of 5,089 acre-feet on a less dependable basis. Further, the Regional System could choose to design and construct the Oak Creek Reservoir in stages as the System demand increases. The Regional System might elect initially to acquire all of the land needed for the full 2,250 acre-foot reservoir, and then develop raw water storage in a staged, incremental manner.

Developing the concept of the first mode, described above, of operating at an annual demand of 5,089 acre-feet with a smaller Oak Creek Reservoir, Figure 20 depicts the System's monthly shortages from an annual demand of 5,089 acre-feet resulting from use of a 1,000 acre-foot Oak Creek Reservoir. The use of the smaller 1,000 acre-foot reservoir would not completely eliminate the direct flow deficits (Figure 19) which the 2,250 acre-foot reservoir could completely eliminate, but the 1,000 acre-foot reservoir could probably operate satisfactorily with its infrequent monthly shortages and with a maximum two-month shortage of approximately 160 acre-feet (1978). Figure 21 depicts the storage contents of the 1,000 acre-foot reservoir over the 1971-1994 period.

Monthly shortages from operating the System with an annual demand of 5,089 acre-feet with reservoirs having capacities of 500 acre-feet and 100 acre-feet are depicted on Figures 22 and 23, respectively. The frequency, magnitude, and cumulative magnitude of these shortages render selection of such sizes of reservoirs increasingly unacceptable.

Under the second mode of utilization of a smaller reservoir, the Regional System could operate dependably with an annual demand less than 5,089 acre-feet. Figure 24 presents a summary of various dependable yields resulting from utilization of smaller reservoirs on Oak Creek. One will note that a fairly small reservoir of 500 acre-feet or so will generate almost the same dependable yield as would the full-scale 2,250 acre-foot reservoir. With a storage of 500 acre-feet, the System can generate a dependable yield of 4,700 acre-feet per year. This compares with the yield of 5,089 acre-feet per year achievable with the full-scale reservoir.

Under the third mode of operation the Regional System could choose to operate with a reservoir smaller than that which would provide dependable yields. For example, the System could choose to construct a 1,500-acre-foot reservoir and then use it to provide an annual supply of 5,089 acre-feet, whereas a full-scale, 2,250 reservoir is actually indicated to be necessary to develop a dependable yield of 5,089 acre-feet per year. Figure 25 depicts the monthly shortages which would result from operation of the Regional System in this fashion. These shortages are minimal, with a maximum monthly shortage of 70 acre-feet and a two-month cumulative shortage of 100 acre-feet.

A variation of this third mode would be to operate the System at an annual demand in excess of 5,089 acre-feet but with a full-scale 2,250 acre-foot reservoir. Because such a reservoir would be too small to provide a dependable yield in excess of 5,089 acre-feet per year, this mode of operation can be characterized as one involving a "smaller" reservoir.

Figure 26 depicts the monthly reservoir shortages resulting from operating the System at an annual demand of 5,300 acre-feet in conjunction with the use of a 2,250 acre-foot reservoir. The few shortages (one-month shortage of 140 acre-feet; two-month cumulative shortage of 190 acre-feet) may be tolerable, although these shortages would really stress the system. Thus, the System could satisfactorily operate at an annual demand slightly in excess of 5,089 acre-feet per year.

Figure 27 depicts the monthly shortages from operation the System at an annual demand of 5,500 acre-feet in conjunction with the use of a 2,250 acre-foot reservoir. These resultant shortages are too frequent and too large to be considered tolerable.

Figure 27 begins to illustrate that the System's existing supplies have a limit in the amount of water they can provide and why increasing reservoir size does not return a consistently greater overall yield. Part of the reason for the limit stems from the amount of water which is storable for future use in satisfying deficits from the System's direct flow supplies. As the System's demand and direct use of its storable water rights increase, there is simply less of the System's supply which may be stored. Figure 28 demonstrates this point. At fairly low annual demands of up to 3,000 acre-feet, some 420 acre-feet per year of water storable under 80CW93, and the water rights providing for this storable water are the Union Ditch, the Adobe/Mineral Creek Pipe, the Newlin Creek Pipe, the Coal Creek Pipe, and the Williamsburg Pipe. Beyond an annual demand of 3,000 acre-feet, however, the increased demand requires more use of the Union Ditch water for augmentation of the Florence Treatment Plant Diversion Works water right, and there becomes less water storable from the Union Ditch rights. As the demand continues to increase, the storability of the last four "Pipe" rights decreases as well, because the System requires them more and more for its direct needs.

# WATER SYSTEM MASTER PLAN

for the

# CITY OF FLORENCE REGIONAL WATER SYSTEM

FLOPPIC 6
Sppi 2"

January 6, 1998

The **Engineering** Co.
Fort Collins, Colorado
Project No. 96-027

# I. Introduction

## A. Forward

The Florence Regional Water System consists of the City of Florence and the Towns of Rockvale, Coal Creek, and Williamsburg. The Regional Water System also provides water to the Federal Prison (located southeast of Florence) and the East Florence Water District. The Regional Water System now encompasses an area of approximately 43 square miles that includes the City limits and areas outside of each of the communities. The area is primarily composed of small, rural communities that have their origins in the oil mining industry. The Regional Water System currently serves a population of approximately 5,600 people through 1,700 water taps. The service area for each of the regional entities is found on Exhibit I-1.

Currently, the Regional Water System produces over 490 million gallons of water per year or an average of 1.34 million gallons per day (MGD). Maximum daily use has reached 2.9 MGD. Recognizing that careful planning is required to continue effective service on this scale, the City of Florence initiated this Water System Master Plan study.

The communities in the Regional Water System have a long history of working to develop a reliable water system. All communities within the Regional Water System are experiencing some growth; and since the Federal Prison was added in 1993, water usage has increased substantially.

In addition, the Regional Water System has received a number of significant requests for service in various locations within its service area. Developments currently being planned or developed include the Bear Paw Subdivision, High Meadows Subdivision, Pike View Subdivision, and other subdivisions located in the Regional Water System service area.

Past planning studies have addressed specific problems or issues, but a comprehensive study of the Regional Water System has never been conducted. The purpose of this project is to review past efforts, assess existing conditions, project future needs, and develop a comprehensive plan for the next 20 years. This Master Plan was prepared by The **Engineering** Co. and Martin and Wood Water Consultants in cooperation with the City of Florence staff and members of the Regional Water System entities.

## B. Water System History

The City of Florence has a long and storied history related to the development of a reliable water system. Beginning in the late 1800's, the City of Florence began to develop a central water system to replace its wells and cisterns that were used by many of the residences. In 1899, the Newlin Creek system was completed with one reservoir. During the 1920's, the Adobe and Mineral Creek systems were constructed. In 1962, the Minnequa point of diversion was negotiated with the Union Ditch Company and CF&I; and a filter plant was constructed at the West Mesa site.

In 1980, the City of Florence and the Towns of Williamsburg and Coal Creek entered into a cooperative agreement to consolidate their water resources into a Regional Water System. The intent was that, by joining supplies, the neighboring communities could better address the issues of system reliability and water shortages that had historically been problems for these smaller communities. The following is an outline of the formation of the Regional Water System.

1. 1962 North plant built.

2. 1973 Extend and improve the City's water system including construction of a new water storage facility and the installation of additional distribution lines. This project included the construction of the west million-gallon tank and added a clarifier filtration system to the north plant.

3. 1980 Cooperative agreement for the procurement of additional water service between the City of Florence and the Towns of Williamsburg and Coal Creek. This agreement was in reference to the Regional Water Project that included upgrading and expanding the north treatment plant, constructing a storage facility tank for Coal Creek and Williamsburg, installing a 10-inch transmission main from Coal Creek to connect with the Florence system, and relocating Florence filters.

4. 1982 - 1983 This project included upgrading and expanding the north treatment plant, constructing a storage facility tank for Coal Creek and Williamsburg, and installing a 10-inch transmission main from Coal Creek to connect with the Florence system.

5. 1988 - 1989 Agreement to establish facilities to make water available for use in the Regional Water System. This agreement refers to the Phase I and Phase II water projects. The Phase I Water Project was the installation of a new pipeline from the Adobe/Mineral

Creek headwaters to the south reservoirs. The south treatment plant was built in the Phase II Water Project.

6. 1990-1991 Installation of a 14-inch raw waterline from the south plant to the north reservoir pump station.

7. 1991 - 1992 Phase II improvements included construction of the south water plant and the east million-gallon water tank.

8. 1992 - 1993 Phase III improvements included upgrades to the City of Florence's internal distribution system.

9. 1994 Rockvale becomes a member of the Regional Water System.

10. 1994 - 1995 This project included rehabilitating the Newlin Creek pipeline intake system, increasing the capacity of the Newlin Creek pipeline, storage capacity of the South Field reservoirs, installing a new distribution system in Rockvale, tying Rockvale into the Regional Water System, and construction of a new 2.0 MG north water treatment plant.

## C. Scope

For the purpose of this report, the service area covers the Florence Regional Water System, which includes the communities of the City of Florence and the Towns of Rockvale, Coal Creek, and Williamsburg. The system also serves the Federal Prison and the East Florence Water District. The entire study area has the potential to service approximately 120 square miles.

The items to be considered as a part of this study include:

1. Determine the design criteria to be used (such as ultimate annual, maximum-day, and peak-hour demands for water).
2. Determine a population projection for the area.
3. Review the water-metering records and develop a hydraulic model to reflect current demands and additions to the system.
4. Work with staff to evaluate the current water system operations and determine the impact caused by increased future demands and conditions.

5. Evaluate the impact of projected demands on the existing system(s) and determine those improvements required to supply the projected demands including the need for, location of, and size of treatment plants, storage tanks, distribution lines, and pump stations.
6. Develop a proposed phased construction of the selected alternatives.
7. Prepare a written report summarizing the basis of the study, the impacts on the existing water system, and the improvements required to meet the projected demands.

# II. Design Criteria

## A. Land Use

The area served by the Regional Water System is located on semi-arid uplands south of the Arkansas River. Agricultural use of the land is not widespread in this area due to the lack of irrigation. The historical land use has been related to oil exploration and mining, fruit orchards, and livestock grazing. Population density is centered primarily around the communities which are in this study, but some outlying subdivisions and residences do exist.

## B. Population Projections

To be meaningful, growth studies must produce results that are reliable yet flexible enough to reflect the consequences of local change and must be sufficiently detailed to serve as a basis for the design of local facilities. However, even under the best conditions, making projections that accurately indicate future conditions are difficult.

Currently, the Regional Water System serves approximately 5,143 people[1]. This includes 3,791 in the City of Florence, 373 people in Rockvale, 190 people in Coal Creek, and 789 people in Williamsburg.

Population projections were determined by two methods. The first method used specific information concerning growth for each community. The second method used variable straight-line projections at different growth rates. The following is a discussion of each method.

---

[1] Colorado Conservation Trust Fund Population Estimate ( 7-1-95) for Review.

## 1. Method One

The population forecast for the Regional Water System is based on past trends as determined from records and data supplied by the City of Florence and the other regional communities. The population projections for future growth are based on trends developed from past population records dating from 1985. For the purposes of this study, population was recorded for each of the communities since 1985. Projections were then made based on the growth rates that are anticipated by each community. Growth rates for Williamsburg, Rockvale, and Coal Creek were based on anticipated annexations and subdivisions that each of the towns are aware of. Similarly, growth for Florence is based on anticipated growth due to subdivisions that have been approved or are currently being planned. Table II-1 lists the proposed subdivisions that have been planned in the Florence area and the growth that could occur if those subdivisions are developed. Projections assume one residential tap for each lot and 3.0 persons per house. This is population that is typically used for planning purposes based on data from Colorado Communities.

**Table II-1**
**City of Florence**
**Anticipated Growth**

| Subdivision | Total No. of Taps | Total Population | Taps per Year | Persons per Year |
|---|---|---|---|---|
| **Bear Paw** | 2,400 | 7200 | 120 | 360 |
| **High Meadows** | 234 | 700 | 40 | 140 |
| **Pike View** | 106 | 318 | 37 | 111 |
| **Last Mile Estates** | 123 | 369 | 12 | 36 |
| **Total** | **2,863** | **8,587** | **209** | **647** |

Based on the above projections, the addition of 209 additional taps per year would create a population of 647 persons. This is a 16% annual increase. Over a 5-year period at a constant growth rate, the increase would be approximately 3,030 persons. In 1990, the population of Florence was 2,990; and the population in 1996 is estimated to be 3,791, as previously stated. This equates to an historical annual growth rate of approximately 5.3%. This indicates that the subdivision build-out projections may be somewhat optimistic.

County-wide population projects were developed by the State of Colorado on a county-wide basis throughout the state for a period of 1990 to 2020. For Fremont County, the 1995 population was determined to be 39,951. Annual percentage increases were estimated for each 5-year period. The increases are found on Table II-2.

**Table II-2**
**County Population Projections**

| County | 1990-95 | 1995-2000 | 2000-05 | 2005-10 | 2010-15 | 2015-20 |
|---|---|---|---|---|---|---|
| Fremont | 4.4 | 1.1 | 0.9 | 0.8 | 0.7 | 0.7 |
| Chaffee | 3.1 | 2 | 1.7 | 1.5 | 1.4 | 1.3 |
| Park | 8.2 | 3.8 | 2.7 | 2.3 | 1.9 | 1.8 |
| Lake | 2.3 | 1.7 | 1.4 | 1.1 | 1.01 | 0.9 |
| Custer | 7.0 | 5.6 | 4.3 | 3.4 | 2.8 | 2.5 |

County-wide projections are shown to be considerably lower. Custer County projections are higher than Fremont County, but it should be noted that the 1995 base population is only 2,699 so the annual population increase is small compared to the overall growth in Fremont County. The high growth rates projected by private developers would be improbable based on past growth trends and other growth rates experienced throughout the state. Therefore, a conservative annual rate increase of 4% was used for the City of Florence projections.

The Town of Williamsburg provided information for this study that estimates the current population to be 812 persons. Currently, there are 172 taps in Williamsburg. By dividing the number of taps from the population, the current per capita tap value is 4.7 persons per tap. The Town also submitted information that anticipates growth will double the number of taps to 344 over a 5-year period. This would also increase the population to approximately 1,600 persons by the year 2000 based on a similar capita per tap value of 4.7 persons/tap.

The Town of Rockvale provided information for this study that estimated the current population to be approximately 375 people. Currently, there are 163 taps in Rockvale. By dividing the number of taps from the population, the current per capita tap value in 2.3 persons per tap. The Town submitted information that they anticipate annexation of 400 to 500 acres that will be developed into 200 to 250 homesites. They anticipate a development rate of 15 homes per year for a 20-year period. This could produce approximately 30 to 45 new residents per year. Based on the 250 new taps for each new home and an average population of 2.3 persons/tap over a 20-year planning period, approximately 575 new residents could be added in Rockvale for a total population of 950 persons. These projections were used for growth in Rockvale.

The Town of Coal Creek provided information for this study that estimates the current population to be approximately 170 people. Currently, there are 102 taps in Rockvale. By dividing the number of taps from the population, the current per capita tap value in 1.7 persons per tap. An assumption was made that four to five new persons would be added each year during the planning period. The 2020 population was projected to be 300.

Table II-3 is a summary of the population projections for each of the communities in the Regional Water System. The total population projection for the year 2020 is 14,431 people.

**Table II-3**

**Projected Population**

| Year | Florence | Williamsburg | Rockvale | Coal Creek | Total |
|---|---|---|---|---|---|
| 1980* | 2,990 | 102 | 275 | 258 | 3,625 |
| 1985* | 2,990 | 123 | 287 | 312 | 3,712 |
| 1990* | 2,990 | 145 | 300 | 366 | 3,801 |
| 1995* | 3,791 | 812 | 375 | 170 | 5,148 |
| 2000 | 4,612 | 1,600 | 525 | 190 | 6,927 |
| 2005 | 5,612 | 1,900 | 675 | 216 | 8,403 |
| 2010 | 6,827 | 2,200 | 825 | 243 | 10,095 |
| 2015 | 8,307 | 2,400 | 975 | 260 | 11,942 |
| 2020 | 10,106 | 2,900 | 1,125 | 300 | 14,431 |

* Populations are based on records of past population provided by the City of Florence and the individual communities.

Figure 1 is a graph of the projected population in the City of Florence and the adjacent towns.

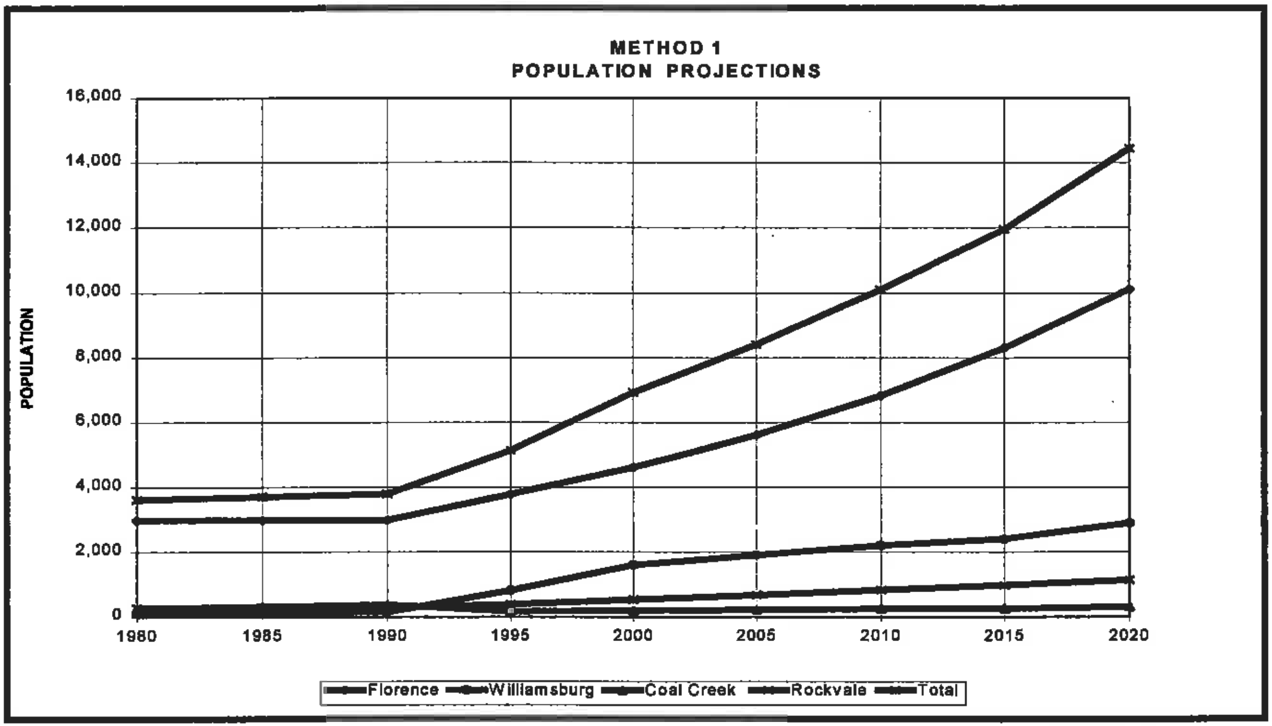

Figure 1

### 2. Method Two

The second method of population projection was to determine growth at different annual rates beginning at the current, combined population of the Regional Water System. This method provides for a range of growth that offers some variability if growth occurs at different rates. From the current population of 5,143, growth was projected at annual rates of 1.5%, 3%, and 4%. The population projections are shown on Table II-4 and are also shown on Figure II-4.

**Table II-4**
**Regional Water System Population Projections**

| Percent Growth (%) | 1995 | 2000 | 2005 | 2010 | 2015 | 2020 |
|---|---|---|---|---|---|---|
| 1.5 | 5143 | 5540 | 5969 | 6430 | 6927 | 7462 |
| 3.0 | 5143 | 6257 | 7613 | 9262 | 11269 | 13710 |
| 4.0 | 5143 | 6882 | 9210 | 12325 | 16494 | 22073 |

This analysis indicates an upper limit build-out of 22,073 people and a lower limit build-out of 7,462 persons in the year 2020. The middle range of 13,710 ultimate population closely matches the population numbers developed in the Method One analysis. A system-wide growth rate of 3% would exceed county-wide projections; but based on the development activity and potential for growth, that rate will be used to determine water demands for the Regional Water System.

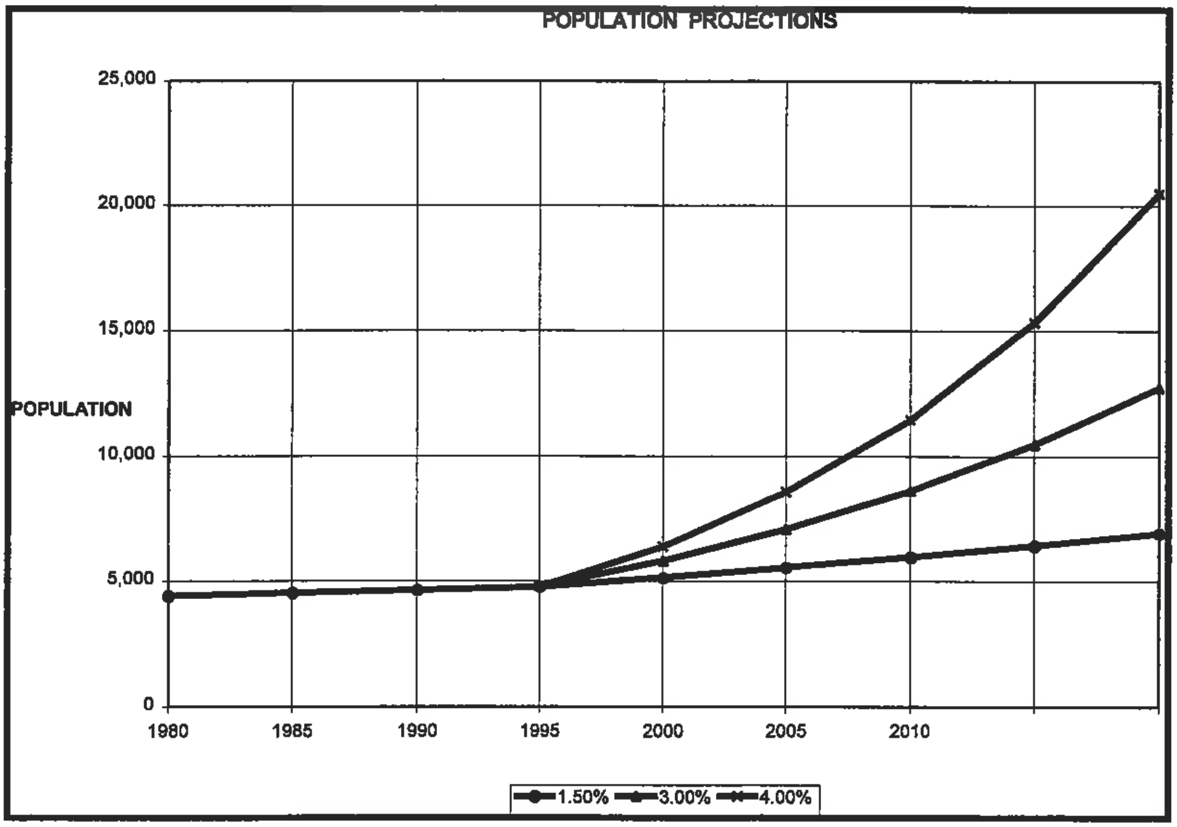

Figure 2

## C. Regional Water System - Demand Analysis

The characteristics of water use that are of importance in the design of the water distribution system components include the average-day demand, the maximum-day demand, the peak-hour demand, and the needed fire flow. The average daily consumption data is important for the management of the water system because it is used to estimate the total annual usage and determine the adequacy of the raw water supply. The maximum-day demand is used to size the treatment plant, transmission lines, main pump stations, storage reservoirs, and the main distribution lines. The peak-hour demands are used to size the distribution lines and booster pump stations that do not pump to a storage tank. Fire flows are also used in sizing the distribution lines as well as storage tanks.

Development of flow records was based on data received from the individual communities. The City of Florence maintains daily and monthly flow records for water production from the north and south treatment plants. Table II-5 reflects monthly flow production from both treatment plants. These flows are the total flows that are supplied to Florence, the Federal Prison, Williamsburg, Rockvale, Coal Creek, and the East Florence Water Association.

### Table II -5
### Total Monthly Water Production
### Regional Water System
### (million gallons)

| Year | Jan | Feb | Mar | Apr | May | June | July | Aug | Sept | Oct | Nov | Dec | Total | Avg Annual* |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1992 | 14.19 | 12.74 | 15.59 | 19.82 | 27.6 | 32.25 | 38.85 | 34.49 | 38.33 | 29.47 | 21.52 | 21.99 | 306.84 | 0.84 |
| 1993 | 23.75 | 25.54 | 25.66 | 28.73 | 37.29 | 49.17 | 50.5 | 38.82 | 37.89 | 34.33 | 28.8 | 29.2 | 409.68 | 1.12 |
| 1994 | 28.94 | 28.27 | 31.14 | 33.37 | 39.97 | 55.42 | 60.79 | 51.69 | 47.48 | 38.31 | 33.24 | 35.64 | 484.26 | 1.33 |
| 1995 | 33.16 | 30.92 | 35.52 | 34.22 | 37.29 | 45.97 | 57.95 | 58.29 | 45.88 | 45.04 | 32.43 | 33.59 | 490.26 | 1.34 |
| 1996 | 32.65 | 26.71 | 38.33 | 47.04 | 53.22 | 57.47 | - | - | - | - | - | - | - | - |

* Average Annual Demand is the total yearly demand divided by 365 days.

The monthly flows are shown on Figure 3.

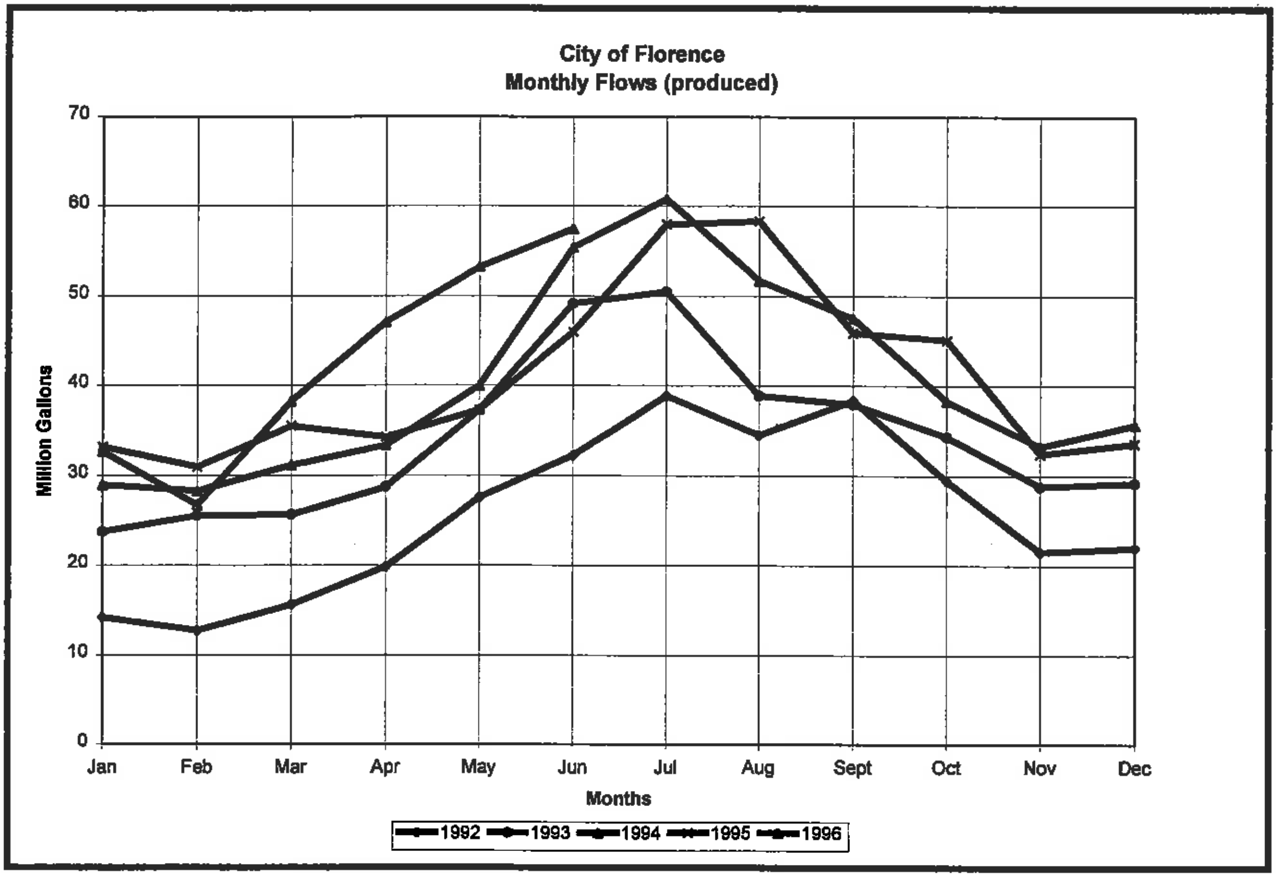

Figure 3

Table II-6 reflects the annual usage on a monthly basis for the communities served. The flows were developed from meter records for the individual communities.

### Table II- 6
### 1995 Monthly Meter Readings for Individual Communities

| Entity | Jan | Feb | Mar | Apr | May | June | July | Aug | Sept | Oct | Nov | Dec | Total | Avg. Annual* |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Coal Creek** | .29 | .25 | .25 | .36 | .49 | .66 | .79 | .83 | .59 | .56 | .32 | .32 | 5.72 | 0.016 |
| **Williamsburg** | .97 | .78 | .81 | .77 | 1.07 | 1.72 | 20.68 | 2.27 | 1.51 | 1.42 | 1.00 | 1.01 | 15.41 | 0.042 |
| **Rockvale** | .50 | .53 | .53 | .58 | .59 | .88 | 1.23 | 1.77 | 1.11 | .83 | .69 | .62 | 9.87 | 0.027 |
| **Prison** | 12.20 | 11.60 | 13.80 | 12.70 | 14.30 | 17.10 | 20.20 | 22.10 | 16.60 | 17.30 | 14.80 | 14.10 | 186.80 | 0.510 |
| **EFWA** | .56 | .52 | .49 | .52 | .51 | .64 | .91 | .80 | .61 | .57 | .49 | .60 | 7.22 | 0.020 |
| **Florence** | 25.59 | 24.72 | 26.88 | 26.06 | 30.00 | 36.96 | 49.68 | 54.17 | 37.46 | 35.42 | 27.57 | 27.19 | 271.32 | 0.740 |
| **Total** | **40.12** | **38.42** | **42.76** | **41.00** | **46.98** | **57.97** | **74.83** | **81.95** | **57.90** | **56.10** | **44.89** | **43.83** | **496.35** | **1.360** |

* Average Annual Demand is the total yearly demand divided by 365 days.

Figure 5 shows the average demand on a monthly basis for all the user entities in the Regional Water System.

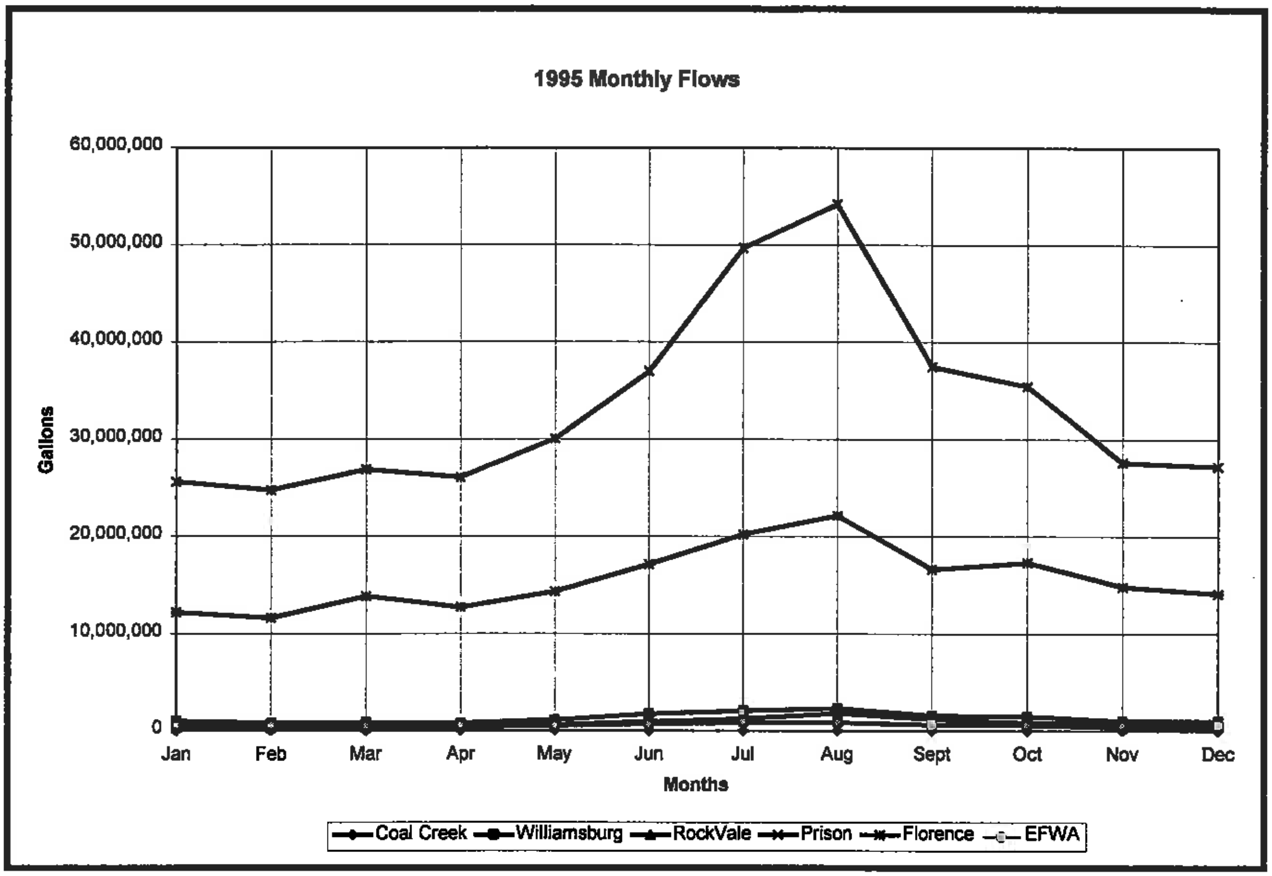

**Figure 5**

Using the average daily demand listed in Table II-5, the water consumption was determined for the various communities. Table II-7 shows the maximum-daily demand and the peak-hourly demands. Maximum-daily demands are based on an evaluation of daily water production records for the treatment plants. Maximum-daily demands were determined from data in 1991 and 1992. During 1991, the maximum-daily demand was 1.38 MGD. The average-daily demand on an annual basis was 0.628 MGD. The ratio between maximum-daily demand and average-daily demand is 2.2. This is within the range of values generally accepted for determination of future maximum-daily demands. For the purpose of this study, a factor of 2.5 was used.

The peak-hour demands are estimated assuming a ratio of 1:5 between the average demand on the maximum-day and the peak-hour demand. This ratio has been confirmed in a number of different systems and is the generally-accepted figure used where actual rates are not available.

### Table II-7
### Water Consumption Comparison
### (Based on Plant Production)

| | Florence* | Williamsburg | Rockvale | Coal Creek | Prison |
|---|---|---|---|---|---|
| Population 1995 | 3,791 | 812 | 375 | 170 | -- |
| No. of Taps | 1,395 | 172 | 163 | 102 | -- |
| Avg. Pop./Tap | 2.72 | 4.7 | 2.3 | 1.7 | -- |
| **Annual Consumption** | | | | | |
| 1995 Use (MG) | 278.5 | 15.4 | 10.6 | 6.1 | 186.8 |
| Gal/Tap/Month | 16,639 | 7,478 | 5,435 | 4,983 | -- |
| Per Capita Use (gal/day) | 201 | 52 | 72 | 98 | -- |
| **Maximum-Day Consumption** | | | | | |
| Max-Day (MGD) | 1.91 | 0.11 | 0.07 | 0.04 | 1.27 |
| Avg. Max-Day (gpm/tap) | 0.95 | 0.43 | 0.31 | 0.29 | -- |
| Per Capita Use (gal/day) | 502 | 130 | 180 | 245 | -- |
| **Peak-Hour Consumption** | | | | | |
| Peak-Hour (MGD) | 2.87 | 0.16 | 0.11 | 0.07 | 1.17 |
| Avg. Peak-Hour (gpm/tap) | 1.43 | 0.64 | 0.47 | 0.50 | -- |
| Per Capita Use ( gal/day) | 753 | 195 | 270 | 367 | -- |

* Includes East Florence Water Association

As shown in Table II-7, the per capita water consumption for the City of Florence is considerably higher than that in the other communities. This is attributed to Florence historically using more water for lawn irrigation and larger commercial users.

## D. Future Demands

The projected maximum-day demands for the Regional Water System are summarized in Table II-8 through the year 2020. These projections are based on the population projections in Table II-3. Average annual water demands in acre-feet/year were determined for their impact on the water resources. Maximum-daily demands were based on a ratio of 2.5 times average-daily demand, and peak-hourly demands were based on the ratios of 1.5 times maximum-daily demands.

**Table II-8**
**Projected Water Demands**

| Year | Population | Average-Daily Demand (MGD) | Annual Usage (acre-feet/year) | Maximum-Daily Demands (MGD) | Peak-Hourly Demands (MGD) |
|---|---|---|---|---|---|
| 1980* | 3,625 | 0.94 | 1,057 | 2.36 | 3.54 |
| 1985* | 3,712 | 0.97 | 1,082 | 2.42 | 3.62 |
| 1990* | 3,801 | 0.99 | 1,108 | 2.47 | 3.71 |
| 1995* | 5,148 | 1.34 | 1,504 | 3.35 | 5.03 |
| 2000 | 6,927 | 1.8 | 2,019 | 4.51 | 6.76 |
| 2005 | 8,403 | 2.19 | 2,500 | 5.47 | 8.20 |
| 2010 | 10,095 | 2.63 | 2,943 | 6.57 | 9.85 |
| 2015 | 11,942 | 3.11 | 3,482 | 7.77 | 11.66 |
| 2020 | 14,431 | 3.76 | 4,207 | 9.39 | 14.09 |

* Populations are based on records of past population provided by the City of Florence and the individual communities.

As indicated in Section I, the City of Florence has received requests for service from a number of significant developments. The largest request has been from the Bear Paw development which includes approximately 600 acres southeast of Florence. The developer projects that this area will eventually serve 2,400 residential taps.

It is not clear what impact these large developments will have on the population projections for the system. If they generate more interest in the area than anticipated, the projections may have to be revised. If they do not, the projected build-out schedules are probably too optimistic on the part of the developers.

In addition to the above demands, previous discussions have considered the possibility of serving the Brewster area. Projection of the future demands for the district as a whole (as indicated above) is based, to a large extent, upon the historical growth in the area. It is very difficult, however, to predict the location or the magnitude of the future demands. Obviously, the demands are dependent upon the location of future developments and the development of new industries. Given the uncertainty of these factors, an estimate of the future distribution of the demands is made by assuming that the future demands will be distributed uniformly throughout the system. The analysis of the distribution system will allow for evaluating alternative locations of development and determining the impact on the system.

## E. Pressures

The goal of the design of a water distribution system is to provide the peak-hour demands while maintaining a minimum acceptable pressure. In addition, municipal systems should be capable of supplying the average demand on the maximum-day plus the needed fire flows. The State Health Department recommends that the normal working pressure in the distribution system be approximately 60 psi with the minimum pressure not less than 35 psi. It further states that the system should be designed to maintain a minimum of 20 psi at all points under all conditions of flow. For the purpose of this study, these requirements have been interpreted to mean that 35 psi will be maintained during the peak-hour conditions and that a minimum of 20 psi will be maintained during the maximum-day plus fire flow conditions.

The maximum static pressure recommended for direct service is 100 psi. Pressures above this level can cause water heater safety valves to release and can also cause leakage problems in older lines. Where static pressures exceed this level, either zone or individual pressure-reducing valves must be installed.

## F. Storage Requirements

In addition to the guidelines for the minimum pressures, the Health Department design criteria includes recommendations on the minimum amount of storage that should be provided. That criteria recommends that the storage volume be sufficient to supply one average-day demand plus fire flow demand. We believe a better guideline is to size the storage volume equal to 25% of the maximum-day demand for equalization, plus the required fire storage, plus one average-day demand as an emergency supply. Using this guideline, the volume used for equalization would be equal to approximately 35% of the total storage available. This is within the range recommended by the AWWA.[2]

A more conservative approach is to size the storage volume equal to the maximum-day demand. This guideline has been used by other utilities which have found a number of benefits for the system operation. Those benefits include more stable pressures, more constant demands on the treatment plant, and better control of automatic

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American Water Works Association, "Distribution System Requirements for Fire Protection," AWWA Manual of Water Supply Practices M31.

valves and pumps. This approach is particularly attractive for systems with long transmission lines such as the Florence Regional Water System and is the criteria that will be used in this analysis.

## G. Main Sizing

The Health Department criteria recommends that all water mains be sized based on a hydraulic analysis of the projected demands and the minimum pressures. For systems which provide fire protection, the minimum size for mains connected to fire hydrants is six inches. It also states that mains not designed to carry fire flows should not have fire hydrants connected to them. Another recommendation is that dead-end mains should be minimized by looping (whenever practical).

Many communities have adopted development standards that incorporate the above criteria. Typically, those regulations require a minimum main size with larger mains spaced in a grid system (e.g., a grid with a 12-inch main every half mile with 8-inch mains in the streets within the quarter-section). Such a grid provides mains large enough to supply domestic, irrigation, and fire protection flows. Other requirements typically include a maximum acceptable headloss for 6-inch, 8-inch, and 12-inch mains of two feet per 1,000 feet of main. At that headloss, the velocity in the pipeline is approximately 2.5 feet per second (fps), which is also a generally-accepted rule-of-thumb for the maximum velocity under normal operating conditions. Another rule-of-thumb is that the maximum allowable velocity during a fire situation is five feet per second which is equal to a headloss of about eight feet per 1,000 feet of main. These guidelines have been used in evaluating the existing system and developing the proposed improvements.

## H. Fire Flows

The Health Department criteria recommends that systems which provide fire protection should be designed such that the fire flows are in accordance with the State Insurance Services Office (ISO) guidelines. The ISO guidelines recommend "Needed Fire Flows" based on the type of building zone and the separation between buildings. For one- and two-family homes not exceeding two stories in height, the ISO recommends the following needed fire flows:

**Table II-9**
**Residential Fire Flows**

| Building Separation | Needed Fire Flow (gpm) |
|---|---|
| Over 100' | 500 |
| 31-100' | 750 |
| 11-30' | 1,000 |
| 10' or less | 1,500 |

For commercial and industrial areas, the needed fire flows are determined for each individual structure from the Commercial Fire Rating Schedule. That schedule considers the size of the building, the type of construction, the proximity to other structures, and the type of occupancy. Typical figures for multi-family dwellings are in the range of 2,500 gpm while figures for commercial and industrial areas can be as high as 3,500 gpm or more. The flows can vary widely depending on the type of construction and the presence of fire divisions. Furthermore, the needed fire flows can be substantially reduced by the installation of a fire sprinkler system.

The ISO guidelines also specify the required duration of the fire flows. For a fire flow of up to 2,500 gpm, the required duration is two hours. For flows of up to 3,500 gpm, the required duration is three hours.

The ISO rating schedule also includes guidelines on the distribution of fire hydrants. Those guidelines specify the amount of credit allowed for each hydrant depending upon the distance from a test location. For example, hydrants within 300 feet of a location can be credited with a flow of up to 1,000 gpm. For hydrants within 301 feet to 600 feet, the credit is 670 gpm; and for hydrants within 601 feet to 1,000 feet, the credit is 250 gpm. These credits are subject to the ability of the system to supply the credited flows. Using these guidelines and applying them to a residential area with a needed fire flow of 1,500 gpm, each structure should be within 300 feet of one hydrant and 600 feet of a second hydrant or within 1,000 feet of two other hydrants. Thus, the generally-accepted spacing for hydrants in residential areas is approximately 600 feet. For a commercial area with a fire flow of 3,500 gpm, each structure should be within 300 feet of three hydrants with a fourth hydrant within 600 feet. From this requirement, the typical spacing for commercial areas is 300 feet.

In 1993, an insurance classification study was conducted by ISO Commercial Risk Services, Inc. In that study, fire flow requirements were determined for 12 hydrants in the Regional Water System. Fire flow tests were conducted in the field to determine if the hydrants could supply the needed fire flow. Appendix B is a Hydrant Flow Data Summary. All hydrants were able to deliver the needed fire flows, except hydrants located in

Rockvale and Williamsburg. The analysis of the flows within the system will be discussed in the following chapter.

# III. Proposed System Improvements

## A. Pump Stations

The City of Florence operates a number of pump stations in its water system. These pump stations are used to deliver water from the supply locations to the water treatment plants. After treatment, water is delivered from the treatment plants to the distribution systems with pump stations located at the treatment plant clearwell. Additional pumping is required to deliver water from lower zones to the Coal Creek tank and to the Airport water system. Table III-1 is a summary of all of the pump stations currently in the system.

**Table III-1**
**Pump Station Summary**

| No. | Description | Type | No. of Pumps | Horsepower | Discharge/TDH (gpm)/(feet) |
|---|---|---|---|---|---|
| 1 | Minnequa Canal | Vert Turbine | 2 | 100 | 2100/160 |
| 2 | North Reservoirs | Vert. Turbine | 2 | 100 | 2100/200 |
| 3 | West Pump Station | Vert. Turbine | 2 | 25 | 150/376 |
| 4 | Airport Supply | End Suction | 2 | 15 | 150/100 |
| 5 | North Plant Clearwell | Vert Turbine | 2 | 100 & 100 | 1400/80 |
| 6 | South Plant Clearwell | Vert Turbine | 3 | 2-100, 1-50 | 800/160 |
| 7 | Airport Upper Pump Station | (1)Jet Pump, (2) End suction | 3 | 1-1, 2- 2 | |

### 1. Minnequa Canal Pump Station

The Minnequa Canal pump station is used to pump water from the canal to the north raw water reservoirs. The pump station is located south of the Minnequa Canal and consists of two vertical turbine pumps mounted on a wetwell. Water is diverted from the canal through a gated outlet and is piped to the wetwell. The current intake is susceptible to freezing problems during the winter. There is no sediment trap on the system so the wetwell is susceptible to filling. Sediment-laden water also reduces pump capacity and life.

Because this pump station delivers water from the most reliable source and also has the potential for providing water on a long-term basis, the following items should be considered for modifications.

1. Improve the existing diversion to prevent freezing problems and provide a sediment trap.
2. Install additional pumps to deliver water directly to the South Field reservoirs.
3. Provide wetwell capacity to allow for future pumps to meet increased demand.
4. Provide for an emergency generator to power pumps in the event of a power outage.

Table III-2 shows the cost of the proposed improvements.

**TABLE III-2**
**Minnequa Canal Pump Station**
**Cost Estimate**

| ITEM | UNITS | NO. UNITS | UNIT PRICE | TOTAL COST |
|---|---|---|---|---|
| Outlet Replacement and Sediment Trap | L. S. | 1 | $75,000 | $75,000 |
| Clearwell Modifications | L. S. | 1 | $50,000 | $50,000 |
| Additional Pump | Each | 2 | $ 20,000 | $40,000 |
| Emergency Generator | L. S. | 1 | $35,000 | $35,000 |
| Contingencies | | | | $20,000 |
| Engineering and Admin. | | | | $25,000 |
| **TOTAL** | | | | **$245,000** |

## 2. North Raw Water Reservoir Pump Station

The North Raw Water Reservoir Pump Station is used to deliver water from the north raw water reservoirs to the south raw water reservoirs and south treatment plant. This pump station is operated manually on a periodic basis to maintain the level in the south raw water reservoirs. Problems have occured when water is being delivered from the Rockvale reservoirs to the south plant at the same time as the North Raw Water Pump Station is running. The Rockvale reservoirs have overflowed, due to the north plant pump station operating at a head that is higher than the Rockvale reservoirs. The North raw water line and the Rockvale line join at Moore Drive and County Road 95, where the flow in a common line to the south reservoirs. The flow in the common line create enough frictional resistance to cause the pressures to increase to a point where some of the flows are directed to the Rockvale reservoirs.

Currently of the balancing between the pumping of the Minnequa Canal and the delivery from the north raw water reservoir to the South Field is done on a manual, as-required basis. If improvements are made to the Minnequa Canal pump station, piping improvements adjacent to the north raw water pump station will allow the

Minnequa Canal pump station to bypass the north reservoirs and directly feed the South Field system. A control system should be added, that will prevent water being pumped from the Minnequa canal or the north raw water reservoirs to overflow the Rockvale reservoirs. This may include adding variable speed controls to the pumps. The estimated cost for the piping and control improvements would be **$50,000.**

### 3. West Pump Station

The west pump station is used to pump water from the west 1.0 MG tank into the distribution system for areas supplied by the Coal Creek tank. This pump station is important in that it augments flows for areas that are supplied by the Coal Creek tank and utilizes the storage out of the west 1.0 MG tank. This pump station should be utilized as-is, but consideration for providing emergency generation should be considered. The cost for an emergency generator is approximately **$35,000.**

### 4. Airport Supply Pump Station and Airport Booster Pump Station

The Airport Supply pump station is located on the south side of the Arkansas River along Highway 67. This pump station delivers water to two 17,000-gallon tanks located by the southwest edge of the airport. From those tanks, a closed-loop booster system that supplies water to the Airport Industrial Park.

The Airport Supply pump station contains two end-suction pumps. As will be discussed in the **Storage** section of this report, a new tank should be installed to provide for gravity feed for the entire airport area. As part of this improvement, the pumps will have to be changed to meet the maximum-daily demand of the system and pump to an elevation that will be established by the new elevated tank. This can be achieved in the same building by replacing the pumps and making piping modifications. Additionally, the existing tanks and pump station at the Airport can be abandoned. The estimated cost for these improvements would be **$35,000.**

### 5. North Treatment Plant Clearwell

The north treatment plant clearwell pumps from the treatment plant into the distribution system to fill both the east 1.0 MG and the west 1.0 MG tanks. The largest pump delivers approximately 1,800 gpm but is cycling off and on every five minutes. This short cycle time increases pumping costs and reduces the life of the pumps. The pump operating range should be changed to operate over a 3-foot to 4-foot range rather than the current 18 inches.

### 6. South Treatment Plant Clearwell

The south treatment clearwell pump station is located in the south treatment plant. These pumps are used to deliver water to the distribution system served by the Coal Creek tank and also to serve the Federal Prison. These pumps currently operate from a control that senses water levels in the Coal Creek tank. The level in this tank is used to establish flows at the water plant. The Coal Creek tank provides water to the 5476 pressure zone which includes the Federal Prison, Rockvale, and Williamsburg. The prison uses approximately 38% of the water system demand. If the demand from the prison is separated from the Coal Creek system, the tank level in Coal Creek could be maintained more consistently. To accomplish this, a new line would need to be extended from the south water plant to the existing 12-inch prison supply line. The pump station would be modified to add new pumps to supply the prison. A 12-inch line will need to be extended from the new pump station to the connection at the 16-inch line. It may be possible to use a portion of the abandoned 12-inch line for this new connection. Controls and instrumentation would be needed to control the new pump from a level signal at the prison tank. The estimated cost for this improvement is **$250,000**.

## B. Pressure Zones

The Regional Water System's overall service area, as shown on Exhibit I-1, ranges from a high elevation of 6,196 to a low elevation of 5,210. This 1,086-foot difference in elevation translates into a pressure difference of 471 psi. The existing area that currently has waterlines and taps in place has a high elevation of 5,580 and a low elevation of 5,110. This 470-foot difference in elevation translates to a pressure difference of 204 psi. In order to maintain adequate pressures at the highest elevations while keeping the pressures at the lowest elevations within acceptable limits, the area is separated into pressure zones. The system is served by five storage tanks and two clearwells at the treatment plant. A booster pump system serves the Airport Industrial Park. The basic pressure zones are summarized on Table III-3.

**Table III-3**
**Existing Pressure Zones**

| Tank | Water Surface (High) | Elevation (Low) | Service Area (High) | Pressure @ High Elev. (psi) | Service Area (Low) | Pressure @ Low Elev. (psi) |
|---|---|---|---|---|---|---|
| **Coal Creek Tank** | 5598 | 5570 | 5510 | 26 | 5231 | 106 |
| **South Plant Clearwell** | 5425 | 5411 | 5319 | 40 | 5110 | 136 |
| **West 1 MG Tank** | 5335 | 5287 | 5250 | 16 | 5110 | 96 |
| **Elevated Tank** | 5335 | 5300 | 5250 | 16 | 5110 | 96 |
| **East Tank** | 5335 | 5286 | 5250 | 16 | 5110 | 96 |
| **North Plant Clearwell** | 5260 | 5202 | 5250 | | | |
| **Prison Tank** | 5490 | 5470 | 5374 | 40 | 5300 | 74 |

Exhibit III-1 is a schematic showing the water system and relative grade of the reservoirs. The actual pressure zones are indicated based on the elevation of existing services. Existing pressures were determined based on tanks being at their lowest level. In actual operation, the tanks should be operated between 80% to 100% full at all times. All of the tanks are 28 feet to 50 feet in height so that, when the tanks are full, the pressures will vary 12 psi to 20 psi within the acceptable operating level.

The pressure zones indicated above and shown on the exhibit are included only as guidelines to indicate locations that may have low pressures if they are too close to a tank or high pressures where they are located below the 100 psi pressure line from a particular tank. Development in these areas may have pressures below the desired levels and would require individual booster systems or would have pressures in excess of 100 psi which may require individual pressure-reducing valves.

Exhibit III-1a is a schematic showing the general layout of the Regional Water System that includes all of the facilities described in this chapter.

### 1. Airport Pressure Zone

One area of improvement is the development of a new gravity pressure zone in the airport area. This would include constructing a new tank at a high water elevation of 5,595 and a low elevation of 5,570. This tank would serve a high elevation of 5,450 (40 psi) to a low elevation of 5,250 (138 psi). This tank would be able to serve the entire north section of Florence's planning area. This improvement plan is discussed further in Section C - Storage.

## C. Storage

Storage in the service area is provided by four ground-level steel tanks. One elevated tank is adjacent to the north treatment plant and is used for backwash supply and system storage. Another elevated tank is located on the Federal Prison property and is used for on-site storage requirements.

The total storage volume provided by all the tanks is 3.58 million gallons.

The statistics for each of the tanks is summarized in the Table III-4.

### Table III-4
### WATER STORAGE TANKS

| Name | Diameter (feet) | Height (feet) | Base Elevation | Normal Water Level | Volume (gallons) |
|---|---|---|---|---|---|
| **Coal Creek** | 50 | 28 | 5552 | 5580 | 560,000 |
| **West 1.0 MG Tank** | 73 | 30 | 5305 | 5335 | 1,000,000 |
| **East 1.0 MG Tank** | 60 | 46 | 5286 | 5335 | 1,000,000 |
| **Elevated Tank** | 40 | 75 | 5260 | 5335 | 240,000 |
| **Airport Tanks** | 15 | 20 | 5370 | 5400 | 34,000 |
| **Prison Tank** | 40 | 140 | 5490 | 5350 | 750,000 |
| **Total** | | | | | **3,584,000** |

In addition to the above-described water storage tanks, each treatment plant has storage in a clearwell. Clearwell storage is typically not accounted for as system storage and is considered as part of the treatment plant. The clearwells are used for filter backwashing, chlorine contact, and service pump storage. Table III-5 is a listing of the storage volumes of the clearwells.

### Table III-5
### CLEARWELL STORAGE

| Name | Area (sq.ft.) | Depth (feet) | Base Elevation | Normal Water Level | Volume (gallons) |
|---|---|---|---|---|---|
| South Plant | 9,488 | 14.42 | 5411.25 | 5425.67 | 1,034,000 |
| North Plant | 558 | 8.0 | 5252.33 | 5260.33 | 33,415 |
| **Total** | | | | | **1,067,415** |

The total system storage (including tanks and clearwells) is 4.65 million gallons. As discussed previously, the current and projected storage requirements are calculated based on providing sufficient storage equal to one maximum-daily demand. The current and projected maximum-daily demands and recommended storage volumes are shown in Table III-6. The Federal Prison water system draws water from the regional system but does not feed back to the system. In addition, the north plant clearwell is so small that it should be totally reserved for chlorine contact and not considered as system storage. Therefore, the components of the available supply contained in the Federal Prison tank should not be used for the available storage. The maximum available storage is 3.83 million gallons.

**Table III-6**

**RECOMMENDED STORAGE VOLUMES**

(Million Gallons)

| Location | Available | 1996 | 2000 | 2005 | 2010 | 2015 | 2020 |
|---|---|---|---|---|---|---|---|
| Total System | **3.83** | 3.35 | 4.51 | 5.47 | 6.57 | 7.77 | 9.39 |

The maximum-daily storage guideline recommends that a total of approximately 3.35 MG of storage should be provided for the current demands. This is projected to increase to approximately 9.4 MG by the year 2020. The total existing storage volume available is 3.83 MG which is adequate for the current usage. By the year 2000, the system will need to have an additional 680,000-gallon capacity to meet the storage requirements based on growth projections.

### 1. Airport Storage Tank

To eliminate the closed-loop pumping system at the airport, an elevated tank could be added adjacent to the airport. A tank at this location should be used primarily to supply the north region of Florence's service area. The new tank would be constructed at a high water elevation of 5,595 and a low elevation of 5,570. This tank would be able to serve a high elevation of 5,450 (40 psi) to a low elevation of 5,250 (138 psi). Based on the anticipated demand in the area, the size of the tank would be 250,000 gallons. This tank would be able to serve the entire north section of the Florence service area. Currently, this area has little demand as compared to the rest of the system; and little demand would be placed on the tank until development increases. However, this tank would substantially increase fire protection in the area. Provision should be made to provide an emergency connection so that water can flow back into the system through a PRV.

The estimated cost for a new 250,000-gallon elevated tank is **$400,000.**

### 2. Rockvale Storage Tank

A 250,000-gallon storage tank is planned for the Rockvale area. A detailed discussion of the proposed improvements for Rockvale is included in Section D.4. The storage requirements for Rockvale are based on water usage attributable to Rockvale. The storage required would be 220,000 gallons by the year 2010 and 280,00 gallons by the year 2020 assuming growth continues at the rate estimated by the Town of Rockvale. Storage added in the Rockvale area and would eliminate low pressure problems and improve fire flows. One option for the Rockvale tank would be to relocate the existing tank at the north water plant to a site in the Rockvale area. This would be an alternative to constructing a new tank.

### 3. Future Storage Requirements

As the system demands approach 5.5 MGD, which could occur in the year 2005 (based on previously-described population projections [Table II-8]), an additional 1.0 million-gallon reservoir should be added to the system. The majority of the growth is anticipated in the Bear Paw subdivision, based on current City of Florence planning projections. This development is served primarily by the south treatment plant clearwell. The increased demand will cause increased draws from the south treatment plant clearwell. When additional storage is added to the system, the location must be determined so that the placement occurs at a site that meets the current and projected demands of the system. By adding another 1.0 MG of storage tank at the same level as the south clearwell, demands caused by development in the Bear Paw, Pike View, and Arrowhead subdivisions could be supplied.

## D. Distribution System

### 1. General

To analyze the operation of the Regional Water System, a model was developed to simulate the flow of water in a pressurized system. To accomplish this, the computer program EPANET was selected as the modeling software. EPANET is a powerful water distribution system modeling and analysis software package which was developed by the Environmental Protection Agency (EPA). The program tracks the flow of water in each pipe, the pressure at each pipe junction, and the height of water in each storage tank. In addition, the program has the capability to analyze the concentration of chemical substances throughout the system. The program is Windows-based and has the capability to provide graphic output of the results.

### 2. System Analysis

The hydraulic model was developed using maps provided by the City of Florence and the other regional communities. A system map was developed showing the entire water system. The map is an AutoCAD drawing file that can be used for many planning and exhibition purposes. The map of the system is found in Appendix J. After the map was completed, all of the data that contains information about the water system (such a pipe length, diameter, tank level, node elevation, and node demand) was coded into the model input data. A network model map was developed from the system maps and shows all of the identifiers for the pipes and valves in the system. Prints of the network model maps are also found in Appendix C of this report. EPANET input data is also found in Appendix C.

Demands were based on the projections found in Table II-7. For each community, the demands per tap on a maximum-day basis were distributed evenly across the nodes. Table III-7 is the per-tap demands used in the model.

**Table III-7**

**Tap Demand for Regional Communities**

| Community | Max-Day Demand gpm/tap | Peak-Hourly Demand gpm/tap |
|---|---|---|
| Florence | .95 | 1.43 |
| Williamsburg | .42 | .64 |
| Rockvale | .31 | .47 |
| Coal Creek | .33 | .50 |

Demands for the Federal Prison were based on determination of a maximum-daily demand at one point of service in the system, similar to a large commercial user.

After all data was input, the model was run to determine current operation during maximum-day and peak-hour conditions. Calibration of the model was done by comparing actual fire flows against fire flows simulated in the model at similar locations.

### a) Fire Flow Calibration

The computer model was used to calculate the fire flows that could be supplied at selected points in the system. That analysis indicates that the existing system could supply a fire flow of up to 3,000 gpm along the 12-inch lines. Appendix D is a summary of Fire Hydrant Flow Tests that were conducted in 1993 by ISO Commercial Risk Services, Inc. Tests were conducted at nine locations in Florence, one location in Coal Creek, one location in Williamsburg, and one location in Rockvale. At all hydrants in Florence and Coal Creek, the available fire flow exceeded the needed fire flow. However, in Rockvale and Williamsburg, the available fire flow was less than the needed fire flows. This information was verified in the hydraulic model by simulating a similar fire flow and determining the residual pressure. Table III-8 is a table that shows the comparison of fire flows conducted in the field and those analyzed by the model.

### Table III-8
### Comparison of
### Field Fire Flows vs. Model Simulated Fire Flows

| Location | Node Number | Field Flow (gpm) | Field Residual Pressure (psi) | Model Flow (gpm) | Model Residual Pressure (psi) |
|---|---|---|---|---|---|
| 2nd and Maple | 115 | 3100 | 20 | 3100 | 32 |
| 5th St. & Wash. St. | 72 | 4000 | 20 | 4000 | 10 |
| 5th & Pikes Peak | 135 | 5400 | 20 | 5400 | 17 |
| 6th & McCandles | 151 | 3300 | 20 | 3300 | 41 |
| 5th & Oriola | 198 | 3600 | 20 | 3600 | 40 |
| Hwy 151 & Gunear | 205 | 3600 | 20 | 3600 | 15 |
| Main and Petroleum | 66 | 3000 | 20 | 3000 | 38 |
| 2nd and Houston | 62 | 2800 | 20 | 2800 | 25 |
| Hwy 62 & Arrowhead | 311 | 1300 | 20 | 1300 | 85 |

The results of this analysis shows that the model flows compare closely to the field measured flows. This indicates that the model gives good representation of actual system performance and can be used for reliable analysis of current system operations and for analysis of proposed system improvements. Appendix C contains individual output graphics showing the results of the fire flow analyses at several locations in Florence.

## 3. Florence System

The water system in Florence provides water at satisfactory pressures and flows. However, when reviewing the system model, several system modifications could be made to improve reliability and performance. The system should be operated so that it optimizes the gravity flow options. An example would be to try to use the south water plant as the base demand plant. Water from the south raw water supply flows from the south reservoirs through the plant and into the clearwell. Water in the clearwell can flow by gravity into the pressure zones served that include the City of Florence.

The following system modifications should be considered:

1. Install altitude valve on line feeding the east 1.0 MG tank. This will allow water to flow by gravity for the south plant into the tank. Currently, the tank is filled by pumping from the north treatment plant, through Florence, and into the system.

2. A PRV is located on the 12-inch line in Union Street south of Railroad Avenue. Presently, this line is closed with a line valve. Open the valve to allow flow from the south clearwell into Florence. The PRV should be set to a downstream pressure of less than 5335 (east 1.0 MG elevations).

3. Low pressures have been indicated along Highland Avenue and Arrowhead Lane. This area is served by a 12-inch line from the south plant clearwell. Service below elevation 5335 should be greater than 40 psi and should have adequate fire flow volumes. It is possible that a valve on the 12-inch line is closed which could reduce the ability to provide higher demands. Operations staff should investigate to see if all valves are open.

## 4. Rockvale Water System

The Town of Rockvale ranges in elevation from 5,425 to 5,520. The high water elevation of the Coal Creek tank is at elevation 5,580. The pressure zone line for the Coal Creek tank is at 5,476. This means that any services in Rockvale that are above the elevation of 5,476 will have pressures less than 40 psi. Approximately 50% of the service connections in Rockvale are above this elevation. The problem of low pressure is amplified during fire flow situations. The Town is currently served through a 10-inch line coming from County Road 83A. This line is the only treated water supply line to the town. The needed fire flows for Rockvale are 1000 gpm. However, fire hydrant testing determined only 150 gpm could be drawn out of the hydrants while maintaining a residual pressure of 20 psi. The model was used to simulate fire flows at node 531 and similar results were observed. Model output graphics of various runs are found in Appendix D. The problem of inadequate fire flows is a result of the single-feed supply pipeline and the high elevations in relation to the Coal Creek tank. Headloss through the pipeline is large enough to reduce the residual pressure during a 100 gpm demand to less than 20 psi.

One option was to look at making a connection to the Williamsburg system on Churchill Avenue. By making this connection, the fire flows could be increased to approximately 400 gpm in Rockvale. This is still below the 1000 gpm needed fire flow. However, this is not a viable option because of the additional metering that would be required into the Rockvale system; and the needed fire flow requirements would still not be met.

Growth in the Rockvale area is anticipated to be primarily to the south of the town. This area is at a higher elevation than the existing town and, therefore, would experience even lower pressures than currently exist. To allow for future development in Rockvale, modification to the system should include a new pump station and a tank located at an elevation high enough to serve the anticipated development area. Existing topography would allow for an ideal tank location at elevation 5,800. A pump station would be located on the existing 8-inch supply line and would pump into the existing Rockvale system in the vicinity of County Road 85 and Mesa Avenue. A new 12-inch line would extend from the existing 10-inch line at South Street to the new tank. The proposed improvements are shown on Exhibit III-3. Pressures for current Rockvale users would increase by approximately 90 psi. Individual pressure-reducing valves (PRV's) may be added to individual homes if these pressures are undesirable.

The connection to the Williamsburg system could also be made as part of the improvements. However, as was previously mentioned, this would require an additional flow meter to account for water going into the Williamsburg system. This connection should only be used to provide flows into Willamsburg under very high demand periods or during fire flow situations. A mainline PRV would be required to reduce pressures to the Coal Creek tank zone.

Table III-9 shows the estimated costs for the Rockvale improvements. One option that could be considered would be to relocate the water plant tank to the Rockvale tank site. The cost of relocating a tank is usually considerably less than constructing a new tank. This option should be evaluated during the preliminary design phase.

### TABLE III-9
### Rockvale System Improvements
### Cost Estimate

| ITEM | UNITS | NO. UNITS | UNIT PRICE | TOTAL COST |
|---|---|---|---|---|
| Pump Station | L. S. | 1 | $ 75,000 | $ 75,000 |
| 250,000-gallon reservoir | L. S. | 1 | $250,000 | $250,000 |
| 12-inch pipeline | L .F. | 4200 | $ 40.00 | $168,000 |
| Emergency generator | L. S. | 1 | $ 35,000 | $ 35,000 |
| PRV on Churchill | L. S. | 1 | $ 15,000 | $ 15,000 |
| Contingencies | | | | $ 54,000 |
| Engineering and Admin. | | | | $ 65,000 |
| **TOTAL** | | | | **$662,000** |

## 5. Williamsburg Improvements

The Williamsburg water system consists of long lengths of pipeline that are not looped. Individual line outages can place all downstream users out of service. At the intersection of County Road 13A and County Road 83A, the system is able to deliver the needed fire flow. However, further west in the system, the needed fire flows cannot be delivered due to line losses in the small pipes. To improve fire protection and system reliability in Williamsburg, additional connections and pipelines would be required. The following items should be considered:

1. Provide emergency connection to the Rockvale line on Churchill Avenue. This should be accomplished along with the previously-stated improvements for Rockvale. A PRV and flow meter would be required at the point of connection.

2. Install an 8-inch line from Oak Creek Estates west to the existing line at the Boys' Ranch west of County Road 11A. The approximate length of this line is 4,800 feet and would have an estimated cost of **$144,000**. This line would increase fire protection capability and would also increase system looping and reliability.

The proposed improvements for Williamsburg are found on Exhibit III-4.

## 6. Los Pinos Subdivision

The elevation of the Los Pinos subdivision ranges from a low elevation of 5,440 to a high elevation of 5,510. Based on the high water level of the Coal Creek tank, the pressures range from 30 psi to 61 psi. These pressures will drop as system demands increase or when the Coal Creek tank levels drop. At a low tank level, the lowest pressures will be 15 psi to 20 psi which is below the recommended design levels. Fire flows are also reduced due to the low pressures in the area and by the small line sizes. The maximum fire flow at node 340, which is at elevation 5,510, would be 200 gpm. Graphic outputs of the model for this analysis are found in Appendix D.

Improvements for the area could include creating an independent system that would be supplied from the south plant system. Pressures need to be increased to a minimum 40 psi throughout the system. A booster pump system would need to be installed on the 6-inch supply line. One type of pump station would be a small booster pump that would supply a tank located above the developments. The tank would need to be located at elevation 5,600. The tank could be sized for equalization storage only. Emergency and fire flows would be utilized from the capacity in the south water plant clearwell. A fire pump would be located in the new pump station. One option that could be considered would be to move the existing storage tanks that are located at the airport and are currently in operation to the Los Pinos tank site when those tanks are replaced with a new elevated tank. The proposed improvements are shown on Exhibit III-5. The estimated costs for the system improvement for Los Pinos are shown on Table III-10.

**TABLE III-10**
**Los Pinos Improvements**
**Cost Estimate**

| ITEM | UNITS | NO. UNITS | UNIT PRICE | TOTAL COST |
|---|---|---|---|---|
| Pump station | L. S. | 1 | $75,000 | $ 75,000 |
| Relocate airport tanks | L. S. | 1 | $15,000 | $ 15,000 |
| 8-inch pipeline | L. F. | 1500 | $ 25 | $ 37,500 |
| Contingencies | | | | $ 25,000 |
| Engineering and Admin. | | | | $ 15,000 |
| **TOTAL** | | | | **$168,000** |

## 7. Future Distribution System Policies

As indicated previously, many water utilities have adopted regulations covering the design and layout of water distribution lines. It is recommended that the communities adopt regulations that require a 12-inch grid system every half mile with alternating 8-inch and 6-inch lines within each quarter-section for the urban-type development areas. For more rural areas, a 12-inch grid system every mile, with a minimum of 6-inch interior lines, is recommended.

## E. Raw Water Supplies and Pipelines

### 1. General

The Adobe-Mineral Creek and the Newlin Creek diversions are located south of Florence in watersheds that drain from the eastern slope of the Wet Mountains. The diversions are used to direct water from the creeks into pipelines that carry the water to the south water storage reservoirs. The City of Florence also has water rights on the Arkansas River that are diverted into the Minnequa Canal. In addition, the Town of Rockvale has a raw water collection system on Oak Creek that has senior water rights and could be further developed as a source of supply. A detailed report was prepared by Martin and Wood Water Consultants as part of this report. The entire report is found in Appendix G - Water Rights. The report describes the existing water supplies of the Florence Regional Water System ("Regional System" or "System") and the ability to satisfy the System's existing and future demands for water. The report describes the System's decreed water rights and their calculated yields over the selected 24-year study period of 1971 through 1994. The report also discusses the need for the Florence-Coal Creek-Williamsburg Reservoir on Oak Creek that is yet to be built.

The following section describes the decreed water rights owned by each present member of the Regional Water System. The members of the Regional Water System include the City of Florence, the Town of Coal Creek, the Town of Williamsburg, and the Town of Rockvale. Exhibit III-6, Map of the Raw Water Supply System, provides locations for the System's present points of diversion, raw water storage reservoirs, raw water pipelines, and treatment plants.

### 2. Water Rights Owned by The City of Florence

The City of Florence owns three decreed water rights in its own name and, together with the Towns of Coal Creek and Williamsburg, owns the rights for Florence Treatment Plant Diversion Works and the proposed Florence-Coal Creek-Williamsburg Reservoir. Solely for the sake of convenience, the two latter and jointly-owned water rights are listed herein under the City of Florence. In addition, the City of Florence owns three decreed storage rights and two decreed groundwater rights. Table III-11 shows the water rights owned by the communities in the Regional Water System.

## Table III-11
## Water Rights Owned by the Regional Water System

| Name of Water Right | Member to Whom Decreed | Decree | Amount (cfs) | Source | Average Annual Yield (1971- 1994) acre-feet |
|---|---|---|---|---|---|
| **Florence Adobe/Mineral Creek Pipe** | Florence | 80CW93 | 2.50 | Adobe and Mineral Creeks | 216 |
| **Florence Newlin Creek Pipe** | Florence | 80CW93 | 5.00 | Newlin Creek | 372 |
| **Union Ditch** | Florence | 80CW93 | 4.47 | Arkansas River | 3,149 |
| **Florence Treatment Plant Diversion Works** | Florence, Coal Creek and Williamsburg | 80CW91 | 7.60 | Arkansas River | 84 |
| **Augmented Florence Treatment Plant Diversion Works** | Florence, Coal Creek and Williamsburg | 80CW93 | 0.68 | Arkansas River | 472 |
| **Coal Creek Pipe** | Coal Creek | 80CW93 | 1.00 | Arkansas River | 90 |
| **Williamsburg Pipe** | Williamsburg | 80CW93 | 0.665 | Arkansas River | 37 |
| **W. H. May Ditch** | Rockvale | CA2637 | 4.56 | Oak Creek | 2,273 |
| **Total Direct Flow Rights** | | | 26.475 | | 6,693 |
| **Florence-Coal Creek-Williamsburg Reservoir** | Florence, Coal Creek and Williamsburg | 90CW92 | 100*<br>All Flows* | Arkansas River,<br>Oak Creek | 1,107<br>213 |
| **Total Storage Rights** | | | | | 1,320 |

*The Reservoir is decreed 2,250 acre-feet of storage

### a) Florence Adobe Creek Pipe and Florence Mineral Creek Pipe

The Water Court's decree entered in 1982 in Case No. 80CW93 changed numerous water rights on Adobe and Mineral Creeks to these newly-named structures. The 80CW93 decree provided that the Adobe Creek Pipe and Mineral Creek Pipe water rights should be administered together for all municipal uses with the following priorities under the original adjudication in Water District No. 12. This report, henceforth, refers to these jointly-administered rights as the "Florence Adobe/Mineral Creek Pipe."

| Priority Date | Amount<br>Cubic Feet Per Second |
|---|---|
| May 31, 1866 | 1.0 |
| May 31, 1867 | 0.5 |
| May 31, 1870 | 0.5 |
| Sept. 30, 1870 | 0.5 |
| Total | 2.5 |

### b) Florence-Newlin Creek Pipe

The decree entered in Case No. 80CW93 also changed several water rights owned by Florence on Newlin Creek (a.k.a. Newland Creek) to one set of water rights called the Florence Newlin Creek Pipe. The 80CW93 decree allowed all of these water rights to be used for all municipal uses.

| Appropriation Date | Amount | Adjudication Date |
|---|---|---|
| April 29, 1873 | 0.5 | February 2, 1899 |
| June 1, 1873 | 0.5 | February 2, 1899 |
| March 31, 1883 0.5 | | February 2, 1899 |
| June 21, 1870 | 3.5 (spring and summer) | February 14, 1916 |
| February 23, 1898 | 3.5 (fall and winter) | February 14, 1916 |
| **Total** | **5.0 CFS** | |

### c) Union Ditch

The decree entered in 1982 in Case No. 80CW93 formally changed Florence's then-total interest of 2,793.1 Union Ditch shares to all municipal purposes. Florence's proportional interest in the total 48 cfs Union Ditch priority of November 30, 1861 is calculated to be 4.47 cfs (48 cfs x 2,793.1 shares/29998 shares). The Union Ditch diverts from the Arkansas River at the headworks of the Minnequa Canal.

### d) Florence Treatment Plant Diversion Works

In Case No. 80CW91 in 1982, the Water Court awarded a 100 cfs direct flow priority from the Arkansas River to the City of Florence and the Towns of Coal Creek and Williamsburg. This water right, named Florence Treatment Plant Diversion Works, bears a priority date of August 26, 1980 for irrigation, domestic, municipal, and all other beneficial uses. Upon demand from the Colorado Supreme Court, the Water Court entered its final decree in 1985, reducing the maximum rate of diversion from 100 cfs to 7.6 cfs.

In 1987, in the decree entered in Case No. 86CW120, the Water Court added the Minnequa Canal as an alternate point of diversion for the Florence Treatment Plant Diversion Works.

### e) Augmented Florence Treatment Plant Diversion

The decree in Case No. 80CW93 allowed an augmentation credit based on the actual extent of municipal use of Florence's changed Union Ditch water rights. Beyond the threshold of 2.00 cfs of municipal use of the Union Ditch, the decree provided for an augmentation credit of 7% of the Union Ditch usage. Then, based on the finding that the municipal use of water was only 25% consumptive, the decree allowed an out-of-priority diversion under the augmented Florence Treatment Plant Diversion Works right at a rate of four times the calculated augmentation credit. For example, if 3.00 cfs of Florence's Union Ditch rights were being diverted and used for municipal purposes, the augmentation credit would be calculated as 0.07 cfs (=7% x [3.00 cfs - 2.00 cfs]). The permissible rate of diversion of the augmented out-of-priority Florence Treatment Plant Diversion Works right would then be 0.28 cfs (=4 x 0.07 cfs).

### f) Florence-Coal Creek-Williamsburg Reservoir

The decree entered in 1982 in Case No. 80CW92 awarded Florence, Coal Creek, and Williamsburg a 2,250-acre-foot storage priority for municipal purposes. The reservoir, to be located on Oak Creek approximately one mile west of Florence, may store water from the Arkansas River via the Florence Treatment Plant Diversion Works at a maximum rate of 100 cfs or from Oak Creek.

In 1987, in the decree entered in Case No. 86CW120, the Water Court added the Minnequa Canal as an alternate point of diversion for the Florence-Coal Creek-Williamsburg Reservoir.

### g) Augmented Florence-Coal Creek-Williamsburg Reservoir

The decree in Case No. 80CW93 also allowed the Union Ditch augmentation credit to be diverted into storage in the Florence-Coal Creek-Williamsburg Reservoir and alternatively to the direct flow usage of the augmentation credit. Such augmentation credit (calculated as 7% of the difference between the Union Ditch usage and the threshold usage of 2.00 cfs) may be stored in the Florence-Coal Creek-Williamsburg Reservoir. Thus, at the maximum Union Ditch usage of 4.47 cfs, the augmentation credit which may be stored is calculated to be 0.17 cfs (=7% x [4.47 cfs - 2.00 cfs]). However, pursuant to another provision of the decree in 80CW93, only 50% of this augmentation credit may be stored in the Florence-Coal Creek-Williamsburg Reservoir.

Similarly, the decree in 80CW93 also provided that 50% of any of the diversions from the Adobe/Mineral Creek Pipe, the Newlin Creek Pipe, the Coal Creek Pipe (subsequently described), and the Williamsburg Pipe (subsequently described) <u>not used for direct municipal purposes</u>, could be stored in the Florence-Coal Creek-Williamsburg Reservoir.

### h) Florence Reservoirs 1, 2, and 3

The decree, entered in 1916 in Case No. 2637 by the District Court for Fremont County, awarded Florence the right to fill and refill three reservoirs from various sources along Newlin Creek and to use such stored waters for domestic, culinary, stock watering, sprinkling of streets, irrigation, firefighting, steam, power, manufacturing, heating, and all other purposes usually connected with and used as a part of a city water supply. The decree later entered by the Water Court in Case No. 80CW93 authorized the continued use of Florence Reservoirs 1, 2, and 3 to store any or all of the water diverted under the rights of the Florence-Adobe Creek Pipe, the Florence-Mineral Creek Pipe, and the Florence-Newlin Creek Pipe for municipal purposes, up to the capacities previously decreed in Case No. 2637: Reservoir 1 - 154 acre-feet; Reservoir 2 - 92 acre-feet; and Reservoir 3 - 138 acre-feet. (The embankment separating Reservoir 1 and Reservoir 2 has been removed, and Reservoir 1 and Reservoir 2 now constitute one reservoir).

### i) Florence Municipal Wells No. 1 and No. 2

The Water Court, in 1971, entered its decree in Case No. W-147 awarding a September 25, 1911 priority for 0.668 cfs to Florence Municipal Well No. 1 and a December 31, 1950 priority for 0.668 cfs to Florence Municipal Well No. 2, both priorities to be used for municipal purposes. Because these wells are reportedly leased to the Fremont RE-2 School District, this report will no longer consider them as a part of the Regional Water System. However, because Florence Municipal Well No. 2 has a post-1948 priority date, it is noted that neither the Town of Florence nor the School District is obligated to provide augmentation water for its continued use under the new rules for use of groundwater promulgated by the Colorado State Engineer.

### 3. Water Rights Owned by The Town of Coal Creek

The decree entered by the Water Court in Case No. 80CW93 changed several water rights owned by Coal Creek into one newly-named water right - the Coal Creek Pipe. This water right carries a priority date of March 5, 1884 for 1.0 cfs for all municipal uses. The point of diversion was established as from the Arkansas River at the Florence Treatment Plant Diversion Works. The decree also imposed monthly diversion limits of 10 acre-feet for June through November and 5 acre-feet for December through May.

In 1987, in the decree entered in Case No. 86CW120, the Water Court added the Minnequa Canal as an alternate point of diversion for the Coal Creek Pipe.

### 4. Water Rights Owned by The Town of Williamsburg

The decree in Case No. 80CW93, likewise, changed several water rights owned by Williamsburg into one new water right - the Williamsburg Pipe. This water right is to divert its 0.665 cfs for all municipal purposes from the Arkansas River at the Florence Treatment Plant Diversion Works. This water right carries a December 31, 1890 priority. The decree limited its monthly diversions to 7 acre-feet from June through November and 4 acre-feet from December through May.

In 1987, in the decree entered in Case No. 86CW120, the Water Court added the Minnequa Canal as an alternate point of diversion for the Williamsburg Pipe.

### 5. Water Rights Owned by The Town of Rockvale

In 1884, in the original adjudication of water rights in Water District No. 12 and in 1916 in Case No. 2637, the District Court for Fremont County entered its decrees approving water rights for the Town of Rockvale. These water rights included a 2.96 cfs priority of May 31, 1867 and a 1.60 cfs priority of December 30, 1875 "for domestic purposes, including the watering of stock, the sprinkling of lawns, the irrigation of ornamental trees, and all other purposes usually connected with and used as a part of a town water supply". The decree provided that these priorities may be diverted from Oak Creek by the W.H. May Ditch or by wells situated on Oak Creek. The decree further provides for the filling and refilling of two small reservoirs (0.33 acre-feet and 3.11 acre-feet) to be used for domestic purposes.

Later, in the decree entered in 1974 in Case No. W-1566, the Water Court changed the point of diversion for 0.4 cfs of the Town's senior 1867 priority of 2.96 cfs to six wells lying upstream from the Town on Oak Creek located on Figure III-3. In 1991, in Case No. 90CW33, the Water Court approved the changes in the location to two of the six wells decreed in Case No. W-1566.

## 6. Assessment of Water Supply and Water Demand

At the Regional Water System's current (1995) use of 1,666 acre-feet of water per year, the System's direct flow supplies of raw water can adequately generate enough water to supply the current regional system. No new water storage reservoir on Oak Creek is needed for the System's present level of use. However, to provide desirable redundancy and security in the event of an outage of a major raw water supply due to pollution or mechanical failure, the Regional Water System would benefit from additional availability of water from a new reservoir on Oak Creek.

The present available direct flow supplies (excluding the 736.63 unchanged Union Ditch shares and the Florence-Coal Creek-Williamsburg Reservoir on Oak Creek) can adequately provide for an annual demand of up to 4,000 acre-feet per year with occasional monthly deficits which the existing raw water reservoirs could handle satisfactorily.

To eliminate deficits completely and to maximize the overall yield of the System, direct flow, and storage supplies, a new 2,250 acre-foot reservoir on Oak Creek would increase the dependable yield of the Regional Water System to 5,000 acre-feet per year.

### a) Recommendation for the Raw Water Supply

1. Change the Water Right for Florence's 736.63 shares of Union Ditch. The water right from the 736.63 unchanged shares of Union Ditch should be changed to the Regional Water System's municipal use. Provisions to store these water rights should be included.

2. Florence-Coal Creek-Williamsburg Reservoir on Oak Creek. The Regional Water System should begin to assess its need to construct a raw water reservoir of some size on Oak Creek. The Regional Water System should consider its needs for a secure supply of supplemental water in the

event of an outage on one of its major raw water sources, and its needs for increased water supply. The Regional Water System should also consider the costs of acquisition of land and rights-of-way for the reservoir in light of any expectations of growth and development within the service area and higher costs in the future of obtaining the same. Undertaking substantial activities in developing that storage right, such as those mentioned herein, will also support the showings of due diligence which is required by the Water Court to keep this conditional storage right alive.

3. Flow Measurement of Oak Creek. The Regional Water System should consider monitoring and recording flows in Oak Creek within the Williamsburg-Rockvale areas to confirm or modify the flows and yields calculated in this study to be available to the storage right on Oak Creek and Rockvale's W.H. May Ditch right.

## 7. Adobe-Mineral Creek System

The Adobe-Mineral Creek pipeline was replaced in 1988 with plastic irrigation pipe, 80 psi. The pipeline is approximately nine miles in length. The pipeline route is shown in Exhibit III-6. The pipeline begins at the metering vault at the south end of the south reservoir. This vault has two inlet boxes. One is for the Adobe/Mineral Creek pipeline and one is for the Newlin Creek pipeline. This vault is used to record flows from each source on a daily basis.

The first section of pipeline extends approximately 4.3 miles, is a 12-inch line, is designed to flow under pressure, and has air-release valves to remove entrapped air from the line. The capacity of this line is approximately 20 cfs under full-pressure flow or 15 cfs under open-channel flow. However, the current junction does not allow more than 4.0 cfs. A weir located in the Mineral/Adobe junction box overflows when flows exceed 4.0 cfs.

A junction box is located where the Mineral Creek line and the Adobe Creek line meet. From that point, a 10-inch plastic pipe extends to the Adobe Creek diversion. The pipeline is designed to operate in an open-channel configuration. Air-release valves or concrete boxes are used to allow free air to enter and exit the pipeline to maintain open-channel flow. Visual inspection of the line located a 2-inch tap at station 462+00. This tap is used to provide water for livestock to an adjacent landowner that provided an easement for the pipeline. This line is an unregulated tap and depletes the yield from the Adobe Creek system. Consideration should be given to providing some control on this line to account for lost flows.

The Adobe Creek diversion consists of a concrete retaining wall and a spillway used to create a pool upstream that can be diverted. The diversion box consists of a stainless-steel trash screen that is used to keep debris smaller than ¼-inch from entering the pipeline. The screen plugs up with debris as the water level rises and then spills over the dam and is lost downstream. Details of the existing structure are shown in Appendix E.

To increase the yield from this diversion, improvement to the diversion outlet box would be required. The depth of the intake needs to be increased so the additional headloss can occur without wasting as much water downstream. The capacity of the outlet is designed at 2.5 cfs, but flow of 4.0 cfs could occur if the diversion box was improved.

From a title search of the property, the site is owned by the Archdiocese. It is unknown if a lease exists for this site. It is recommended that further investigation and possible transfer of ownership to the City of Florence should occur.

### a) Mineral Creek System

The Mineral Creek diversion is located on U. S. Forest Service land. A special-use permit describes the condition for the diversion and is found in Appendix E of this report. Item 32 of the permit states that the authorization of the permit will last until December 31, 1998. It further states that, if the facility is being used, its renewal is allowed under an existing law at the time of the renewal; and it is consistent with existing management plans effective at the time of the renewal.

There has been a current trend for the Forest Service to place additional conditions on the renewal of special-use permits. These could include dedication of minimum stream flows which could be detrimental to the needs of the City of Florence.

It is recommended that discussion and renegotiating should begin with the Forest Service for permit renewal. If it is apparent that conditions to be imposed would be detrimental to the City of Florence, consideration of relocating the diversion to a site off of Forest Service land should be evaluated. The structure would need to be moved approximately 1,000 feet downstream to a new location. The site would need to be acquired from private property owners and a new diversion structure would need to be constructed. The estimated cost for these improvements is shown on Table III-12.

### TABLE III-12
### Mineral Creek Diversion Relocation
### Cost Estimate

| ITEM | UNITS | NO. UNITS | UNIT PRICE | TOTAL COST |
|---|---|---|---|---|
| Demolition of existing structure | L. S. | 1 | $15,000 | $15,000 |
| Concrete | L. S. | 1 | $45,000 | $45,000 |
| New piping | L. S. | 1 | $10,000 | $10,000 |
| Site acquisition | L. S. | 1 | $20,000 | $20,000 |
| Contingencies | | | | $14,000 |
| Engineering and Admin. | | | | $20,000 |
| **TOTAL** | | | | **$124,000** |

## 8. Newlin Creek System

The Newlin Creek system was upgraded in 1994 and 1995. Improvements included a new sedimentation pond, diversion dam, and replacement of the old pipeline. The location of the Newlin Creek pipeline and diversion is shown on Exhibit III-6. As part of the improvement project, a special-use permit was obtained from the U. S. Forest Service. A copy of the permit is found in Appendix F. This permit was issued until the year 2014. It was recommended in the previous section that negotiations begin on the permit renewal for the Mineral Creek Diversion. It would be beneficial to include the Newlin Creek permit at the same time. It is difficult to determine what position the Forest Service will have in the year 2014 when the permit expires. However any conditions set for the Mineral Creek diversion will most likely carry over to the Newlin Creek system at the time of the expiration. If the most advantageous position for the City is to move the Mineral Creek diversion to a site out of Forest Service property, then that same condition would probably apply to the Newlin Creek diversion. If it is necessary to relocate the Newlin Creek Diversion a project similar to the recently completed project would be required. The estimated cost for the project would be approximately **$125,000**, based on the cost estimate developed for the Mineral Creek relocation.

### a) System Capacity

The Newlin Creek Pipe has a capacity of 9.6 cfs under pressure flow and 7.2 cfs if flowing by gravity. The decree is for 5.0 cfs, so the line has adequate capacity to carry the decreed flows.

### b) Hydroelectric Generation

As part of the pipeline project, piping was installed to divert flows from the pipeline to hydroelectric generators. At the present time, the cost of construction of turbines and electrical components would not be economically feasible due to the current cost of electricity on the wholesale level. However, because these facilities do exist, future use could be considered based on further economic evaluation.

## 9. May Ditch System

In 1884, the original adjudication of water rights for the Town of Rockvale included a 2.96 cfs priority of May 31, 1867 and a 1.60 cfs priority of December 30, 1875 "for domestic purposes, including the watering of stock, the sprinkling of lawns, the irrigation of ornamental trees, and all other purposes usually connected with and used as a part of a town water supply." The decree provided that these priorities may be diverted from Oak Creek by the W. H. May Ditch or by wells situated on Oak Creek. The decree further provides for the filling and refilling of two small reservoirs (0.33 acre-feet and 3.11 acre-feet) to be used for domestic purposes.

Later, in the decree entered in 1974 in Case No. W-1566, the Water Court changed the point of diversion for 0.4 cfs of the Town's senior 1867 priority of 2.96 cfs to six wells lying upstream from the Town on Oak Creek located on Exhibit III-3. In 1991, in Case No. 90CW33, the Water Court approved the changes in the location to two of the six wells decreed in Case No. W-1566.

No yields have been independently calculated for the two small decreed Rockvale reservoirs (0.33 acre-feet and 3.11 acre-feet) because these reservoirs are very small and are considered to be regulatory or operational reservoirs.

The current use of the water rights includes the direct diversion of water off of the W. H . May Ditch to be used for irrigation of the Town's field. Upstream of the diversion, six wells are located adjacent to Oak Creek. The locations of these wells are shown on Exhibit III-3. The wells are hand-dug pits that have collection laterals extending from the radius of the wells. Water is collected in a 6-inch, cast-iron line that flows by gravity to the Rockvale storage reservoirs. Currently, these reservoirs are connected to the Regional Water System with a 10-inch PVC raw waterline. The line runs to the south treatment plant. On a weekly basis, the raw waterline is opened; and approximately 500,000 gallons is sent to the treatment plant. The total yield from Rockvale is estimated to be 13.0 million gallons per year. This is an average-daily supply of 0.036 MGD (40 acre-feet/year). The estimated average annual yield of the Rockvale decrees is 2.03 MGD (2,273 acre-feet per year). It shows that a vast amount of water is available for use provided it can be diverted to the Regional Water System.

To accomplish this, improvements would need to occur to the system. These include:

1. Improve the diversion structure for the W. H. May Ditch to include a diversion box and a measuring flume.
2. Construct a new pump station to deliver water to the existing Rockvale reservoirs. Additional daily storage reservoirs may be required to steady inflows to the system.
3. Connect existing well collection system to new pump station.
4. Connect existing town field well to system.

The proposed improvements are shown on Exhibit III-2. The estimated costs for the improvements are found on Table III-12.

**TABLE III-12**
**Rockvale Raw Water Improvements**
**Cost Estimate**

| ITEM | UNITS | NO. UNITS | UNIT PRICE | TOTAL COST |
|---|---|---|---|---|
| New diversion structure | L. S. | 1 | $40,000 | $40,000 |
| New pump station | L. S. | 1 | $60,000 | $60,000 |
| New raw water storage | L. S. | 1 | $20,000 | $20,000 |
| New pipelines | L. S. | 1 | $90,000 | $90,000 |
| Site acquisition | L. S. | 1 | $10,000 | $10,000 |
| Contingencies | | | | $20,000 |
| Engineering and Admin. | | | | $35,000 |
| **TOTAL** | | | | **$275,000** |

### 5. South Plant Raw Water Reservoirs

Florence Reservoirs No. 1, No. 2, and No. 3 store any or all of the water diverted under the rights of the Florence-Adobe Creek Pipe, the Florence-Mineral Creek Pipe, and the Florence-Newlin Creek Pipe for municipal purposes up to the capacities previously decreed in Case No. 2637: Reservoir No. 1 - 154 acre-feet; Reservoir No. 2 - 92 acre-feet; and Reservoir No. 3 - 138 acre-feet. (The embankment separating Reservoir No. 1 and Reservoir No. 2 has been removed, and Reservoir No.1 and Reservoir No. 2 now constitute one reservoir). The volume of the reservoirs was determined from design drawings. The total storage volume in Reservoirs No. 1 and No. 2 is approximately 360 acre-feet (117 million gallons) at a maximum water surface elevation of 5,530. Reservoir No. 3 has a capacity of approximately 90 acre-feet (29 million gallons) at a maximum water surface elevation of 5,542. This amounts to total available storage of 450 million gallons. At the current average annual demand of 1.34 MGD, the average storage is 154 days. At a maximum-daily demand of 3.35 MGD, the storage would be approximately 61 days. The total average annual yield from 1971 to 1996 from the south diversions is estimated to be 588 acre-feet.

The following improvement should be considered to the south reservoirs:

1. Construct a by-pass line to directly feed the treatment plant from the influent box. This will provide the flexibility to treat water of highest source quality. This will allow water to flow directly from the Newlin Creek or Adobe/Mineral systems without adding to the water in the reservoirs. A period of active algae blooms would allow the reservoirs to be by-passed while the reservoir water improves. The estimated cost for this improvement is **$40,000**.

### 10. North Reservoirs

The north raw water reservoirs are located adjacent to the west 1.0 MG tank. The reservoirs are used for storage of Arkansas River water. Water is delivered from the Minnequa Canal pump station to the reservoirs. Each reservoir has approximately 40 acre-feet (13 million gallons) of storage for a total of 80 acre-feet (26 million gallons). Water from these reservoirs can flow to the north treatment plant or can be pumped to the south treatment plant from the north reservoir pump station. If these reservoirs were used to supply the north treatment plant only, these reservoirs would have approximately 35 days of storage. If these reservoirs are used to supply the average annual day demand from both treatment plants of 1.34 MGD, there would be approximately 20 days of storage. It should be noted that during high usage months the system demand is higher; therefore, the available storage will be reduced.

The only consideration for improvement of these reservoirs is to provide for complete by-pass of the Minnequa Canal water to the south treatment plant and reservoirs. This would be beneficial if the north reservoirs were taken out of service or if the south supplies become so deficient that additional Arkansas River water is needed to fill the south reservoirs. These improvements are discussed in Section III.A.1.

## 11. Proposed Oak Creek Reservoir

The Water Court of 1982 in Case No. 80CW92 awarded Florence, Coal Creek, and Williamsburg a 2,250 acre-foot storage priority for a reservoir to be located on Oak Creek. The formal name for this water is the Florence-Coal Creek-Williamsburg Reservoir; but for brevity, this report hereinafter refers to it as the Oak Creek Reservoir.

Based on the decreed location of the dam on Oak Creek and by calculation of the reservoir surface area for the 1:24,000 scale 7-½ minute quadrangle map, a dam creating a depth of water of 57 feet would store 2,.250 acre-feet. The location of the high water line is shown on Exhibit III-7. The water surface level would correspond to an elevation of 5,270 feet.

For purposes of analysis the role the Oak Creek Reservoir could serve relative to the Regional Water System's needs, monthly net evaporation data was developed using gross evaporation data from the State Engineer's Office. The average gross reservoir evaporation rate was taken to be 3.79 feet per year. After subtracting 70% of the average annual precipitation of 12.94 inches for the Cañon City weather station, the net reservoir evaporation used in this study for Oak Creek Reservoir averages 3.04 feet per year for the 1971-1994 study period.

By constructing the Oak Creek dam and reservoir, the calculated dependable yield would reach 5,089 acre-feet per year without shortages or deficits. A detailed analysis of the yield of the Oak Creek Reservoir is found in Appendix F.

### a) Soils Survey

According to the Soil Survey of the Fremont County Area, Colorado, compiled by the United States Department of Agriculture, Natural Resources Conservation Service, and issued in 1995, the site is contained within four different soil regions. Descriptions of these regions are explained in Appendix H with estimated coverage percentages.

### b) Geology

According to the USGS Geologic Map of Colorado compiled by Ogden Tweto in 1979, the site is predominated by the upper unit of the Pierre Shale. This shale formation (Kpu) is a sedimentary rock of upper cretaceous age. It is known to contain high amounts of clay particles with little sands, to have medium to high shrink/swell capacity, and to be abundant in the Colorado Front Range area.

### c) Earthquake Potential

The site lies within the eastern Mountain Province as outlined by Kirkham and Rogers, EARTHQUAKE POTENTIAL in COLORADO, Bulletin 43, Colorado Geologic Survey. This places the site within a region with a recommended Maximum Credible Earthquake of Magnitude 6.0 to 6.75. The closest documented fault to the site is the Wet Mountain Fault which is approximately five miles southwest of the site. Due to the proximity of this fault system, a more detailed investigation of the site is warranted before final design of the dam.

### d) Embankment Design

Dam Embankment. Based on the information on the soils from the SCS Soil Survey and from the soils report by Colorado Soil, it appears the dam will be constructed of low to medium plastic clays. These materials would be expected to provide a relatively impermeable embankment that will present minimal stability problems. The permeability of the material would be expected to be in the $1x10^{-6}$ cm/sec range.

The embankment slopes would be expected to be in the range of 2½:1 to 3:1 for the height of the dam proposed. Strength testing of the embankment and foundation materials will be required to finalize the slopes required.

Dam Foundation. The dam foundation is expected to be silty clays which most likely overlay the Pierre Shale Formation. No significant problems are expected due to the foundation soils. Some areas may contain gravel and cobbles (based on the soils report) and will require a more thorough investigation to determine the seepage potential. The soils report indicates that these soils are clayey, and major seepage problems are not expected. A cutoff into these types of soils may be required depending on the depth below the dam and permeability.

Borrow Materials. Based on the type of soils outlined in the soils report, adequate borrow materials are expected to be available from the reservoir site to construct the dam embankment. It has been estimated that 450,000 cubic yards of soil will be required to construct the dam. This will require a borrow area of 40 acres in size excavated to a depth of seven (7) feet. Due to two of the borings in the soils report indicating groundwater at eight feet, the excavation would not be expected to proceed any deeper than approximately seven feet below grade.

Cost Estimate. The estimated cost of the dam in 1996 dollars is expected to be approximately **$4,218,000** as shown in Table III-13.

The proposed dam details used in the cost estimate consisted of the following. These details are very preliminary at this time as no design calculations or in-depth investigations of the site have been conducted.

1. 3 to 1 embankment slopes.
2. Concrete inlet structure with an inclined gate.
3. Concrete gatehouse structure with a vertical lift gate.
4. Concrete outlet and energy dissipation structure.
5. Forty-eight-inch diameter precast concrete pipe bedded on a concrete cradle.
6. Twenty-four-inch layer of riprap with nine inches of bedding on the upstream face for erosion protection.
7. Six-inch layer of road gravel on dam crest for erosion protection.
8. Internal chimney drain and toe drain to control seepage.
9. Cut-off trench for seepage.
10. Concrete spillway control wall with riprap protection.

### TABLE III-13
### Oak Creek Reservoir
### Cost Estimate

| ITEM | UNITS | NO. UNITS | UNIT PRICE | TOTAL COST |
|---|---|---|---|---|
| Mobilization | L. S. | 1 | $50,000 | $ 50,000 |
| Stripping | Acre | 10 | $1,000 | $ 10,000 |
| Dewatering | L. S. | 1 | $ 20,000 | $ 20,000 |
| Embankment fill | C .Y. | 450,000 | $1.50 | $ 675,000 |
| Cut-off trench excavation | C. Y. | 100,000 | $2.00 | $ 200,000 |
| Cut-off trench fill | C. Y. | 100,000 | $2.00 | $ 200,000 |
| Borrow | C. Y. | 500,000 | $1.50 | $ 750,000 |
| Chimney & toe drain | L. F. | 800 | $100 | $ 80,000 |
| Spillway | L. S. | 1 | $75,000 | $ 100,000 |
| Riprap | C. Y. | 30,000 | $25.00 | $ 750,000 |
| Outlet works - concrete | L. S. | 1 | $120,000 | $ 120,000 |
| Outlet conduit - 48-inch | L. F. | 300 | $150.00 | $ 45,000 |
| Outlet gates | Each | 2 | $10,000 | $ 20,000 |
| Dam crest gravel | C. Y. | 2000 | $15.00 | $ 30,000 |
| Topsoil & seeding | Acre | 8 | $1,500 | $ 27,000 |
| **Subtotal** | | | | **$3,057,000** |
| **Contingencies** | | | | **$ 611,000** |
| **Engineering and Admin.** | | | | **$ 550,000** |
| **TOTAL** | | | | **$ 4,218,000** |

## F. Water Treatment Plant

### 1. Plant Description

The City of Florence currently operates two water treatment plants. The south water treatment plant is located north of the south raw water reservoirs. The north treatment plant is located on the west mesa and is accessed from Marble Street.

The south treatment plant has a capacity of 2.0 MGD. The plant has a 1.0 million-gallon clearwell that is divided into two compartments. A 750,000-gallon compartment was constructed to provide gravity feed to the distribution system and to provide pump supply for the Coal Creek tank. The 250,000-gallon compartment is provided for backwash supply and process water to be used by the plant.

The treatment plant is a Trident package treatment plant designated for use in model TR420A. This system is an adsorption clarifier-type system. This system was selected over a conventional flocculation/sedimentation system due to its smaller size and economy. Drawings of the treatment plant are found in Appendix J.

The north treatment plant has a capacity of 2.0 MGD. The plant was constructed adjacent to the old City filter plant that was built in several phases beginning in 1972. The plant is similar in design to the south treatment plant in that it also uses a Trident treatment system. The plant is connected to the existing clearwell that was part of the original plant. The clearwell has a capacity of 33,000 gallons. Treated water pumps water from the clearwell to the west 1.0 MG tank.

### 2. Regulatory Issues

The Safe Drinking Water Act Amendments of 1986 mandate the establishment of many new drinking water regulations. Those of particular concern to the City of Florence in the Surface Water Treatment Rule, the Lead and Copper Rule, and the Disinfection/Disinfection By-Products Rule. Many of the regulations are directed toward systems that serve more than 50,000 persons; however, the requirements of these rules do apply the to City of Florence and the requirements for compliance.

### a) Surface Water Treatment Rule

This rule was adopted in June of 1989 and is now in effect. The rule reduces the allowable turbidity (a measure of the clarity) of the treated water from 1.0 NT's to 0.5 NTU's. The plants consistently produce water with a turbidity of 0.08 to 0.25 NTU based on monthly averages.

The EPA published the proposed Enhanced Surface Water Treatment Rule on June 10, 1994. The final rule is expected to take effect in June of 1998. The rule includes options that will be refined based on data from the Information Collection Rule. The options include requirements that systems using poor quality water remove microbiological contaminants above levels currently required by the Surface Water Treatment Rule. Considering recent water-borne disease outbreaks attributed to Cryptosporidium, it is likely the regulation will be more stringent in the future and could possibly follow the AWWA goal which is to produce a finished water turbidity of 0.1 NTU. AWWA's rational for adopting the goal was:

> "Today's consumer expects a sparkling clear water. The goal of less the 0.1 NTU insures satisfaction in this respect. There is evidence that the freedom from disease organism is associated with freedom from turbidity, and that complete freedom from taste and odor requires no less than such clarity. Improved technology in the modern treatment process make this goal a completely practical goal."

Assuming the past time frame for changes in the standard, it seems reasonable to assume that any mandatory change to 0.1 NTU would take place over a period of 9 to 15 years beyond 1992 when the 0.5 NTU standard went into effect. The would place the next changes sometime between 2001 and 2007.

### b) Lead and Copper Rule

The final Lead and Copper Rule was published in 1991 and became effective in July of 1992. The rule is extremely complex and mandates extensive, at-the-tap testing for presence of lead and copper. Since surface water along the Front Range is typified by low pH and low alkalinity (which means it can be corrosive to both lead and copper in plumbing systems) some concern could exist about the ability to meet the new regulations. In order to reduce the corrosivity of the water, facilities for stabilizing the water at the plant would be required.

### c) Disinfection/Disinfection By-Product Rule

Proposed regulations for the disinfectants and disinfection by-products have been under development for several years. In 1994, a negotiated rule-making process was completed (referred to as a regulatory negotiation or "reg neg."). The D/DBP Rule was proposed on July 29, 1994. Its provisions are identical to the draft rule. Stage 1 was to be promulgated in December of 1996. However, the complexity of this rule and the delay in promulgation of the Information Collection Rule (ICR) has forced USEPA to reconsider the schedule for promulgating the D/DBP Rule.

Stage 1 of the proposed rule would lower the level of TTHM's to 80 ug/l from the current level of 100 ug/l as well as add MCL's for six new DBP's and establish maximum disinfectant levels (MRDL). The delay in developing standards will probably create regulations and size of community limits that may or may not effect the treatment plant processes. It is advisable to remain current on the status of on-going regulatory changes.

## 3. Chemical Feed System

The existing chemical feed systems at the water plant have the capability of adding chlorine, aluminum sulfate, and polymers. These chemicals are added to plant influent lines prior to entering the clarification portions of the treatment plants. The treatment plants are susceptible to a wide variety of water quality variables. The greatest variability problem can occur from the many different sources that can be treated. Any direct diversion source (Minnequa Canal, Newlin Creek, Adobe/Mineral Creek) is susceptible to changing water quality due to weather conditions and runoff. The raw water reservoirs are terminal points for all water supplies and serve to balance out the variability in direct diversion waters to some degree. However, the reservoirs themselves present their own water quality problems with the formation of algae. Excessive algae increases suspended solid in the water that decreases filter runs and are associated with taste and odor problems.

To control the growth of algae in the reservoirs, copper sulfate has been added to reduce the algae growth. Copper sulfate is an effective chemical to remove algae growth from the raw water reservoirs. However, as regulations change in the future the use of copper sulfate may be limited due the increase in copper levels that it causes. Alternative methods of control of algae, either in the reservoirs or in the treatment plant process, may be required.

## 4. Source of Supply Contamination

The City of Florence is susceptible to acute water shortage problems should one of the water supplies become contaminated. The most likely scenario would be a spill of toxic chemical into the Arkansas River upstream of the Florence diversion. If a chemical were to spill into the river, then the Minnequa Canal pump station would need to stop delivery of water to the north raw water reservoirs.

It is recommended that an Emergency Management Plan be developed in the event of this type of emergency which would have a major impact on the Regional Water System. This plan could include provision for public notification, water-rationing procedures, and operational considerations.

## 5. Alternative Analysis

### a) Plant Capacity

Each treatment plant has a capacity of 2.0 MGD for a total capacity of 4.0 MGD. The current maximum daily plant production in 1995 and 1996 was between 2.5 and 3.0 MGD. It is estimated the plant capacity will be exceeded by the year 2000 based on the population projections described in Chapter 2. Expansion should occur by adding additional 0.5 MGD treatment modules to the existing plants. Each plant has provision to add an additional 0.5 MGD. However, it will be most beneficial to add future expansion improvement at the south plant. The south plant was constructed to add one more treatment train to the plant. The piping has been planned to accommodate this expansion. The estimated cost for the expansion is **$250,000.**

The north plant also was constructed to add one more treatment unit. However, as was previously stated, it would be more advantageous to consolidate all of the future treatment units at the south plant. The advantages are:

1. All operations and controls are accomplished at one site. This means more efficient manpower requirements because time is not spent between the two plants.
2. Treating water from the same source will be easier and more consistent.
3. Higher turnover rates in the south reservoirs will possibly reduce the amount of algae formation which has been a source of treatment problems.
4. Electrical demand charges could possibly be reduced because of less pump start ups and more efficient pumping.

### b) Valves and Piping

The north plant is somewhat limited on the effluent piping due to restrictions in pipe size from 12 inches to 8 inches. The increased piping losses prevent longer filter runs. Consideration should be made to increase all effluent piping from 8 inches to 12 inches. The estimated cost for this improvements is **$65,000**.

At the south plant, air backwash piping creates excessive air in the filters which leads to ineffective backwashing and possibly shorter filter runs. The backwash piping should be modified to eliminate air entraining problems. This should be accomplished along with the next plant expansion.

### c) Chemical Feed Systems

Polymers should be used to the greatest extent possible due to the ease of handing and reduction in sludge. Consideration should be given to using polymer/alum blends. These chemicals are available in various sized containers and could be fed through existing polymer feeders.

### d) Chlorine Dioxide

Chlorine dioxide can be used as an oxidizing agent used for treatment of organic and taste and odor substances in the raw water. It is also effective in keeping levels of Total Trihalomethanes (TTHM) low. TTHM's are the major contaminates that are being considered for the Disinfection/Disinfectant By-Products Rule. It has also been shown to be effective in treatment of soluble manganese sometimes found is surface waters.

Chlorine dioxide is generated on site by combining gaseous chlorine with sodium chlorite. Specific mixing equipment is required to control the mixing and feed rates. Currently, several manufacturers make package-type systems that could be used in the water plants. They are willing to conduct pilot studies prior to adding a permanent system to the plant. The cost for a chlorine dioxide system is approximately **$15,000**.

### e) Chlorine Contact

The State Health Department requires 0.2 mg/l chlorine residual in water after it has been exposed to chlorine for a 30-minute contact time. The chlorine contact at both plants is accomplished in the clearwells. The capacity of the north plant clearwell is 33,000 gallons, and the capacity of south plant clearwell is 1.0 million gallons.

At a plant production rate of 2.0 MGD, the north plant would have a contact time of 23 minutes; and the south plant would have a contact time of 720 minutes. It is apparent that the south plant has the volume for adequate chlorine contact. However, because the clearwell inlet line is so close to the pump suction lines, short-circuiting may occur.

At the north plant, the clearwell has inadequate contact time at the full plant flow. However, the maximum flow through the plant has been 0.91 MGD. At that rate, the clearwell would have a contact time of 52 minutes which is well within the State's requirements. This clearwell also has a problem with the inlet line located close to the pumps which could cause short-circuiting that would reduce contact time.

It is recommended that each clearwell have baffles added which will provide for optimum contact time. The baffles could be made from redwood or fiberglass. The estimated costs for baffles in the north plant is **$10,000** and the south plant is **$20,000**.

# IV. Capital Improvement Plan

## A. Soft Cost Projects

The report has described certain items that should be considered in the operation of the water system. They are items that require staff involvement and possibly assistance from the City's Engineer or Attorney. Because they are not actual capital projects for which specific budgets can be prepared, costs for these items are not included. The following is list of projects:

### 1. Raw Water System

1. Change Water Rights of Florence 736.36 shares of Union Ditch to municipal use.
2. Show due diligence on Oak Creek Reservoir by beginning permitting, land acquisition, and funding alternatives.
3. Develop flow measurement system on Oak Creek to establish better records for annual yields.
4. Develop control system that will prevent water that is being pumped from the north raw water reservoirs to overflow the Rockvale raw water reservoirs.

### 2. Mineral Creek Diversion/ Newlin Creek Diversion

Begin negotiations with U.S. Forest Service on Special Permit Renewal. Begin land acquisition if diversion is to be moved from its current site on Forest Service property. Mineral Creek diversion expires in 1998 and the Mineral Creek diversion expires in 2014.

### 3. Adobe Creek Diversion

Formalize lease with the current land owner to assure continued use into the future.

### 4. Distribution System Design Criteria

Develop policy for future development to construct 12-inch lines every ½ mile and a grid of 8-inch lines every ¼ mile. Six-inch lines shall be the minimum line size for all developments.

### 5. Water Treatment Plants

1. Stay current on status of pending regulations and how they may impact plant operations.
2. Consider the use of blended polymers.
3. Develop Emergency Management Plan for Source of Supply contamination.

## B. Capital Improvements 1996-2000

The following improvements are a summary of the proposed System Improvement described in Chapter III. The projects are listed on a priority basis to allow the City to develop capital improvement budgets for the water system. The improvements are shown on Exhibit IV-1. The costs developed are for feasibility level planning only. The costs are based on 1996 dollars and should be adjusted for inflation when being considered for future budgets. As capital projects become budget items, the scope and cost of each project should be expanded and evaluated on a preliminary design basis since many issues will affect the final cost of each project. Changes in government policy and regulations may change the priority of the improvements, and any changes to the capital improvements listed herein should be amended as needed.

### 1. Improvement to the Raw Water Supply

#### a) Mineral Creek Diversion

Relocating the diversion to a site off of Forest Service land should be evaluated. The structure would need to be moved approximately 1,000 feet downstream to a new location. The estimated cost for this improvement is **$124,000.**

#### b) Adobe Creek Diversion

Modification to the inlet structure to eliminate wasting. The estimated cost is **$40,000.**

### 2. South Treatment Plant Clearwell

A new pump station should be added to the existing clearwell to provide direct feed to the prison system. A 12-inch line will need to be extended from the new pump to the connection at the 16-inch line. It may be possible to use a portion of the abandoned 12-inch line for this new connection. Controls and instrumentation would be needed to control the new pump from a level signal at the prison tank. The estimated costs for this improvement is **$120,000.**

### 3. South Field Raw Water Reservoirs

Construct a bypass line to directly feed the treatment plant from the influent box. This will provide the flexibility to treat water of highest source quality. The estimated cost for this improvement is **$20,000.**

## 4. Airport Storage Tank

The estimated cost for a new 250,000-gallon elevated tank is **$400,000.** Pump station improvements are estimated to be **$35,000**

## 5. Rockvale Water System

1. A pump station would be located on the existing 8-inch supply line.
2. A new 12-inch line would extend from the existing 10-inch line at South Street to the new tank.
3. A new 250,000-gallon tank or relocation of the water plant tank.
4. Emergency connection to the Williamsburg system.
5. The estimated cost for the Rockvale improvements is **$662,000.**

## 6. Water Treatment Plants

### a) Valves and Piping

Increase effluent piping from 8 inches to 12 inches at the north plant. The estimated cost for this improvements is **$65,000.**

### b) Chemical Feed Systems

Polymers should be used to the greatest extent possible due to the ease of handing and reduction in sludge. Consideration should be given to using polymer/alum blends. The cost of chemical feed modifications is **$5,000.**

## 7. Distribution System Improvements

Install altitude valve on line feeding the east 1.0 MG tank. The cost for this would be **$30,000.**

## 8. Los Pinos Subdivision

1. A booster pump system would need to be installed on the 6-inch supply line.
2. The tank would need to be located at elevation 5,600.
3. 1,500 feet of 8-inch pipe.
4. The estimated cost for the Los Pinos Improvements is **$168,000.**

## 9. Minnequa Canal Pump Station

1. Improve the existing diversion to prevent freezing problems and provide a sediment trap.
2. Install additional pumps to deliver water directly to the south field reservoirs.
3. Provide clearwell capacity to allow for future pumps to meet increased demand.
4. Provide for an emergency generator to power pumps in the event of a power outage.
5. The costs of these improvements are **$245,000.**

## 10. North Raw Water Reservoir Pump Station

If improvements are made to the Minnequa Canal pump station, piping improvements adjacent to the north raw water pump station will allow the Minnequa Canal pump station to bypass the north reservoirs and directly feed the south field system. The estimated cost for the piping improvements would be **$50,000.**

## 11. Williamsburg Improvements

Install an 8-inch line from Oak Creek Estates west to the existing line at the Boys' Ranch west of County Road 11A. The approximate length of this line is 4,800 feet and would have an estimated cost of **$144,000.**

## 12. West Pump Station

Add an emergency generator for approximately **$35,000.**

## 13. Water Treatment Plant

### a) Plant Capacity

It is estimated the plant capacity will be exceeded by the year 2000. Expansion should occur by adding additional 0.5 MGD treatment modules to the existing south plant. The estimated cost for the expansion is **$250,000.**

### b) South Plant Piping

The backwash piping should be modified to eliminate air-entraining problems. This should be accomplished along with the next plant expansion. The estimated cost of these improvements is **$15,000.**

The total costs for the projects would be **$2,408,000** based on 1996 dollars.

## C. Future Improvements

### 1. Future Storage Requirements

Add an additional 1.0 million-gallon reservoir at the south treatment plant. The estimated cost for this reservoir is **$850,000.**

### 2. May Ditch System

1. Improve the diversion structure for the W. H. May Ditch to include a diversion box and a measuring flume.
2. Construct a new pump station to deliver water to the existing Rockvale reservoirs. Additional daily storage reservoirs may be required to steady out inflows to the system.
3. Connect existing well collection system to new pump station.
4. Connect existing town field well to system.
5. The estimated costs for the improvements are **$275,000.**

### 3. Oak Creek Reservoir

Construct a dam to utilize the decreed storage. The estimated cost of the dam in 1996 dollars is approximately **$5,715,500.**

### 4. Newlin Creek Diversion

Relocating the diversion to a site off of Forest Service land should be evaluated. The structure would need to be moved approximately 1,000 feet downstream to a new location. The estimated cost for this improvement is **$124,000.**

# V. APPENDIX

## A. Bibliography

1. Environmental Assessment and Preliminary Engineering Report for South Field Water Treatment Plant and Appurtenances, GeoTrans, June 1988.

2. Municiapl Supply Engineering Study, McDermid Engineering, 1983.

3. Water System Report, Mayor Jack McFall, September 1963.

4. Feasiblity Study of Water System Improvements for the Towns os Coal Creek and Williamsburg, CE TEC, May 1977.

5. Addendum to the City of Florence, Newlin Creek Waterline Rehabilitaion, McDermid Engineering, April 1985.

6. Coal Creek Water System Report, unknown author and date.

7. Operation and Maintenance Manual for Adobe Creek - Mineral Creek pipeline, Boesch-Fisher Engineering, inc., February, 1989

## B. ISO Hydrant Flow Data

## C. Network Model Data & Maps

## D. Rockvale, Williamsburg, and Los Pinos Analysis

## E. Adobe/Mineral Creek Information

## F. Newlin Creek Information

## G. Water Rights Study - Martin and Wood Water Engineers

## H. Oak Creek Reservoir

# I. Soils Information for Oak Creek Reservoir

## J. Water Treatment Plant Information

## I. Water System Maps

**PENROSE** — SECURITY

DRAFT

# SOUTHEASTERN COLORADO WATER CONSERVANCY DISTRICT

## Arkansas River Basin Water Storage and Future Needs Assessment

WATER SYSTEM SURVEY (Compiled by BWR)

### 1. General Information

**Entity** PENROSE WATER DISTRICT

**Contact Name/District Manager** RON GASSER

**Address** PO BOX 297
PENROSE CO 81240

**Phone No.** (719) 372-3289

**Fax No.** (719) 372-9347

**Primary Use** [✓ Municipal] Agricultural Industrial Recreational Other

**Master Plan or other Water Resource Planning Documents?** Y [✓ N]

(If yes we must obtain it)
Prepared by: PREPARATION IN PROGRESS

**Geographic Location of Service Area** (obtain service area map)

### 2. Demographics/Water Use

*Historic Water Use*

| Year | Population | Water Use, af | $^3/_4$ -in Domestic Taps (optional) |
|---|---|---|---|
| 1987 | | 406 | |
| 1988 | | 411 | |
| 1989 | | 403 | |
| 1990 | | 403 | |
| 1991 | | 386 | |
| 1992 | | 385 | |
| 1993 | | 431 | |
| 1994 | | 469 | |
| 1995 | | 464 | |
| 1996 | | 488 | ~ 1433 |

*Projected Water Use*

| Year | Population | Water Use, af | $^3/_4$ -in Domestic Taps (optional) |
|---|---|---|---|
| 2000 | | | |
| 2010 | | | |
| 2020 | | | |
| 2040 | | | |

**Major industrial or other uses other than domestic**

# SOUTHEASTERN COLORADO WATER CONSERVANCY DISTRICT

## Arkansas River Basin Water Storage and Future Needs Assessment

WATER SYSTEM SURVEY (Compiled by BWR)

| 3. Estimated Monthly Water Use | |
|---|---|
| | as a percent of total annual use,% |
| JAN | |
| FEB | |
| MAR | |
| APR | |
| MAY | |
| JUN | |
| JUL | |
| AUG | |
| SEP | |
| OCT | |
| NOV | |
| DEC | |
| **TOTAL** | **100%** |

Notes: DUAL SYSTEM

DRAFT

# SOUTHEASTERN COLORADO WATER CONSERVANCY DISTRICT

## Arkansas River Basin Water Storage and Future Needs Assessment

WATER SYSTEM SURVEY (Compiled by BWR)

## 4. Sources of Water

*Surface Water*

**Sources** LEASED SURFACE WATER
"LEASE MORE THAN USE" PRIVATE IRR. CO.

**Point of Diversion** (for larger municipalities attach map, if available)

Location BEAVER PARK WATER INC. (1976)
BRUSH HOLLOW - "VERY LARGE RESERVOIR"

Capacity

*Ground Water*

**Sources**

Tributary

Nontributary

Number of Wells

**Combined Annual Flow Rate** (from decrees or based on conveyance capacity)

(May only be available as an annual total)

| | gpm | cfs | af |
|---|---|---|---|
| JAN | | | |
| FEB | | | |
| MAR | | | |
| APR | | | |
| MAY | | | |
| JUN | | | |
| JUL | | | |
| AUG | | | |
| SEP | | | |
| OCT | | | |
| NOV | | | |
| DEC | | | |
| **TOTAL ANNUAL** | | | |

# SOUTHEASTERN COLORADO WATER CONSERVANCY DISTRICT

## Arkansas River Basin Water Storage and Future Needs Assessment

WATER SYSTEM SURVEY (Compiled by BWR)

### 5. Firm Yield

**District Managers may not have this information, attorneys and/ or consulting engineers may need to be contacted**

| **Monthly Average Firm Yield for 1966-1995** | **af** |
|---|---|
| JAN | |
| FEB | |
| MAR | |
| APR | |
| MAY | |
| JUN | |
| JUL | |
| AUG | |
| SEP | |
| OCT | |
| NOV | |
| DEC | |
| TOTAL ANNUAL 100 AF BY CONTRACT | |

Firm yield can estimated from:

- Response of water rights during critical dry year
- Potential volume limitation per decree or well permit
- Ability to augment out of priority depletions

Consulting Engineer or Attorney

### 6. Future Water Planning

Estimated future yield of existing water rights ____________af/yr

Conditional Water Rights

Direct flow/wells PURCHASE OF DIRECT FLOW RIGHTS

Storage

# SOUTHEASTERN COLORADO WATER CONSERVANCY DISTRICT

## Arkansas River Basin Water Storage and Future Needs Assessment

WATER SYSTEM SURVEY (Compiled by BWR)

### 7. Raw Water Storage

Total Vol. in af

Type:

Fry-Ark

If and When

Shared

Owned 5-6 MG at TREATMENT PLANT (15-18 AF)

### 8. Raw Water Conveyance

Type:

Pipeline

Canal

Estimated Raw Water Conveyance Losses

### 9. Treatment Plant Capacity

Type

Capacity

Also:

1. Attach copies of relevant tables and text from master plans, or water resource planning documents.
2. Compare data found in reports to data obtained from contacting entity via telephone or previous survey.

Notes:

# Φ GEI Consultants, Inc.

# FAX

5660 Greenwood Plaza Blvd., Suite 202
Englewood, CO 80111-2418

Tel. (303) 779-5565
Fax (303) 779-5653

DATE 8/8/97

PROPOSAL/ PROJECT NO. 97411

Task Code 1010

NO. OF PAGES 6 (including this page)

TO: RON GASSER PENROSE WATER DISTRICT

FAX NO. (719) 372-9347

FROM: BRAD RASTALL

MESSAGE: ATTACHED IS THE SURVEY YOU COMPLETED FOR SECWCD. THANKS FOR THE INFORMATION YOU PROVIDED WHEN WE SPOKE THIS MORNING. COULD YOU PLEASE SEND POPULATION PROJECTIONS FOR 2000, 2010, 2020 AND 2040; HISTORIC POPULATION FOR '87-'97; AND YOUR HISTORICAL ESTIMATE OF PER CAPITA WATER DEMAND IN gpcd.

**PLEASE LET US KNOW IF THE TRANSMISSION IS UNSATISFACTORY**
**** THANK YOU ****

---

SERVICES

**Geotechnical Engineering**
- Site Evaluation
- Foundation Design
- Construction

**Forensic Engineering**
- Failure Investigation
- Litigation Support
- Construction Claim Analysis
- Expert Testimony

**Environmental Engineering**
- Process Engineering
- Site Evaluation
- Remediation
- Litigation Support

**Geohydrology & Hydrology**
- Water Supply Development and Protection
- Contaminated Ground Water Remediation
- Construction Dewatering
- Flood Routing Studies

**Dam Engineering**
- Site Studies
- Dam Design
- Inspection

**Air Quality**
- Operating Permits
- Emission Inventories
- Control Technology Engineering
- Measurements and Modeling

MISC\FORMS\FAXCVR.6-1

10/11/96

RE-SENT
NO REPLY

RECEIVED
SEP 1996
Southeastern Colorado Water
Conservancy District

# Survey of Water Users
# in the
# Southeastern Colorado Water Conservancy District

Please take a few minutes to fill out this important survey. It will assist the Southeastern Colorado Water Conservancy District in assessing the future demand for Fryingpan-Arkansas Project water and storage space. If you have questions or comments regarding this survey, you can call Steve Arveschoug (719-544-2040). **Please complete and return the survey to the District in the enclosed envelope before Monday, September 23, 1996.** Your cooperation is appreciated.

Name of Organization PENROSE WATER DISTRICT
Contact Person RON GASSER Phone (714)372-3289

User Group—Municipal____ Agricultural____ Industrial_____
Recreation____ Other DOMESTIC

What is your primary source of supply? (surface water rights, ground water rights, or leased water, please describe)

LEASED SURFACE WATER

Do you have a raw-water storage system? Yes_____ No X
(Please describe your existing water storage system, rights.)

APP. 5-6 MILLION GALLONS AT TREATMENT PLANT FOR DETENTION & SETTLING PURPOSES

Do you currently request Fryingpan-Arkansas Project Water? (If yes, please describe your existing use, amount and purpose, of Project Water)

NO

Have you used Fry-Ark Project IF-and-When storage space for the storage of your own water rights? Yes______ No X

## Project Storage Space Use Trends

List your current and historic use of Project storage space for your own (non-Project) water. (acre-feet)

| | Amt. of Stored Water (af) | Facility(s) |
|---|---|---|
| Current Yr | N/A | |
| 1995 | | |
| 1994 | | |
| 1993 | | |
| 1992 | | |
| 1991 | | |
| 1990 | | |
| 1985 | | |
| 1980 | | |

## Water Use Trends

List your historic use of water for municipal or agricultural use, and your historic use of Project water (acre-feet).

| | Population | Irr. Acreage | Water Use | Proj. Water Use |
|---|---|---|---|---|
| Current Yr. | | | | |
| 1995 | | | | |
| 1994 | | | | |
| 1993 | | | | |
| 1992 | | | | |
| 1991 | | | | |
| 1990 | | | | |
| 1985 | | | | |
| 1980 | | | | |

## Municipal Population and Irr. Acreage Water/Storage Demand Projections

List your projected use of water and Project water (acre-feet).

| Year | Population | Irr. acreage | Water Use | Storage Use | Proj. Water Use |
|---|---|---|---|---|---|
| Current | | | | | |
| 2000 | | | | | |
| 2010 | | | | | |
| 2020 | | | | | |

Please describe your projected future demand for Fry-Ark Project Water and Storage (include copies of any reports or studies which provide the basis for your projections).

## Water Resource Planning Efforts

Do you currently have a water resource plan to meet future water/storage demands? Yes X & No X If yes, do your plans include the construction of raw-water storage facilities? Yes No POSSIBLY

Please describe your current water resource planning efforts and any construction plans.

DISTRICT IS IN PROCESS OF ACQUIRING RIGHTS ON ARK. RIVER. NEEDS AFTER PURCHASE ARE YET TO BE DEFINED. ENGINEER'S STUDY IS IN PROGRESS. STORAGE NEEDS AND USE OF PROJECT WATER IS PART OF STUDY

Would you be willing to participate in a cooperative effort to assess the future demands for water and storage in the Arkansas River Basin and the future need for Fry-Ark Project Water and storage.

Yes No Need more information X

Comments

**Arkansas Valley Pipeline**

Are you aware of the Fry-Ark Project's originally proposed Arkansas Valley Pipeline? Yes_____ No__X__ If yes, would you have an interest in taking another look at the cost/benefits of such a treated-water delivery system?

Comments ______________________________________________

**Any additional comments?**

Thank you for your help!

RECEIVED
SEP 1996
Southeastern Colorado Water Conservancy District

# Survey of Water Users in the Southeastern Colorado Water Conservancy District

Please take a few minutes to fill out this important survey. It will assist the Southeastern Colorado Water Conservancy District in assessing the future demand for Fryingpan-Arkansas Project water and storage space. If you have questions or comments regarding this survey, you can call Steve Arveschoug (719-544-2040). **Please complete and return the survey to the District in the enclosed envelope before Monday, September 23, 1996.** Your cooperation is appreciated.

---

Name of Organization PENROSE WATER DISTRICT
Contact Person RON GASSER Phone (719)372-3289

User Group—Municipal____ Agricultural____ Industrial____
Recreation____ Other DOMESTIC

What is your primary source of supply? (surface water rights, ground water rights, or leased water, please describe)

LEASED SURFACE WATER

Do you have a raw-water storage system? Yes____ No X
(Please describe your existing water storage system, rights.)

APP. 5-6 MILLION GALLONS AT TREATMENT PLANT FOR DETENTION & SETTLING PURPOSES

Do you currently request Fryingpan-Arkansas Project Water? (If yes, please describe your existing use, amount and purpose, of Project Water)

NO

Have you used Fry-Ark Project IF-and-When storage space for the storage of your own water rights? Yes____ No X

## Municipal Population and Irr. Acreage Water/Storage Demand Projections

List your projected use of water and Project water (acre-feet).

| Year | Population | Irr. acreage | Water Use | Storage Use | Proj. Water Use |
|---|---|---|---|---|---|
| Current | | | | | |
| 2000 | | | | | |
| 2010 | | | | | |
| 2020 | | | | | |

Please describe your projected future demand for Fry-Ark Project Water and Storage (include copies of any reports or studies which provide the basis for your projections).

____________________

____________________

____________________

____________________

## Water Resource Planning Efforts

Do you currently have a water resource plan to meet future water/storage demands? Yes X & No X If yes, do your plans include the construction of raw-water storage facilities? Yes______ No POSSIBLY

Please describe your current water resource planning efforts and any construction plans.

DISTRICT IS IN PROCESS OF ACQUIRING RIGHTS ON ARK. RIVER. NEEDS AFTER PURCHASE ARE YET TO BE DEFINED. ENGINEER'S STUDY IS IN PROGRESS. STORAGE NEEDS AND USE OF PROJECT WATER IS PART OF STUDY

Would you be willing to participate in a cooperative effort to assess the future demands for water and storage in the Arkansas River Basin and the future need for Fry-Ark Project Water and storage.

Yes______ No__________ Need more information X

Comments____________________

____________________

____________________

# COLORADO SPRINGS UTILITIES

WATER RESOURCES DEPARTMENT
Resources & Planning

COLORADO SPRINGS UTILITIES

RECEIVED
SEP 26 1996
Southeastern Colorado Water
Conservancy District

September 24, 1996

Mr. Steve Arveschoug
General Manager
Southeastern Colorado Water Conservancy District
P.O. BOX 440
Pueblo, Colorado 81002

Dear Steve:

Enclosed is the Survey of Water Use in the Southeastern Colorado Water Conservancy District which we received from your office. We have completed the survey as completely as possible, however, if you or any of your staff have questions please contact myself or Philip Saletta at (719) 448-8700.

We appreciate the effort being put forth to determine the needs of all of the Southeastern Districts water users.

Sincerely,

James C. McGrady

James C. McGrady
Senior Analyst

cmf

Enclosure

c: Philip Saletta

30 S. Nevada Ave., Suite 703 • TEL 719-448-8700 FAX 719-448-8735
Mailing Address: Post Office Box 1103, Mail Code 730 • Colorado Springs, Colorado 80947-0730

## Survey of Water Use
## in the
## Southeastern Colorado Water Conservancy District

Please take a few minutes to fill out this important survey. It will assist the Southeastern Colorado Water Conservancy District in assessing the future demand for Fryingpan-Arkansas Project water and storage space. If you have questions or comments regarding this survey, you can call Steve Arveschoug (719-544-2040). **Please complete and return the survey to the District in the enclosed envelope before Monday, September 23, 1996.** Your cooperation is appreciated.

---

Name of Organization: **Colorado Springs Utilities Water Resources Department**
Contact Person: **Philip L. Saletta** Phone **(719) 448-8713**
User Group - Municipal___X Agricultural___ Industrial____
Recreation_______ Other_______

What is your primary source of supply? (surface water rights, ground water rights, or leased water, please describe)

**Surface and groundwater rights; local Pikes Peak watershed , Pinello and Hanna Ranch wells, Blue River Project, Homestake Project, Twin Lakes Reservoir and Canal Company, Fryingpan-Arkansas Project, Colorado Canal Exchange Program, Denver Basin Groundwater. (Please see attached Table 1 and map of Colorado Springs Water Supply.)**

Do you have a raw-water storage system? Yes____X____ No ________ (Please describe your existing water storage system, rights.)

**(Please see attached Table 2 of Raw Water Storage Systems.)**

Do you currently request Fryingpan-Arkansas Project Water? (If yes, please describe your existing use, amount and purpose, of Project Water)

**Our current use of Fryingpan-Arkansas Project Water is for municipal uses. On an annual bases, we purchase between 4,000 and 6,000 (af).**

Have you used Fry-Ark Project IF-and-When storage space for the storage of your own water rights?
Yes___X___ No_____

**Project Storage Space Use Trends**

List your current and historic use of Project storage space for your own (non-Project) water. (acre-feet)

| | Amt of Stored Water (af)* | Facility(s) | Contract Amount (af) |
|---|---|---|---|
| Current Year | **11,915** | **Pueblo "If & When"** | **10,000** |
| 1995 | **28,292** | " | **10,000** |
| 1994 | **25,683** | " | **10,000** |
| 1993 | **27,763** | " | **10,158** |
| 1992 | **21,597** | " | **6,000** |
| 1991 | **16,794** | " | **6,000** |
| 1990 | **13,592** | " | **2,500** |
| 1985 | **0** | " | **0** |
| 1980 | **0** | " | **0** |

* For more detail see attached Table 3 entitled "Total Monthly Inflows"

**Water Use Trends**

List your historic use of water for municipal or agricultural use, and your historic use of Project water (acre-feet).

| | Population | Colorado Springs Fry-Ark Project Allocation | Historic Water Use |
|---|---|---|---|
| Current Year | **341,810** | **3,500** | |
| 1995 | **335,413** | **6,000** | **68,588** |
| 1994 | **324,558** | **5,000** | **73,372** |
| 1993 | **313,704** | **4,000** | **70,757** |
| 1992 | **302,849** | **2,554** | **68,211** |
| 1991 | **291,995** | **3,250** | **65,167** |
| 1990 | **281,140** | **4,915** | **65,395** |
| 1985 | **262,889** | **Not available** | **65,577** |
| 1980 | **215,105** | **Not available** | **56,144** |

## Municipal Population and Irr. Acreage Water/Storage Demand Projections

List your projected use of water and Project water (acre-feet).

| Year | Population | Project Water Use | Storage Use (Additional) | Total Projected Water Use |
|---|---|---|---|---|
| Current | 341,810 | 1,200 | N/A | 80,374 |
| 2000 | 370,574 | 1,200 | 19,000 | 85,085 |
| 2010 | 471,106 | 14,353 | 42,000 | 102,149 |
| 2020 | 616,273 | 14,353 | 88,000 | 125,795 |

Please describe your projected future demand for Fry-Ark Project Water and Storage (include copies of any reports or studies which provide the basis for your projections).

Future Fryingpan-Arkansas demand is 14,353 af/year. Future Fry-Ark storage is 19,000 af in year 2000 and 42,000 af in year 2010. Additional storage would also be required before 2020. This would be storage in Williams Creek Reservoir of 18,000 af and terminal storage in Jimmy Camp Creek Reservoir of 28,000 af.

### Water Resource Planning Efforts

Do you currently have a water resource plan to meet future water/storage demands? Yes X No

If yes, do your plans include the construction of raw-water storage facilities? Yes X No

Please describe your current water resource planning efforts and any construction plans.

Colorado Springs Utilities Water Resources Department has a Water Resource Plan to meet demands through 2040. There is an ongoing public process and a Water Resource Plan Document has been published. Attached is a map of our proposed major delivery system from Pueblo Reservoir.

Would you be willing to participate in a cooperative effort to assess the future demands for water and storage in the Arkansas River Basin and the future need for Fry-Ark Project Water and storage.

Yes __X__ No________ Need more information________

Comments Colorado Springs Utilities Water Resources Department is available to assist in this cooperative effort.

**Arkansas Valley Pipeline**

Are you aware of the Fry-Ark Project's originally proposed Arkansas Valley Pipeline? Yes __X__ No______ If yes, would you have an interest in taking another look at the cost (benefits of such a treated-water delivery system?

Comments Yes, this needs to be looked at again for communities in the lower Arkansas Valley that are within the District.

**Any additional comments**

We look forward to working with the Southeastern Colorado Water Conservancy District and the other water users to determine the storage needs and availability in the Arkansas River VAlley.

***Thank you for your help!***

DRAFT

# SOUTHEASTERN COLORADO WATER CONSERVANCY DISTRICT

## Arkansas River Basin Water Storage and Future Needs Assessment

WATER SYSTEM SURVEY (Compiled by BWR)

### 1. General Information

**Entity** COLORADO SPRINGS UTILITIES

**Contact Name/District Manager** JAMES C. McGRADY

**Address** P O BOX 1103 CODE 730
COLORADO SPRINGS, CO 80947-0730

**Phone No.** (719) 448-8700

**Fax No.** (719) 448-8735

**Primary Use** [✓ Municipal] Agricultural Industrial Recreational Other

**Master Plan or other Water Resource Planning Documents?** [✓ Y] N

(If yes we must obtain it)

**Prepared by:** BLACK AND VEACH

**Geographic Location of Service Area** (obtain service area map)

### 2. Demographics/Water Use

*Historic Water Use*

| Year | Population | Water Use, af | ¾-in Domestic Taps (optional) |
|---|---|---|---|
| 1987 | | | |
| 1988 | | | |
| 1989 | | | |
| 1990 | 281,140 | 65,395 | |
| 1991 | 291 995 | 65,167 | |
| 1992 | 302,849 | 68,211 | |
| 1993 | 313,704 | 70,757 | |
| 1994 | 324,558 | 73,372 | |
| 1995 | 335,413 | 68,588 | |
| 1996 | 341,810 | | |

*Projected Water Use*

| Year | Population | Water Use, af | ¾-in Domestic Taps (optional) |
|---|---|---|---|
| 2000 | 372,100 | 84,100 | |
| 2010 | 473,200 | 101,300 | |
| 2020 | 618,800 | 124,500 | |
| 2040 | 918,700 | 181,700 | |

**Major industrial or other uses other than domestic**

# SOUTHEASTERN COLORADO WATER CONSERVANCY DISTRICT

## Arkansas River Basin Water Storage and Future Needs Assessment

WATER SYSTEM SURVEY (Compiled by BWR)

### 3. Estimated Monthly Water Use

| | as a percent of total annual use,% |
|---|---|
| JAN | 5.2 |
| FEB | 5.3 |
| MAR | 5.5 |
| APR | 7.9 |
| MAY | 9.0 |
| JUN | 12.7 |
| JUL | 14.1 |
| AUG | 11.1 |
| SEP | 10.6 |
| OCT | 7.5 |
| NOV | 5.7 |
| DEC | 5.3 |
| **TOTAL** | **100%** |

Notes:

DRAFT

# SOUTHEASTERN COLORADO WATER CONSERVANCY DISTRICT

## Arkansas River Basin Water Storage and Future Needs Assessment

WATER SYSTEM SURVEY (Compiled by BWR)

### 4. Sources of Water

*Surface Water*

**Sources**

SEE SECOND SURVEY

**Point of Diversion** (for larger municipalities attach map, if available)

Location

ATTACHED

Capacity

*Ground Water*

**Sources**

Tributary

ATTACHED

Nontributary

Number of Wells

**Combined Annual Flow Rate** (from decrees or based on conveyance capacity)

(May only be available as an annual total)

| | gpm | cfs | af |
|---|---|---|---|
| JAN | | | |
| FEB | | | |
| MAR | | | |
| APR | | | |
| MAY | | | |
| JUN | | | |
| JUL | | | |
| AUG | | | |
| SEP | | | |
| OCT | | | |
| NOV | | | |
| DEC | | | |
| **TOTAL ANNUAL** | | | 100,900 |

# SOUTHEASTERN COLORADO WATER CONSERVANCY DISTRICT

## Arkansas River Basin Water Storage and Future Needs Assessment

WATER SYSTEM SURVEY (Compiled by BWR)

### 5. Firm Yield

**District Managers may not have this information, attorneys and/ or consulting engineers may need to be contacted**

| | |
|---|---|
| **Monthly Average Firm Yield for 1966-1995** | **af** |
| JAN | |
| FEB | |
| MAR | |
| APR | |
| MAY | |
| JUN | |
| JUL | |
| AUG | |
| SEP | |
| OCT | |
| NOV | |
| DEC | |
| TOTAL ANNUAL | |

Firm yield can estimated from:
- Response of water rights during critical dry year
- Potential volume limitation per decree or well permit
- Ability to augment out of priority depletions

Consulting Engineer or Attorney

### 6. Future Water Planning

Estimated future yield of existing water rights 195,100 af/yr

Conditional Water Rights

Direct flow/wells

Storage

57,100 AF/YR

# SOUTHEASTERN COLORADO WATER CONSERVANCY DISTRICT
## Arkansas River Basin Water Storage and Future Needs Assessment

WATER SYSTEM SURVEY (Compiled by BWR)

### 7. Raw Water Storage

| | |
|---|---|
| Total Vol. in af | 230,212 |
| Type: | |
| Fry-Ark | 57,090 AF |
| If and When | |
| Shared | 113,135 AF |
| Owned | 59,942 AF |

### 8. Raw Water Conveyance

| | |
|---|---|
| Type: | |
| Pipeline | SEE ATTATCHED TABLE 5 |
| Canal | |
| Estimated Raw Water Conveyance Losses | |

### 9. Treatment Plant Capacity

| | |
|---|---|
| Type | |
| Capacity | |

Also:

1. Attach copies of relevant tables and text from master plans, or water resource planning documents.
2. Compare data found in reports to data obtained from contacting entity via telephone or previous survey.

Notes:

# III. POPULATION AND WATER USE

## A. Population

CSU does not have a policy to encourage or discourage growth within the service area. Rather, the Department's mission is to provide safe, reliable water service to consumers in response to the complex dynamics of economic and population growth.

Demographic and economic projections through year 2040 for the Colorado Springs area were prepared by CSU's Electric Department. The Electric Department based the forecasts on information provided by the Demographic Research Institute up to the year 2019 and the U.S. Bureau of Economic Analysis after the year 2019. Forecasts have been adopted by the Pikes Peak Area Council of Governments for regional planning purposes.

The city's projected population growth will be significantly affected by job growth and economic development. The extent of growth and development is not known, so CSU generated forecasts for two different scenarios. The base trend has a 50 percent chance of being exceeded. The high trend has a 10 to 15 percent chance of being exceeded. The population projections within the study area for the two scenarios are summarized in Table 1.

Table 1
Projected Population, 2000 to 2040

| Year | Base Trend | Base Trend 10 Year Annual Growth Rate | High Trend | High Trend 10 Year Annual Growth Rate |
|---|---|---|---|---|
| 2000 | 357,000 | | 372,100 | |
| 2010 | 417,700 | 1.57% | 473,200 | 2.4% |
| 2020 | 483,100 | 1.45% | 618,800 | 2.68% |
| 2030 | 553,400 | 1.36% | 759,400 | 2.05% |
| 2040 | 622,300 | 1.17% | 918,700 | 1.90% |

non-potable water usage by year 2040 will be approximately 5.1 mgd. Figure 1 illustrates the city's total projected water use.

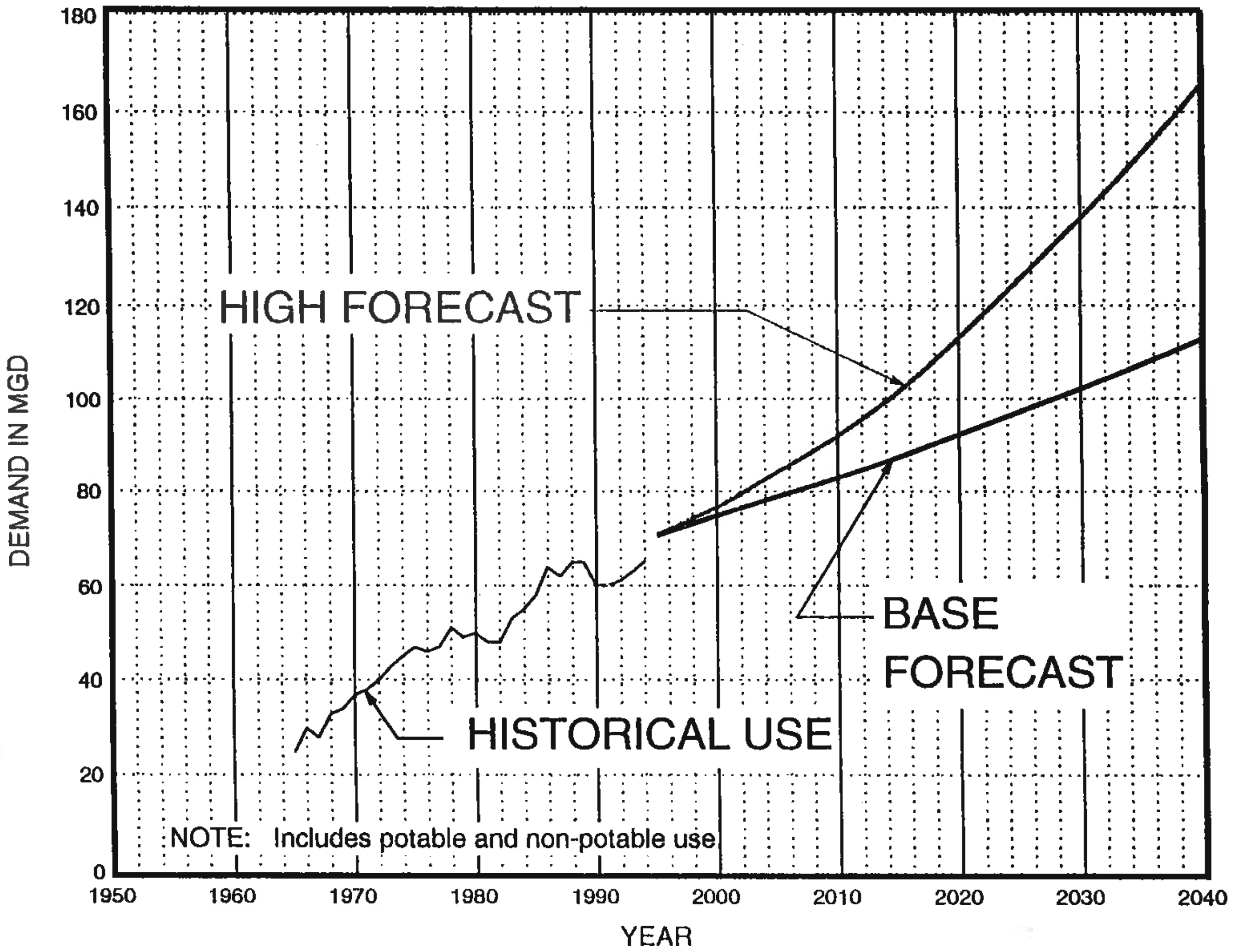
Table 2
Projected Potable Water Demands*

| Year | Average Annual Day w/ Drake (mgd) | Average Annual Day w/ Drake (ac-ft) | Peak Day (mgd) |
|---|---|---|---|
| 1995 | 70.6 | 79,100 | 164.5 |
| 1996 | 71.6 | 80,200 | 166.8 |
| 1997 | 72.3 | 81,000 | 168.5 |
| 1998 | 73.1 | 81,900 | 170.3 |
| 2000 | 75.1 | 84,100 | 175.0 |
| 2010 | 90.4 | 101,300 | 210.6 |
| 2020 | 111.2 | 124,500 | 259.1 |
| 2030 | 133.3 | 149,300 | 310.6 |
| 2040 | 159.6 | 178,800 | 371.9 |
| 2042 | 162.2 | 181,700 | 378.0 |

*Projected water demands for high trend scenario and with Martin Drake plant using a potable source. All figures have been rounded.

## C. Water Conservation

Colorado Springs has been "conservation-minded" for many years. For instance, in the 1940's, recognizing the inherent value of water as a resource, CSU completed a metering program for all water use. This practice was not widespread in the U.S. at that time. In the years since, metering has significantly contributed to controlled water consumption. CSU has also implemented a pilot "seasonal" rate structure for

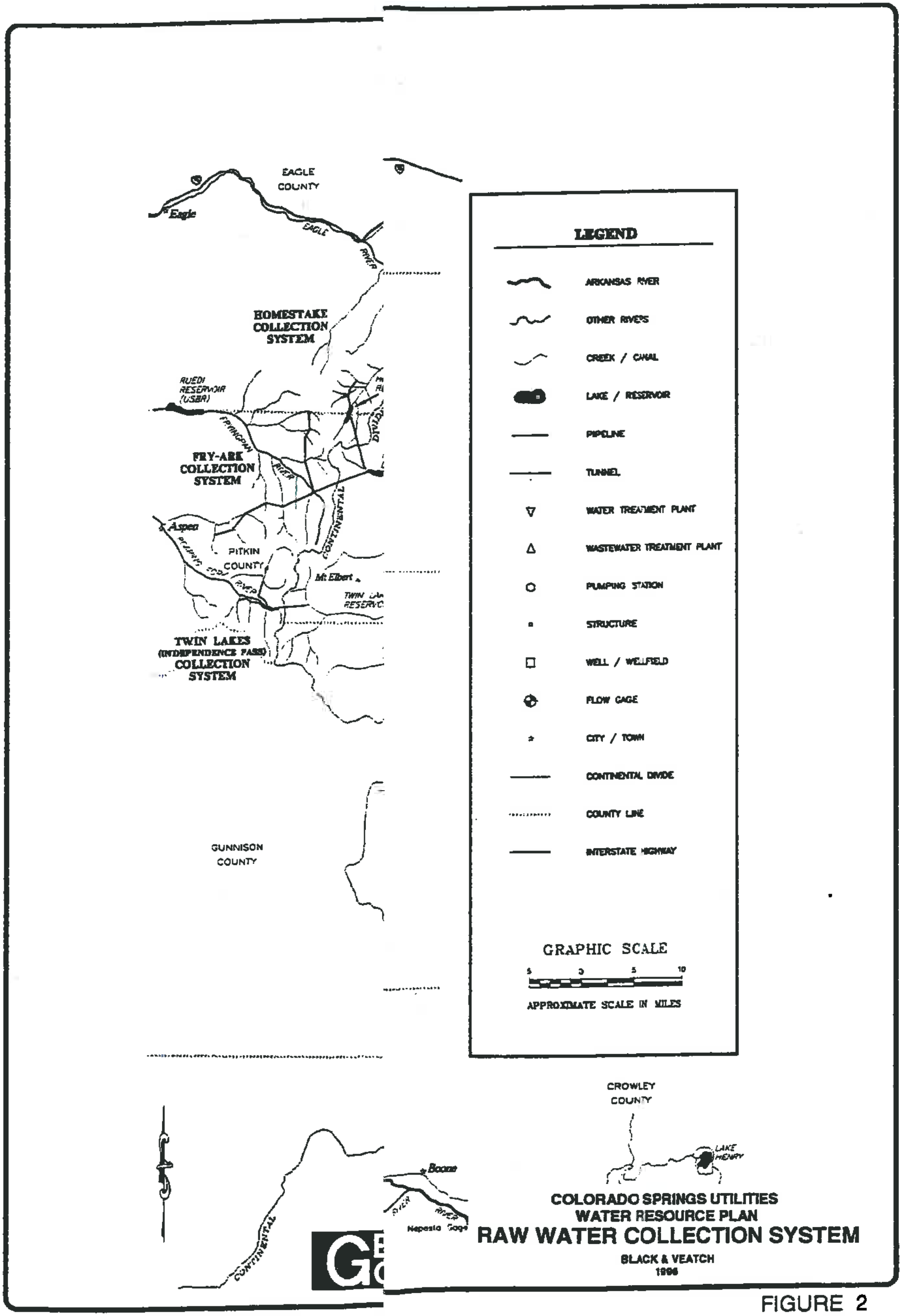


COLORADO SPRINGS UTILITIES
WATER RESOURCE PLAN

**TOTAL WATER USE PROJECTION**

BLACK & VEATCH
1996

FIGURE 1



COLORADO SPRINGS UTILITIES
WATER RESOURCE PLAN
RAW WATER COLLECTION SYSTEM
BLACK & VEATCH
1996

FIGURE 2

## TABLE 3.
## COLORADO SPRINGS UTILITIES ESTIMATED ANNUAL YIELDS

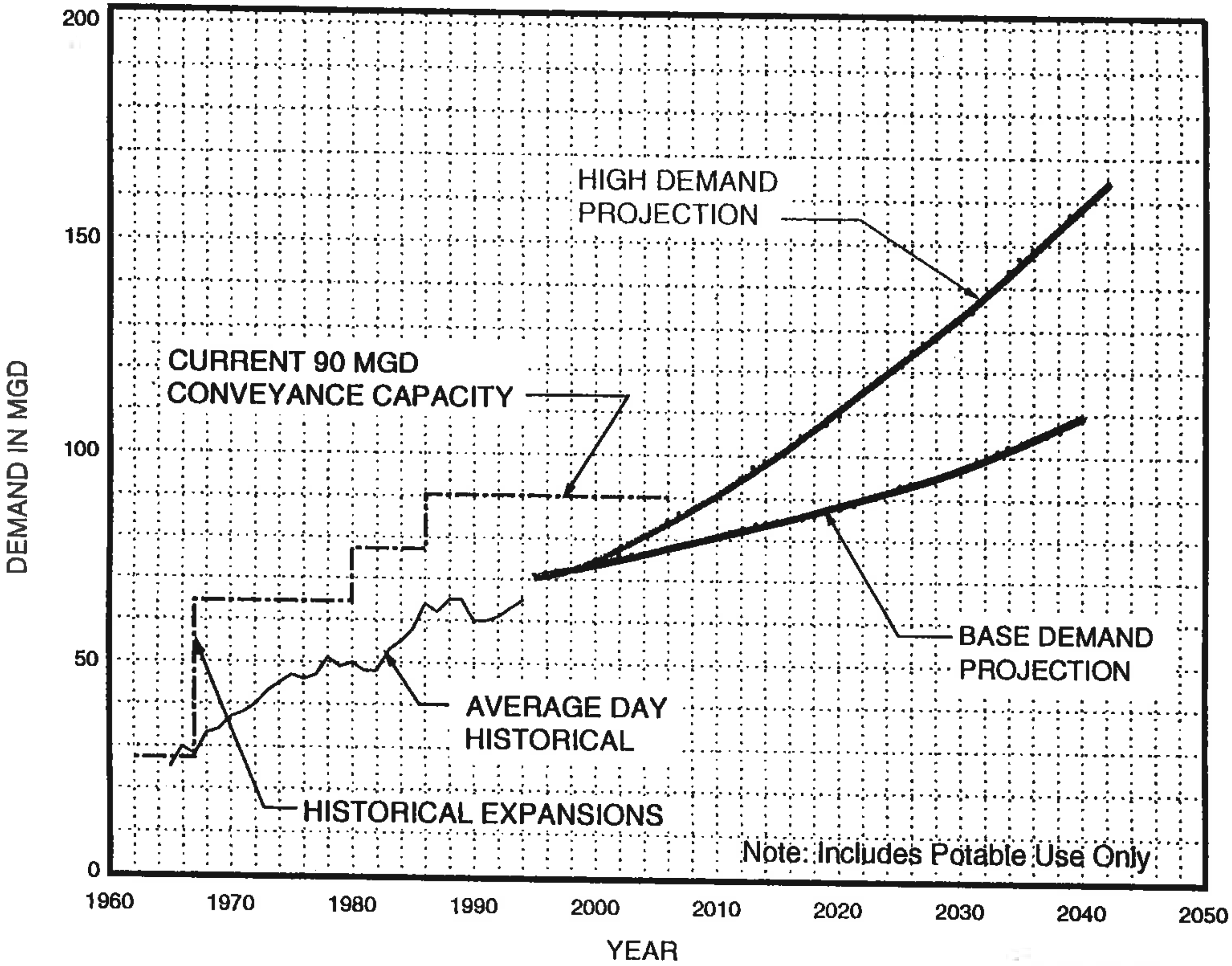
### DEVELOPED POTABLE SUPPLIES

| Reusable Systems/Supplies | Avg Annual Yield (ac-ft) | Firm Yield (ac-ft) |
|---|---|---|
| Blue River (Blue River & Platte River Basins) | 13,100 | 10,200 |
| Homestake I (Eagle River Basin) | 14,600 | 13,800 |
| Twin Lakes (Roaring Fork River Basin) | 30,500 | 28,700 |
| Fry-Ark (Fryingpan River Basin) | 12,400 | 11,300 |
| Colorado Canal (Arkansas River Basin) | 14,800 | 13,700 |
| CF&I (Arkansas River Basin) | 800 | 100 |
| Wastewater Return Flows | 22,000 | 18,400 |
| Irrigation Return Flows | 2,800 | 2,800 |
| Total Reusable Supplies | 111,000 (99.1 mgd) | 99,000 (88.4 mgd) |
| Native Systems/Supplies | | |
| Twin Lakes (Arkansas River Basin) | 6,700 | 6,300 |
| Fry-Ark (Arkansas River Basin) | 3,100 | 2,900 |
| 33rd Street | 6,900 | 6,300 |
| Northfield | 900 | 700 |
| North Slope | 4,500 | 3,100 |
| Ruxton Creek | 3,700 | 3,600 |
| South Slope | 2,400 | 1,800 |
| South Suburban | 4,300 | 3,200 |
| Total Native Potable Supplies | 32,500 | 27,900 |
| Total Potable Supplies | 143,500 (128.1 mgd) | 126,900 (113.3 mgd) |
| **DEVELOPED NON-POTABLE SUPPLIES** | | |
| Pikeview | 500 | 500 |
| Rosemont | 600 | 600 |
| Total Native Non-Potable Supplies | 1,100 | 1,100 |
| Total Developed Supplies | 144,600 (129.1 mgd) | 128,000 (114.3 mgd) |
| **UNDEVELOPED SUPPLIES** | | |
| Reusable Systems/Supplies | | |
| Bear Creek | 1,100 | 1,000 |
| Pikeview | 3,300 | 2,600 |
| Rosemont | 1,700 | 500 |
| Homestake II | 10,100 | 8,500 |
| Homestake, Eagle-Ark | 1,600 | 400 |
| Wastewater Return Flows (2040 population) | 43,300 | 38,900 |
| Irrigation Return Flows (2040 population) | 9,200 | 9,200 |
| Groundwater | 6,000 | 6,000 |
| Total Undeveloped Supplies | 76,300 | 67,100 |
| Total Water Supplies | 220,900 (197.2 mgd) | 195,100 (174.2 mgd) |

## TABLE 4.
## COLORADO SPRINGS UTILITIES DEVELOPED STORAGE

| Collection System | Reservoir | Colorado Springs Active (1) Storage Space (ac-ft) |
|---|---|---|
| Blue River Collection System | | |
| | Upper Blue | 2,119 |
| | Montgomery | 4,668 |
| Homestake Collection System | | |
| | Homestake | 16,207 |
| Twin Lakes Collection System | | |
| | Grizzly | 600 |
| Upper Arkansas River Basin | | |
| | Turquoise | |
| | Homestake | 15,000 |
| | CF&I | 17,416 |
| | Twin Lakes | 29,756 |
| Fry-Ark Space | | |
| | Pueblo (Fry-Ark) | 57,090 |
| Colorado Canal | | |
| | Lake Meredith | 20,660 |
| | Lake Henry | 6,709 |
| Local Collection System | | |
| | Rampart | 37,872 |
| | Nichols | 586 |
| | Northfield | 276 |
| | N. Catamount | 9,318 |
| | S. Catamount | 2,102 |
| | Crystal | 1,611 |
| | Pikeview | 90 |
| | Gold Camp | 368 |
| | S. Suburban | 233 |
| | Wilson | 669 |
| | Big Horn | 190 |
| | Boehmer | 340 |
| | Mason | 1,664 |
| | McReynolds | 1,750 |
| | Lake Moraine | 1,123 |
| | Big Tooth | 153 |
| | Rosemont | 2,000 |
| TOTAL DEVELOPED STORAGE | | 230,217 |

1) The active space shown in this table is storage volumes which are normally available for water regulation. Reservoirs may have additional space which is not routinely used due to operational, recreational, fish, wildlife and other considerations.



COLORADO SPRINGS UTILITIES
WATER RESOURCE PLAN

**PROJECTED WATER DEMAND AND CONVEYANCE CAPACITY**

BLACK & VEATCH
1996

FIGURE 3

Previous estimates of required conveyance capacity, which were calculated based on then-available water demand projections, have ranged from 65,000 ac-ft per year in a 1989 study to 30,000 ac-ft per year in a 1994 study. The variance in these projections demonstrates the sensitivity of long-term water supply planning to all of the factors associated with demand projections. It is recognized that demand elasticities associated with the cost of water, varying degrees of water conservation program effectiveness, different growth rates, lifestyle changes and other factors may change the shape of the projected water demand curve thereby affecting the timing, sizing and definition of alternatives. Due to the large deficit in existing conveyance capacity compared to future "high" demand projections, it is clear that a major new delivery system will be required. The final size of the delivery system will be decided as additional information regarding population growth/water use in the service area becomes available and improvements to the existing system are implemented.

In general, CSU should plan for the storage, pumping and pipeline facilities to be in place five years before the facilities are planned to be in operation. This will allow for unanticipated delays in permitting, design and construction. To have completed substantial improvements to the existing system by the year 2005, CSU should begin planning immediately. As previously stated, permitting, design, land acquisition and construction is a lengthy process.

Table 5
Expected Firm Yields of the Existing Raw Water Conveyance Systems

| Conveyance Facilities | Firm Capacity (mgd) | ac-ft/yr |
|---|---|---|
| Local Systems | 17 | 19,000 |
| Blue River Pipeline | 9.1 | 10,200 |
| Fountain Valley Conduit | 12.9 | 14,500 |
| Homestake Pipeline | 51.0 | 57,200 |
| **TOTAL** | **90.0** | **100,900** |

**Φ GEI Consultants, Inc.**

5660 Greenwood Plaza Blvd., Suite 202
Englewood, CO 80111-2418

Tel. (303) 779-5565
Fax (303) 779-5653

# FAX

DATE 7/29/97

PROPOSAL/ PROJECT NO. 97411

NO. OF PAGES 3 (including this page)

Task Code 1020

TO: PHILIP SALETTA

FAX NO. (719) 449-8735

FROM: BRAD RASTALL

MESSAGE: THE ATTACHED LIST CONTAINS THE ADDITIONAL INFORMATION WE NEED TO COMPLETE DATA COLLECTION FOR COLORADO SPRINGS UTILITIES. IF POSSIBLE, PLEASE GIVE THIS INFORMATION TO DICK WESTMORE WHEN YOU MEET ON 8/5/97.

**PLEASE LET US KNOW IF THE TRANSMISSION IS UNSATISFACTORY**
**** THANK YOU ****

## SERVICES

**Geotechnical Engineering**
- Site Evaluation
- Foundation Design
- Construction

**Forensic Engineering**
- Failure Investigation
- Litigation Support
- Construction Claim Analysis
- Expert Testimony

**Environmental Engineering**
- Process Engineering
- Site Evaluation
- Remediation
- Litigation Support

**Geohydrology & Hydrology**
- Water Supply Development and Protection
- Contaminated Ground Water Remediation
- Construction Dewatering
- Flood Routing Studies

**Dam Engineering**
- Site Studies
- Dam Design
- Inspection

**Air Quality**
- Operating Permits
- Emission Inventories
- Control Technology Engineering
- Measurements and Modeling

Additional information needed for Southeastern Colorado Water Conservancy District's Arkansas Basin Future Water Storage Needs Assessment Project:

1. Population and historic water use for 1987, 1988, 1989.
2. Average monthly water use as a percent of total monthly use.
3. Monthly firm yield.

**Φ GEI Consultants, Inc.**

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2. Average monthly water use as a percent of total monthly use.
3. Monthly firm yield.

WATER RESOURCES

COLORADO SPRINGS UTILITIES

Date: 1/2/98

To: DICK WESTMORE / STEVE ARVESCHOUG ℅ GEI

From: PHILIP SALETTA (719) 448-8713

Subject: STORAGE NEEDS ASSESSMENT STUDY

For: ☐ Your comments/recommendations

☐ Your approval

☑ Your information/file

☐ Your signature and return

☐ Your action

Copies to:

Remarks: HERE ARE SOME COMMENTS ON THE 10/31/97 DRAFT. I ONLY INCLUDED THOSE PAGES THAT I HAD SUGGESTED CHANGES OR QUESTIONS.

CALL ME IF ANY ?'S.

Signature:

NOV 18 1997

# 1. INTRODUCTION

## 1.1 Scope of Work

Water use throughout the west and particularly in the Arkansas Basin (Figure 1.1) is experiencing a high of level of competitive on ~~tension~~ for water resources. This situation is exacerbated by traditional natural drought cycles and increasing population. Water managers now labor under the increased burden of man-made or regulatory-imposed water demands that further stress limited resources. In the Arkansas Basin, the U.S. Supreme Court finding relative to the Arkansas River Compact in Kansas vs. Colorado will further stress the limited water resources. Therefore, a carefully defined assessment of future water supply needs in the Basin was deemed to be critical. This assessment includes identification of potential storage alternatives to meet future needs of Basin water users, while protecting major recreational and environmental interests. The goal of the Assessment Project is to establish future water demands in the District, coupled with developing alternative strategies on how to meet the future needs for the municipal and agricultural water users.

DO NOT [illegible] IMPLY
STORAGE STUDY IS
INPUT FOR KANSAS
(T1S [illegible]
COLO [illegible]

The Southeastern Colorado Water Conservancy District (SECWCD)/Arkansas Basin Future Water and Storage Needs Assessment Project (the "Assessment Project") was initiated in July 1997. The work was conducted by a team of consultants headed by GEI Consultants, Inc. (GEI) and subconsultants Helton and Williamsen, P.C., and David Bamberger & Associates. The GEI team operated under an Agreement between the Southeastern Colorado Water and Storage Needs Assessment Enterprise and GEI, which was executed on June 26, 1997.

The scope of work for the Assessment Project included the following major tasks:

| Task No. | Description |
|---|---|
| 1 | Data Collection and Review |
| 2 | Description of Water Systems |
| 3 | Population Projections |
| 4 | Agricultural Water Use |
| 5 | Current and Potential Water Conservation Efforts |
| 6 | Water Demand Forecasts |
| 7 | Supply and Demand Comparison |
| 8 | Need for Additional Water Supplies |

SHOULD THERE BE A BRIEF PARAGRAPH ON FVA & ITS MEMBERS PRIOR TO DETAIL ON CS, SH, WIDEFIELD, SECURITY & FOUNTAIN?

### 2.2.1.6 *Penrose Water District (WD)*

The Penrose WD currently leases surface water from Beaver Park Water, Inc. Current use is 488 af/yr (1996), and the maximum water supply from Beaver Park Reservoir that could be obtained by Penrose WD is 1000 af. Penrose is considering acquisition of direct flow water rights on the Arkansas River and evaluating its diversion and storage options.

### 2.2.1.7 *Colorado Springs*

Colorado Springs Utilities provides water to a service area population of 341,810. Water is supplied from four major sources: local supplies from Pikes Peak watershed; the Blue River Pipeline; the Homestake Creek Pipeline; and the Fryingpan-Arkansas Project via the Fountain Valley Pipeline. Other supplies include Denver Basin wells and the Colorado Canal Exchange Program. Developed supplies total 143,500 af (average annual yield). Water resources owned by Colorado Springs include "reusable" supplies and "native" supplies, as identified below:

Utilities — global except where referring to City limits or population numbers.

| | | Average Yield |
|---|---|---|
| **Developed "Reusable" Supplies** | | |
| Blue River/Homestake | | 27,700 ok |
| Fry-Ark/Twin Lakes | | 42,900 |
| Arkansas Basin | | 15,600 |
| Return Flows | | 24,800 |
| | **Subtotal** | 111,000 |
| **Developed "Native" Supplies** | | |
| Arkansas Basin | | 9800 ~~10,800~~ |
| Local Supplies | | 22,700 ~~[illegible]~~ |
| | **Subtotal** | 32,500 |
| **Developed Non-Potable** | | 1,100 |
| **Undeveloped Supplies** | | 76,300 |
| | **TOTAL** | 220,900 |

Utilities [redacted]

Colorado Springs has over 230,000 af of reservoir storage. Of this total, approximately 147,000 af is associated with Arkansas Basin and Fryingpan-Arkansas Project supplies, as indicated below:

| | Storage Volume |
|---|---|
| ~~Twin Lakes Collection System~~ ? ~~WEST SLOPE~~ | ~~600~~ ← THIS IS WEST SLOPE STORAGE |
| Turquoise (Homestake Project) | 15,000 |
| CF&I | 17,416 |
| Twin Lakes | 29,756 |
| Pueblo (Fry-Ark Space) | 57,090 |
| Lake Meredith | 20,660 |
| Lake Henry | 6,709 |
| | ~~147,231~~ 146,631 |

The 1996 Survey Questionnaire was mailed to all water supply entities in the District. Responses were obtained from the entities identified in "**bold**" in the following tabulation:

## MUNICIPAL WATER USER ENTITY SECWCD SURVEY RESPONSES

### Major Municipal Entities

City of Buena Vista
**City of Salida**
**City of Canon City**
Park Center Water District
City of Florence
**Penrose Water District**
**~~City of~~ Colorado Springs** Utilities
**Stratmoor Hills Water District**
**Widefield Water and Sanitation District**
**Security Water District**
**City of Fountain**
**Pueblo Board of Water Works**
**Pueblo West Metropolitan District**
**St. Charles Mesa Water District**
Crowley County Water Association
Town of Ordway
**Town of Fowler**
**City of Rocky Ford**
**City of La Junta**
Bents Fort Water Association
**Town of Las Animas**
**City of Lamar**
**May Valley Water Association**
**(Fountain Valley Authority)**
**(El Paso County Parks Department)**

### Other Municipal Entities (Aggregated in Their Respective Counties):

**Chaffee County**
**Upper Arkansas Water Conservancy District**
Town of Poncha Springs

**Fremont County**
**Upper Arkansas Water Conservancy District**
Orchard Park Water Company
East Florence Water Company
Brookside Water Company

**Pueblo County**
Avondale Water and Sanitation District
**Town of Boone**
O'Neal Water Works
Joseph Water Company
Sunset View Water Association

**Crowley County**
Crowley County Water System
Town of Crowley
96 Pipeline
**Town of Olney Springs**
Town of Sugar City
**Sugar City Pipeline Company**

**Otero County**
Town of Cheraw
Town of Manzanola
Town of Swink

A water supply master plan [Black & Veatch, 1996] has identified several projects for implementation by the year 2010. Colorado Springs has an in-place water conservation program and is implementing non-potable water re-use, supplemented with ground water development. Improvements to the existing raw water delivery systems also are being implemented to increase conveyance capacity. The fourth element of the long-range plan is construction of the Southern Supply System, consisting of a new pipeline from Pueblo Reservoir to a terminal storage reservoir. The new pipeline will parallel the existing Fountain Valley Pipeline and will have a capacity of 53 mgd. Future demand for Fryingpan-Arkansas Project water is estimated to be 14,350 af/yr, with storage needs of 19,000 af in the year 2000, and 42,000 af in the year 2010. In addition, the City is planning to construct storage on Williams Creek (18,000 af) or Jimmy Camp Creek (28,000 af). These reservoirs would be terminal storage for water that would be conveyed from Pueblo Reservoir via the new Fountain Valley Pipeline (Southern Supply System).

Colorado Springs Utilities is currently developing a System Optimization Mod that will more accurately determine its storage needs.

### 2.2.1.8 *Stratmoor Hills WD*

The Stratmoor Hills WD obtains its water from the Fountain Valley Authority and from ground water. Current use is approximately 880 af/yr. Approximately 75 percent of the demand is met from Fountain Valley Authority (Fry-Ark) supplies, with the remainder from wells. Stratmoor Hills WD will continue to obtain 600 af/yr from the Fry-Ark Project, with the remainder of its demand met from its ground water resources, which can yield 1270 af/yr with effective recharge and 770 af/yr without recharge.

### 2.2.1.9 *Widefield Water and Sanitation District (WSD)*

The Widefield WSD has two sources of water -- ground water and Fry-Ark Project supplies. Currently, 1500 af of Project water and 1600 af of ground water is provided to customers within the Widefield WSD. In the future, the full allocation of Project water (1500 af), re-use of Project water return flows, ground water (both existing and new wells), and artificial recharge facilities will be used to meet water demands.

### 2.2.1.10 *Security Water District (WD)*

The Security WD currently serves a population of approximately 16,000 persons. Water use was 6100 af in 1995. Much of the service area is not metered. When metering is implemented, a decrease in per tap water use of 20 to 25 percent is expected. Currently, Security WD obtains water from fully augmented ground water sources totaling 2000 af/yr. The District used 1646 af of Fry-Ark project water in 1996. Up to 6500 af

### 2.3.1 Larger Ditch Systems

The 11 canal/ditch systems between Pueblo Dam and Las Animas include:

| System | 1985 Irrigated Area (acres) | 1965-1995 Average Diversion from Arkansas River (acre-feet) | 1950-1985 Average Pumping (acre-feet) |
|---|---|---|---|
| Bessemer | 17,713 | 61,746 | 8,589 |
| Excelsior | 1,509 | 1,754 | 3,251 |
| Colorado * | 30,611 | 71,773 | 4,785 |
| Rocky Ford Highline | 21,220 | 86,206 | 5,025 |
| Oxford | 4,855 | 25,453 | 6,440 |
| Otero | 3,303 | 6,852 | 1,175 |
| Catlin | 16,893 | 91,092 | 8,578 |
| Holbrook | 14,174 | 39,209 | 3,510 |
| Rocky Ford * | 7,214 | 42,379 | 1,963 |
| Fort Lyon | 91,124 | 254,220 | 26,348 |
| Las Animas | 6,502 | 28,701 | 4,148 |

POSSIBLY NOTE IN TABLE THAT ~~[illegible]~~ COLO. CANAL & ROCKY FORD ARE IN PART ~~[illegible]~~ MUNICIPAL

#### 2.3.1.1 *Bessemer Ditch*

The Bessemer Ditch is owned and operated by the Bessemer Ditch Irrigating Ditch Company. In 1996, the Company reported an irrigated area of 19,000 acres and a need for 10,000 af of storage for winter water. Winter storage in 1996 was 5000 af. In 1992-1995, the Company stored 8854 af of water in Pueblo Reservoir. In both 1994-1995 and 1995-1996, stored water was spilled. The Company reported a need for additional Project storage space for winter water to meet growing M&I needs while maintaining storage for agricultural users.

#### 2.3.1.2 *Excelsior Ditch*

The Excelsior Irrigation Company did not report its irrigated area on the SECWCD's survey form. The ditch was being rehabilitated in 1996. Since 1987, Excelsior has not requested Project water, but planned to do so in 1997.

### *2.3.1.3 Colorado Canal*

other cities and Aurora

Stored in Lake Meredith

The Colorado Canal Company provides irrigation water to 6800 acres, with a reported water use of 8500 af/yr. In the 1980s, Colorado Springs purchased a majority interest in the Colorado Canal, Lake Henry, and Lake Meredith. Water is diverted into the Colorado Canal, and then exchanged ultimately upstream to Twin Lakes ~~the intake for the Otero Pump Station~~ or Aurora Otero Pump Station on the from which municipal water is delivered to Colorado Springs through the Homestake Pipeline. No change in the amount of irrigated land or water use is expected for the Colorado Canal. Colorado Springs owns over half of the system and Aurora about one-quarter of the system. Irrigation was continued for re-vegetation purposes up to 1994. Average yield from Colorado Canal water rights to Aurora is reported to be 6000 af/yr and to Colorado Springs is reported to be 14,800 af/yr. ←

??

### *2.3.1.4 Rocky Ford Highline Canal*

The Highline Canal Company reports an irrigated area of 22,500 acres, with no forecast of increased acreage or water use. Project water use was 5000 af in 1996. The Company participates in the Winter Water Storage Program.

### *2.3.1.5 Oxford Ditch*

The owners of Oxford Ditch did not respond to the SECWCD survey in 1996.

### *2.3.1.6 Otero Ditch*

The Otero Ditch Company reports an irrigated area of 4973 acres. Direct flow rights are supplemented by Fry-Ark Project water. The Company reports a Project water need of 2500 af to meet minimum crop requirements in most years. Allocations of Fry-Ark water have steadily increased over the past 5 years to the 1996 allocation of 2500 af.

### *2.3.1.7 Catlin Canal*

The Catlin Canal Company reports an irrigated area of 19,000 acres and water use of 100,000 af/yr and service population of 5000 persons. No change in water use is predicted for the next 30 years. In 1996, 11,000 af of Project water was allocated to the Catlin Canal. In 1996-1997, the Company stored 14,558 af in Pueblo Reservoir under the Winter Water Storage Program. The Company predicts a storage need of 12,500 af and Project water use of 6000 af/yr for the next 30 years.

# SECWCD/Arkansas Basin Future Water and Storage Needs Assessment Project
## SURVEY TABULATION FOR MUNICIPAL WATER SUPPLY ENTITIES

| Municipal Entity | Year | Population | Water Use | Unit Demand | Avg. Unit Demand | Projected Water Use | Firm Yield | Project Water Use | Stored Water | Project Storage | | | | Other Storage | Storage Use |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | persons | af | gpc/day | gpc/day | af | af | af | af | Trqouise L. af | Twin L. af | Pueblo af | If and Whe af | af | af |
| City of Florence | | | | | | | | *Historic Water Use Trends* | | | | | | | |
| | 1980 | | | | | | | | | | | | | | |
| | 1985 | | | | | | | | | | | | | | |
| | 1990 | 3,801 | 1,108 | 260 | | | | | | | | | | | |
| | 1991 | | | | | | | | | | | | | | |
| | 1992 | | | | | | | | | | | | | | |
| | 1993 | | | | | | | | | | | | | | |
| | 1994 | | | | | | | | | | | | | | |
| | 1995 | 5,148 | 1,666 | 289 | | | | 0 | | | | | | | |
| | Current Yr. | | | | | | | 21 | | | | | | | |
| | | | | | 275 | | | | | | | | | 210 | |
| | | | | | | | | *Water Use Projections* | | | | | | | |
| | 2000 | 6,927 | 2,019 | 260 | | 2,130 | | | | | | | | | |
| | 2010 | 10,095 | 2,943 | 260 | | 3,105 | | | | | | | | | |
| | 2020 | 14,431 | 4,207 | 260 | | 4,438 | | | | | | | | | |
| | 2040 | | | | | | | | | | | | | | |
| Penrose Water District | | | | | | | | *Historic Water Use Trends* | | | | | | | |
| | 1980 | | | | | | | | | | | | | | |
| | 1985 | | | | | | | | | | | | | | |
| | 1990 | | 403 | | | | | | | | | | | | |
| | 1991 | | 386 | | | | | | | | | | | | |
| | 1992 | | 385 | | | | | | | | | | | | |
| | 1993 | | 431 | | | | | | | | | | | | |
| | 1994 | | 469 | | | | | | | | | | | | |
| | 1995 | | 464 | | | | | | | | | | | | |
| | Current Yr. | | | | | | | | | | | | | | |
| | | | | | | | 1,000 | | | | | | | | |
| | | | | | | | | *Water Use Projections* | | | | | | | |
| | 2000 | | | | | | | | | | | | | | |
| | 2010 | | | | | | | | | | | | | | |
| | 2020 | | | | | | | | | | | | | | |
| | 2040 | | | | | | | | | | | | | | |
| Colorado Springs Utilities | | | | | | | | *Historic Water Use Trends* | | | | | | | |
| | 1980 | 215,105 | 56,144 | 233 | | | | | 0 | | | | | | |
| | 1985 | 262,889 | 65,577 | 223 | | | | | 0 | | | | | | |
| | 1990 | 281,140 | 65,395 | 208 | | | | | 13,592 | | | | | 4,915 | |
| | 1991 | 291,995 | 65,167 | 199 | | | | | 16,794 | | | | | 3,250 | |
| | 1992 | 302,849 | 68,211 | 201 | | | | | 21,597 | | | | | 2,554 | |
| | 1993 | 313,704 | 70,757 | 201 | | | | | 27,763 | | | | | 4,000 | |
| | 1994 | 324,558 | 73,372 | 202 | | | | | 25,683 | | | | | 5,000 | |
| | 1995 | 335,413 | 68,588 | 183 | | | | | 28,915 | | | | | 6,000 | |
| | Current Yr. | 341,810 | ~~80,374~~<br>78,517 | 210 | | | | 1,200 | 11,915 | | | | | 3,500 | |
| | | | | | 207 | | 126,900 | | | | 29,756 | 57,090 | | 143,371 | |
| | | | | | | | | *Water Use Projections* | | | | | | | |
| | 2000 | 370,574 | 85,085 | | | 85,756 | | 1,200 | | | | | | | 19,000 |
| | 2010 | 471,106 | 102,149 | | | 109,020 | | 14,353 | | | | | | | 42,000 |
| | 2020 | 616,273 | 125,795 | | | 142,614 | | 14,353 | | | | | | | 88,000 |
| | 2040 | | | | | | | | | | | | | | |

ALSO SEE ATTACHED TABLE FOLLOWING

- City of Colorado Springs -- Benchmark projections were not used, because both local base and local high projections were provided.

2. Where local projections were provided and benchmark projections were not previously calculated, the local projections were used for both the base and the high projections. The only exception to this method was Bents Fort Water Association. Here, the local forecast was for no growth; therefore, the no growth forecast was used as the base projection, and the high projection was based on the projected decade growth percentage for Bent County.

3. Where no local projections were provided and benchmark projections were previously calculated, the benchmark projections were used for both the base and high projections. This method was used for the following entities:
   - City of Buena Vista
   - Town of Ordway
   - City of Lamar
   - Town of Eads

The resulting population projections by county and major water supply entity within the SECWCD are provided in Tables 3.1 (Base Projection) and 3.2 (High Projection).

As shown in the tables, total SECWCD population is projected to increase from 560,000 persons in 1995 to 936,000 in 2040 under the base case and to 1,528,000 under the high case scenario. Population growth by region is summarized below:

| | Projected Population in Thousands[1] (Base/High) | | | |
|---|---|---|---|---|
| Location | 1995 | 2000 | 2020 | 2040 |
| **Total SECWCD** | 560 | 619/657 | 798/1058 | 936/1529 |
| Colorado Springs | 323 | 357/~~372~~ 371 | 483/~~619~~ 616 | 568/~~1014~~ 918 |
| Pueblo | 101 | 106/111 | 125/140 | 144/162 |
| Other Municipal Entities[2] | 125 | 141/160 | 171/279 | 201/329 |
| Other Population[3] | 11 | 15/14 | 19/20 | 23/24 |

THIS SHOULD BE RESOLVED ALREADY BUT PLEASE CHECK AGAIN (See attached)

[1] Population within SECWCD boundaries only.
[2] Population for the other 21 larger municipal entities.
[3] Population in smaller towns, water districts, and in portions of counties within the SECWCD.

|  |  | Without Conservation |  | With Conservation |  |  |
|---|---|---|---|---|---|---|
| Year | WS High Population | per Capita Use (gpd) | TOTAL PRODUCTION (MGD) | per Capita Use (gpd) | TOTAL PRODUCTION (MGD) | TOTAL PRODUCTION (AF) |
| 1995 | 334,040 |  |  |  |  |  |
| 1996 | 341,810 | 212.35 | 72.58 | 209.95 | 71.76 | 80,374 |
| 1997 | 349,415 | 211.95 | 74.06 | 208.04 | 72.69 | 81,415 |
| 1998 | 356,618 | 211.98 | 75.60 | 206.62 | 73.68 | 82,524 |
| 1999 | 363,580 | 212.52 | 77.27 | 205.76 | 74.81 | 83,784 |
| 2000 | 370,574 | 213.12 | 78.98 | 205.01 | 75.97 | 85,085 |
| 2001 | 377,840 | 214.78 | 81.15 | 205.33 | 77.58 | 86,889 |
| 2002 | 386,186 | 215.77 | 83.33 | 205.06 | 79.19 | 88,692 |
| 2003 | 395,604 | 215.86 | 85.40 | 203.97 | 80.69 | 90,374 |
| 2004 | 405,450 | 215.72 | 87.46 | 202.73 | 82.19 | 92,056 |
| 2005 | 415,124 | 215.67 | 89.53 | 201.62 | 83.70 | 93,739 |
| 2006 | 424,752 | 215.65 | 91.60 | 200.59 | 85.20 | 95,421 |
| 2007 | 435,096 | 215.28 | 93.67 | 199.27 | 86.70 | 97,103 |
| 2008 | 446,431 | 214.44 | 95.73 | 197.57 | 88.20 | 98,785 |
| 2009 | 458,551 | 213.29 | 97.80 | 195.63 | 89.71 | 100,467 |
| 2010 | 471,106 | 211.99 | 99.87 | 193.60 | 91.21 | 102,150 |
| 2011 | 483,587 | 212.21 | 102.62 | 192.85 | 93.26 | 104,449 |
| 2012 | 496,930 | 212.06 | 105.38 | 191.81 | 95.31 | 106,749 |
| 2013 | 510,542 | 211.80 | 108.13 | 190.71 | 97.37 | 109,049 |
| 2014 | 524,159 | 211.55 | 110.89 | 189.68 | 99.42 | 111,349 |
| 2015 | 538,217 | 211.14 | 113.64 | 188.54 | 101.47 | 113,648 |
| 2016 | 552,951 | 210.50 | 116.39 | 187.20 | 103.51 | 115,931 |
| 2017 | 568,217 | 209.69 | 119.15 | 185.95 | 105.66 | 118,336 |
| 2018 | 583,871 | 208.78 | 121.90 | 184.64 | 107.81 | 120,742 |
| 2019 | 599,961 | 207.77 | 124.66 | 183.27 | 109.96 | 123,148 |
| 2020 | 616,273 | 206.72 | 127.40 | 182.26 | 112.32 | 125,795 |
| 2021 | 632,175 | 205.39 | 129.84 | 181.00 | 114.42 | 127,675 |
| 2022 | 645,660 | 204.88 | 132.29 | 180.48 | 116.53 | 129,554 |
| 2023 | 659,360 | 204.33 | 134.73 | 179.92 | 118.63 | 131,434 |
| 2024 | 673,360 | 203.72 | 137.17 | 179.31 | 120.74 | 133,313 |
| 2025 | 687,559 | 203.06 | 139.62 | 178.66 | 122.84 | 135,192 |
| 2026 | 701,609 | 202.48 | 142.06 | 178.08 | 124.94 | 137,068 |
| 2027 | 715,624 | 201.93 | 144.51 | 177.53 | 127.04 | 138,943 |
| 2028 | 729,885 | 201.33 | 146.95 | 176.94 | 129.15 | 140,819 |
| 2029 | 744,514 | 200.66 | 149.39 | 176.28 | 131.25 | 142,694 |
| 2030 | 759,383 | 199.95 | 151.84 | 175.60 | 133.35 | 144,570 |
| 2031 | 774,481 | 199.98 | 154.88 | 175.57 | 135.98 | 146,801 |
| 2032 | 789,578 | 200.00 | 157.92 | 175.54 | 138.60 | 149,032 |
| 2033 | 804,895 | 199.98 | 160.96 | 175.47 | 141.23 | 151,263 |
| 2034 | 820,456 | 199.89 | 164.00 | 175.34 | 143.86 | 153,494 |
| 2035 | 836,346 | 199.73 | 167.04 | 175.15 | 146.49 | 155,725 |
| 2036 | 852,121 | 199.60 | 170.08 | 174.99 | 149.11 | 157,951 |
| 2037 | 868,077 | 199.43 | 173.12 | 174.80 | 151.74 | 160,177 |
| 2038 | 884,437 | 199.18 | 176.17 | 174.53 | 154.36 | 162,403 |
| 2039 | 901,347 | 198.82 | 179.21 | 174.17 | 156.99 | 164,629 |
| 2040 | 918,732 | 198.37 | 182.25 | 173.73 | 159.61 | 166,855 |

DRAFT

## TABLE 3.2 – HIGH POPULATION PROJECTIONS WITHIN SECWCD BOUNDARIES, YEAR 2000 to 2040

| | HIGH PROJECTION | | | | |
|---|---|---|---|---|---|
| ENTITY | 2000 | 2010 | 2020 | 2030 | 2040 |
| **Chaffee County** | | | | | |
| City of Buena Vista | 2,251 | 2,629 | 3,001 | 3,373 | 3,746 |
| City of Salida | 6,087 | 7,111 | 8,117 | 10,877 | 12,073 |
| Other Chaffee County Areas in District | 6,094 | 7,119 | 8,127 | 9,134 | 10,141 |
| Total Chaffee County in District | 14,432 | 16,859 | 19,245 | 23,384 | 25,960 |
| **Fremont County** | | | | | |
| Canon City | 15,882 | 31,544 | 36,268 | 38,807 | 41,135 |
| City of Florence | 5,775 | 8,720 | 13,730 | 14,691 | 15,573 |
| Park Center WD | 4,000 | 4,360 | 4,665 | 4,992 | 5,291 |
| Penrose WD | 3,563 | 3,884 | 4,156 | 4,446 | 4,713 |
| Other Fremont County Areas in District | 230 | 237 | 262 | 269 | 299 |
| Total Fremont County in District | 29,450 | 48,745 | 59,081 | 63,205 | 67,011 |
| **Pueblo County** | | | | | |
| City of Pueblo | 111,000 | 125,000 | 140,000 | 151,200 | 161,784 |
| Pueblo West MD | 14,350 | 28,350 | 41,850 | 45,198 | 48,362 |
| St. Charles Mesa WD | 10,743 | 11,943 | 13,143 | 14,194 | 15,188 |
| Other Pueblo County Areas in District | 1,328 | 1,449 | 1,572 | 1,694 | 1,817 |
| Total Pueblo County in District | 137,421 | 166,742 | 196,565 | 212,286 | 227,151 |
| **Crowley County** | | | | | |
| Town of Ordway | 1,198 | 1,327 | 1,430 | 1,533 | 1,636 |
| Crowley County WA | 4,400 | 4,500 | 5,000 | 5,500 | 6,000 |
| Other Crowley County Areas in District | 680 | 2,100 | 2,244 | 2,380 | 2,526 |
| Total Crowley County in District | 6,278 | 7,927 | 8,674 | 9,413 | 10,162 |
| **Otero County** | | | | | |
| Town of Fowler | 1,195 | 2,000 | 2,010 | 2,131 | 2,258 |
| City of La Junta | 8,463 | 9,567 | 10,832 | 11,482 | 12,171 |
| City of Rocky Ford | 4,800 | 5,800 | 6,800 | 7,208 | 7,640 |
| Other Otero County Areas in District | 2,675 | 2,875 | 3,058 | 3,242 | 3,425 |
| Total Otero County in District | 17,133 | 20,242 | 22,700 | 24,063 | 25,494 |
| **Bent County** | | | | | |
| Town of Las Animas | 3,000 | 3,900 | 4,500 | 4,635 | 4,774 |
| Bents Fort WA | 1,541 | 1,649 | 1,699 | 1,750 | 1,802 |
| Other Bent County Areas in District | 712 | 762 | 789 | 815 | 842 |
| Total Bent County in District | 5,253 | 6,311 | 6,988 | 7,200 | 7,416 |
| **Prowers County** | | | | | |
| City of Lamar | 8,861 | 9,345 | 9,476 | 9,606 | 9,736 |
| May Valley WA | 1,700 | 1,800 | 2,000 | 2,120 | 2,247 |
| Other Prowers County Areas in District | 1,168 | 1,806 | 1,832 | 1,857 | 1,882 |
| Total Prowers County in District | 11,729 | 12,951 | 13,308 | 13,583 | 13,865 |
| **Kiowa County** | | | | | |
| Total Kiowa County in District | 835 | 873 | 885 | 898 | 910 |
| **El Paso County** | 370,574 | 471,106 | 616,273 | 759,385 | |
| City of Colorado Springs | 372,000 | 473,200 | ~~618,808~~ | ~~792,064~~ | ~~1,013,842~~ 918,732 |
| City of Fountain | 15,000 | 25,000 | 41,000 | 45,510 | 50,061 |
| Security WD | 19,000 | 22,000 | 25,000 | 30,000 | 33,000 |
| Widefield Homes WC | 21,400 | 28,400 | 35,400 | 36,816 | 40,498 |
| Stratmoor Hills WD | 6,300 | 9,300 | 9,300 | 10,323 | 11,355 |
| Other El Paso County Areas in District | 1,176 | 1,361 | 1,526 | 1,691 | 1,857 |
| Total El Paso County in District | 434,876 | 559,261 | 731,026 | 916,404 | 1,150,613 |
| **Total SECWCD** | 657,407 | 839,911 | 1,058,472 | 1,270,436 | 1,528,584 |

## 4.3 Irrigated Acreages

Irrigated acreages within the SECWCD service area were obtained from two sources: 1) the Arkansas River Basin Study (Boyle, 1990) for canals and ditches diverting water from the river below Pueblo; and 2) measurements made from orthophoto maps of irrigated lands upstream of Pueblo Reservoir and lands supplied with water from Fountain Creek. As shown in Table 4.3, approximately 256,000 acres of land were irrigated within the boundaries of the SECWCD in 1985.

During the 1950-1985 period, an average of 242,000 acres of land were irrigated in the area from Pueblo to Las Animas. In 1985, the irrigated area was approximately 222,000 acres. Since that time, there has been further reduction in irrigated acreage due to acquisition of irrigated land by municipal entities and conversion of agricultural water rights to municipal use. The reduction in irrigation to date, however, has not been too significant because of continuing irrigation of lands to establish native vegetation and lease back of water to irrigators. The following conversions of agricultural water to M&I users are completed or in progress:

- In 1982, Public Service Company (PSCo) changed the use of the water rights for the Las Animas Consolidated and Consolidated Extension Canal Companies to include industrial purposes. The shares acquired by PSCo have been leased back annually to farmers under the two systems so the irrigated acreage has not changed substantially to date. PSCo's interests represent about 81 percent of the water supply.
- In 1986, the water right for the Rocky Ford Canal was changed to include municipal uses. As of 1992, approximately two-thirds of the irrigated crop land involved in the change continued to be irrigated to initiate re-vegetation. When the re-vegetation is complete in the year 2000, about ____ acres will be retired and about ____ acres will remain under irrigation.
- In the 1980s, the water rights for the Colorado Canal Company, Lake Meredith Reservoir Company, and Lake Henry Reservoir Company were changed to include municipal purposes. Through 1996, the irrigated acreage decreased to ____ acres. When the conversion is complete, 6800 acres will remain under irrigation.

Check
w/
Allen Ringle
@ Colorado Canal

# STATMOOR HILLS

RECEIVED
SEP [illegible] 1996
Southeastern Colorado Water
Conservancy District

# Survey of Water Users
# in the
# Southeastern Colorado Water Conservancy District

Please take a few minutes to fill out this important survey. It will assist the Southeastern Colorado Water Conservancy District in assessing the future demand for Fryingpan-Arkansas Project water and storage space. If you have questions or comments regarding this survey, you can call Steve Arveschoug (719-544-2040). **Please complete and return the survey to the District in the enclosed envelope before Monday, September 23, 1996.** Your cooperation is appreciated.

---

Name of Organization Stratmoor Hills Water District

Contact Person Roy Heald Phone 719-576-0311

User Group—Municipal ✓ Agricultural ____ Industrial ____
Recreation ____ Other ____

What is your primary source of supply? (surface water rights, ground water rights, or leased water, please describe)

Fountain Valley Authority (Fry-Ark Project Water)

Do you have a raw-water storage system? Yes ____ No ✓
(Please describe your existing water storage system, rights.)

Do you currently request Fryingpan-Arkansas Project Water? (If yes, please describe your existing use, amount and purpose, of Project Water)

Municipal Use thru Fountain Valley Authority - 601 a/f per year

Have you used Fry-Ark Project IF-and-When storage space for the storage of your own water rights? Yes ____ No ✓

## Municipal Population and Irr. Acreage Water/Storage Demand Projections

List your projected use of water and Project water (acre-feet).

| Year | Population | Irr. acreage | Water Use<br>includes project water | Storage Use | Proj. Water Use |
|---|---|---|---|---|---|
| Current | 6,100 | N/A | 880 | * | 601 |
| 2000 | 6,300 | | 910 | | 601 |
| 2010 | 9,300 | | 1,455 | | 601 |
| 2020 | 9,300 | | 1,455 | | 601 |

Please describe your projected future demand for Fry-Ark Project Water and Storage (include copies of any reports or studies which provide the basis for your projections).

*- Stratmoor's only projected demand for storage is for our allocation of Fountain Valley Authority water

## Water Resource Planning Efforts

Do you currently have a water resource plan to meet future water/storage demands? Yes__✓__ No______ If yes, do your plans include the construction of raw-water storage facilities? Yes______ No__✓__

Please describe your current water resource planning efforts and any construction plans.

Would you be willing to participate in a cooperative effort to assess the future demands for water and storage in the Arkansas River Basin and the future need for Fry-Ark Project Water and storage.

Yes______ No_________ Need more information___✓_____

Comments

DRAFT

# SOUTHEASTERN COLORADO WATER CONSERVANCY DISTRICT

## Arkansas River Basin Water Storage and Future Needs Assessment

WATER SYSTEM SURVEY (Compiled by BWR)

### 1. General Information

**Entity** STRATMOOR HILLS

**Contact Name/District Manager** ROY HEALD

**Address** 1811 B STREET
COLORADO SPRINGS, CO 80906

**Phone No.** (719) 576 - 0311

**Fax No.** (719) 576 - 0313

**Primary Use** [✓ Municipal] Agricultural Industrial Recreational Other

**Master Plan or other Water Resource Planning Documents?** [✓ Y] N
(If yes we must obtain it)
**Prepared by:**

**Geographic Location of Service Area** (obtain service area map)

### 2. Demographics/Water Use

*Historic Water Use*

| Year | Population | Water Use, af | $^3/_4$ -in Domestic Taps (optional) |
|---|---|---|---|
| 1987 | 5850 | 805 | |
| 1988 | 5850 | 876 | |
| 1989 | 5850 | 892 | |
| 1990 | 5850 | 818 | |
| 1991 | 5850 | 818 | |
| 1992 | 5900 | 781 | |
| 1993 | 5950 | 853 | |
| 1994 | 6000 | 902 | |
| 1995 | 6000 | 829 | |
| 1996 | 6100 | 880 | |

*Projected Water Use*

| Year | Population | Water Use, af | $^3/_4$ -in Domestic Taps (optional) |
|---|---|---|---|
| 2000 | 6300 | 910 | |
| 2010 | 7200 | 1455 | |
| 2020 | 9300 | 1455 | |
| 2040 | 9800 | | |

**Major industrial or other uses other than domestic**

### 3. Estimated Monthly Water Use

| | as a percent of total annual use,% |
|---|---|
| JAN | 6.7 |
| FEB | 6.3 |
| MAR | 6.7 |
| APR | 6.8 |
| MAY | 9.9 |
| JUN | 11.3 |
| JUL | 12.0 |
| AUG | 10.3 |
| SEP | 8.0 |
| OCT | 7.9 |
| NOV | 6.3 |
| DEC | 6.8 |
| **TOTAL** | 100% |

Notes:

DRAFT

# SOUTHEASTERN COLORADO WATER CONSERVANCY DISTRICT

## Arkansas River Basin Water Storage and Future Needs Assessment

WATER SYSTEM SURVEY (Compiled by BWR)

## 4. Sources of Water

### *Surface Water*

**Sources** FRY-ARK PROJECT - FVA
3/4 FVA 1/4 DISTRICT ON WELLS

**Point of Diversion** (for larger municipalities attach map, if available)

Location F VA 600 AF BEFORE LOSSES
575-580 AF WITH LOSSES

Capacity

### *Ground Water*

**Sources**

Tributary

Nontributary

Number of Wells

**Combined Annual Flow Rate** (from decrees or based on conveyance capacity)
(May only be available as an annual total)

| | gpm | cfs | af |
|---|---|---|---|
| JAN | | | |
| FEB | | | |
| MAR | | | |
| APR | | | |
| MAY | | | |
| JUN | | | |
| JUL | | | |
| AUG | | | |
| SEP | | | |
| OCT | | | |
| NOV | | | |
| DEC | | | |
| **TOTAL ANNUAL** | | | |

## 5. Firm Yield

**District Managers may not have this information, attorneys and/ or consulting engineers may need to be contacted**

| | |
|---|---|
| **Monthly Average Firm Yield for 1966-1995** | **af** |
| JAN | |
| FEB | |
| MAR | |
| APR | |
| MAY | |
| JUN | |
| JUL | |
| AUG | |
| SEP | |
| OCT | |
| NOV | |
| DEC | |
| TOTAL ANNUAL | 770 AF W/OUT RECHARGE<br>1270 AF WITH RECHARGE |

Firm yield can estimated from:

- Response of water rights during critical dry year
- Potential volume limitation per decree or well permit
- Ability to augment out of priority depletions

Consulting Engineer or Attorney

## 6. Future Water Planning

Estimated future yield of existing water rights ____________af/yr

Conditional Water Rights

Direct flow/wells

Storage

DRAFT

# SOUTHEASTERN COLORADO WATER CONSERVANCY DISTRICT

## Arkansas River Basin Water Storage and Future Needs Assessment

WATER SYSTEM SURVEY (Compiled by BWR)

### 7. Raw Water Storage

Total Vol. in af 601 AF

Type:
Fry-Ark

If and When

Shared FVA 601 AF

Owned

### 8. Raw Water Conveyance

Type:
Pipeline

Canal

Estimated Raw Water Conveyance Losses

### 9. Treatment Plant Capacity

Type

Capacity

Also:

1. Attach copies of relevant tables and text from master plans, or water resource planning documents.
2. Compare data found in reports to data obtained from contacting entity via telephone or previous survey.

Notes:

Φ **GEI Consultants, Inc.**

5660 Greenwood Plaza Blvd., Suite 202
Englewood, CO 80111-2418

Tel. (303) 779-5565
Fax (303) 779-5653

# FAX

DATE 8/1/97

PROPOSAL/ PROJECT NO: 97411

NO. OF PAGES 3 (including this page)

Task Code 1010

TO: ROY HEALD

FAX NO. (619) 576-0313

FROM: BRAD RASTALL

MESSAGE: THE ATTACHED LIST CONTAINS THE ADDITIONAL INFORMATION WE NEED TO COMPLETE DATA COLLECTION FOR STRATMOOR HILLS WATER AND SANITATION DISTRICT

PLEASE LET US KNOW IF THE TRANSMISSION IS UNSATISFACTORY
** THANK YOU **

SERVICES

**Geotechnical Engineering**
- Site Evaluation
- Foundation Design
- Construction

**Forensic Engineering**
- Failure Investigation
- Litigation Support
- Construction Claim Analysis
- Expert Testimony

**Environmental Engineering**
- Process Engineering
- Site Evaluation
- Remediation
- Litigation Support

**Geohydrology & Hydrology**
- Water Supply Development and Protection
- Contaminated Ground Water Remediation
- Construction Dewatering
- Flood Routing Studies

**Dam Engineering**
- Site Studies
- Dam Design
- Inspection

**Air Quality**
- Operating Permits
- Emission Inventories
- Control Technology Engineering
- Measurements and Modeling

# Stratmoor Hills Water And Sanitation Districts

1811 B Street Colorado Springs, Colorado 80906-5396
Phone: 576-0311

August 14, 1997

RECEIVED
AUG 15 1997
GEI CONSULTANTS, INC.
ENGLEWOOD, CO

Mr. Brad Rastall
GEI Consultants, Inc.
5660 Greenwood Plaza Blvd., Suite 202
Englewood, CO 80111-2418

Dear Mr. Rastall:

This letter is in response to your 8-1-97 request for information regarding the Stratmoor Hills Water District for the SECWCD Storage and Needs Assessment. The answers to your questions are as follows:

1. *Location of service area:*

See attached map.

2. *Historic population and water use for 1987, 1988, 1989:*

| Year | 1987 | 1988 | 1989 |
|---|---|---|---|
| Population (estimated) | 5,850 | 5,850 | 5,850 |
| Water use (acre feet) | 805 | 876 | 892 |

3. *Population projection for the year 2040.*

9,800

4. *Estimated monthly water use as a percentage of annual water use.*

Calculations based on average of last 4 years (1993 thru 1996)

| Jan. | Feb. | Mar. | Apr. | May | June | July | Aug. | Sept | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 6.7% | 6.3% | 6.7% | 7.8% | 9.9% | 11.3% | 12.0% | 10.3% | 8.0% | 7.9% | 6.3% | 6.8% |

5. *Sources of water other than FVA.*
Stratmoor has 3 producing wells and 6 inactive wells in the Widefield Aquifer. We have water rights that provide augmentation under several decrees, allowing us to pump up to 770 acre-feet without recharge and 1270 acre-feet with effective recharge.

6. *Monthly and annual firm yield.*

| | Jan. | Feb. | Mar. | Apr. | May | June | July | Aug. | Sept | Oct. | Nov. | Dec. | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| FVA (a/f) | 46 | 46 | 46 | 60 | 60 | 60 | 60 | 60 | 60 | 34 | 34 | 34 | 601 → 575-580 af<br>w/losses |
| Wells (a/f) w/o rechg | 120 | 120 | 120 | 120 | 120 | 120 | 120 | 120 | 120 | 120 | 120 | 120 | 770* |
| Wells (a/f) with rechg | 220 | 220 | 220 | 220 | 220 | 220 | 220 | 220 | 220 | 220 | 220 | 220 | 1,270* |
| Total (a/f) w/o rechg | 166 | 166 | 166 | 180 | 180 | 180 | 180 | 180 | 180 | 154 | 154 | 154 | 1,371 |
| Total (a/f) with rechg | 266 | 266 | 266 | 280 | 280 | 280 | 280 | 280 | 280 | 254 | 254 | 254 | 1,871 |

* - Total of maximum monthly pumping exceeds maximum annual pumping. There is also a maximum quarterly pumping rate, which was omitted here for simplicity.

If you have any questions or need additional information, please let me know.

Sincerely,

Roy E. Heald

Roy E. Heald, Administrator

# Stratmoor Hills Water District

# WIDEFIELD

W. W. Wheeler and Associates, Inc.
Water Resources Engineers

June 9, 1998

Mr. Dick Westmore
GEI Consultants, Inc.
6950 South Potomac Street, Suite 200
Englewood, Colorado 80112

**Re: #603 - Southeastern District**
**Storage Needs Assessment**
**Widefield Water & Sanitation District**

Dear Dick:

The purpose of this letter is to provide information concerning the present water supply available to Widefield Water and Sanitation District.

Fry-Ark Project Water. Widefield's delivery of Fry-Ark Project water is equal to 1,500 acre-feet per year. Pipeline leakage, if any, and backwash losses at the treatment plant are subtracted from the 1,500 acre-feet. The total loss is normally equal to several percent, with an expected maximum of five percent. Therefore, the minimum annual water delivery to Widefield will be equal to about 1,425 acre-feet.

Fry-Ark Project Return Flows. After an initial use of Fry-Ark Project water by Widefield, roughly 60 percent of the water returns to Fountain Creek in the form of treated sewage effluent and lawn irrigation return flows. This water is available for purchase, on an as-needed basis, for augmentation of water pumped from the wells used by Widefield. Widefield annually purchases the volume of return flows that it needs to meet its current water supply requirements.

Colorado Springs Transmountain Return Flows. Widefield has a contract right to purchase Colorado Springs transmountain return flows on a year-round basis, limited to about 1,021 acre-feet per year. This water is available for use in Widefield's augmentation plan.

Fountain Mutual Ditch. Widefield owns 571 shares of stock in the Fountain Mutual Irrigation Company that have been included in the court-approved augmentation plans. The estimated augmentation yield associated with Widefield's 571 shares is equal to about 400 acre-feet.

**Wells.** Under the terms of the Widefield Aquifer stipulation, Widefield is entitled to pump 2,575 acre-feet per year. In addition, Widefield has wells in the Windmill Gulch aquifer and the Jimmy Camp Creek aquifer, with a total annual yield of approximately 850 acre-feet. Therefore, the total well capacity is equal to approximately 3,425 acre-feet, less 450 acre-feet that may be deliverable to another water district pursuant to contract. Upon construction of future artificial recharge facilities, the well yield may increase substantially.

**Theoretical Water Supply Yield.** We estimate that a maximum municipal water demand of about 4,400 acre-feet can be met from the existing augmentation water system, excluding artificial recharge. This demand includes 1,425 acre-feet from Fry-Ark Project water and 2,975 acre-feet from wells under Widefield's augmentation plan. This level of water supply represents an increase of roughly 1,400 acre-feet over the present water demand of 3,000 acre-feet. Upon possible future construction of facilities for artificial recharge, the annual water supply may increase to 5,875 acre-feet.

**Water Quality Considerations.** The quality of water produced from Widefield's wells is generally improved by blending with Fry-Ark Project water. The well water is relatively hard, with high dissolved solids content. Water quality concerns may provide a limitation on the expansion of Widefield's well system. Therefore, the effective yield of Widefield's water rights, without the infusion of additional high-quality water, may be substantially less than 5,875 acre-feet.

**Future Water Supply Project.** Widefield is interested in discussing possible participation in a future water supply project that would provide additional water from Pueblo Reservoir. This project would presumably require the use of storage capacity in

Pueblo Reservoir. We do not have any information concerning the future volume of water that may be required by Widefield.

We hope this information is adequate for your present needs. Please call if you have any questions or comments.

Very truly yours,

W. W. WHEELER & ASSOCIATES, INC.

Gary B Thompson
Gary B. Thompson, P.E.

GBT:fq
cc: Larry Bishop
M:\603\980609.WES

W. W. Wheeler and Associates, Inc.
Water Resources Engineers

3700 South Inca Street, Englewood, CO 80110
Phone (303) 761-4130 FAX (303) 761-2802

# FAX TRANSMITTAL

June 9, 1998

NUMBER OF PAGES INCLUDING THIS COVER LETTER: 8

ORIGINAL WILL ~~NOT~~ FOLLOW BY MAIL

RE: #603

TO: Dick Westmore

FAX NO.: 662-8757

FROM: Gary Thompson

BY:

MESSAGE:

# Survey of Water Users
# in the
# Southeastern Colorado Water Conservancy District

Please take a few minutes to fill out this important survey. It will assist the Southeastern Colorado Water Conservancy District in assessing the future demand for Fryingpan-Arkansas Project water and storage space. If you have questions or comments regarding this survey, you can call Steve Arveschoug (719-544-2040). **Please complete and return the survey to the District in the enclosed envelope before Monday, September 23, 1996.** Your cooperation is appreciated.

---

Name of Organization Widefield Homes Water Company

Contact Person Gary Thompson Phone 303-761-4130

User Group—Municipal X Agricultural____ Industrial_____
Recreation____ Other____

What is your primary source of supply? (surface water rights, ground water rights, or leased water, please describe)

Groundwater rights, supplemented by Fry-Ark Project water

Do you have a raw-water storage system? Yes_____ No X
(Please describe your existing water storage system, rights.)

Do you currently request Fryingpan-Arkansas Project Water? (If yes, please describe your existing use, amount and purpose, of Project Water)

Yes, 1,500 acre-feet per year, together with reuse of a portion of the return flows (currently 300 acre-feet per year)

Have you used Fry-Ark Project IF-and-When storage space for the storage of your own water rights? Yes______ No X

## Project Storage Space Use Trends

List your current and historic use of Project storage space for your own (non-Project) water. (acre-feet) NONE

| | Amt. of Stored Water (af) | Facility(s) |
|---|---|---|
| Current Yr | | |
| 1995 | | |
| 1994 | | |
| 1993 | | |
| 1992 | | |
| 1991 | | |
| 1990 | | |
| 1985 | | |
| 1980 | | |

## Water Use Trends

List your historic use of water for municipal or agricultural use, and your historic use of Project water (acre-feet).

| | Population | Irr. Acreage | Water Use | Proj. Water Use |
|---|---|---|---|---|
| Current Yr. | 20,000 | | 3,100 | 1,500 |
| 1995 | 20,000 | | 2,900 | 1,500 |
| 1994 | 20,000 | | 2,900 | 1,500 |
| 1993 | 20,000 | | 2,900 | 1,500 |
| 1992 | 20,000 | | 2,900 | 1,500 |
| 1991 | 20,000 | | 3,100 | 1,500 |
| 1990 | 20,000 | | 2,800 | 1,500 |
| 1985 | 18,000 | | 2,900 | 0 |
| 1980 | 15,500 | | 3,000 | 0 |

## Municipal Population and Irr. Acreage Water/Storage Demand Projections

List your projected use of water and Project water (acre-feet).

| Year | Population | Irr. acreage | Water Use | Storage Use | Proj. Water Use |
|---|---|---|---|---|---|
| Current | 20,000 | | 3100 | 5,963 | 1,500 |
| 2000 | 21,400 | | 3,300 | 5,963 | 1,500 |
| 2010 | 28,400 | | 4,400 | 5,963 | 1,500 |
| 2020 | 35,400 | | 5,500 | 5,963 | 1,500 |

Please describe your projected future demand for Fry-Ark Project Water and Storage (include copies of any reports or studies which provide the basis for your projections).

Widefield will use its maximum allocation of Project water and storage each year. Widefield's use of return flows will gradually increase.

## Water Resource Planning Efforts

Do you currently have a water resource plan to meet future water/storage demands? Yes x No______ If yes, do your plans include the construction of raw-water storage facilities? Yes______ No x

Please describe your current water resource planning efforts and any construction plans.

The plan includes the construction of additional wells and artificial recharge facilities.

Would you be willing to participate in a cooperative effort to assess the future demands for water and storage in the Arkansas River Basin and the future need for Fry-Ark Project Water and storage.

Yes______ No______ Need more information x

Comments______

**Arkansas Valley Pipeline**

- Are you aware of the Fry-Ark Project's originally proposed Arkansas Valley Pipeline? Yes__X__ No______ If yes, would you have an interest in taking another look at the cost/benefits of such a treated-water delivery system?

  Comments NO

**Any additional comments?**

Thank you for your help!

DRAFT

# SOUTHEASTERN COLORADO WATER CONSERVANCY DISTRICT

## Arkansas River Basin Water Storage and Future Needs Assessment

WATER SYSTEM SURVEY (Compiled by BWR)

### 1. General Information

**Entity** WIDEFIELD HOMES WATER COMPANY

**Contact Name/District Manager** GARY THOMPSON @ W.W. WHEELER

**Address** OR LARRY BISHOP

3 WIDEFIELD BLVD

COLORADO SPRINGS, CO 80911 719-390-7111

**Phone No.** (303) 761 - 4130 719-392-3412

**Fax No.** ( ) -

**Primary Use** [✓ Municipal] Agricultural Industrial Recreational Other

**Master Plan or other Water Resource Planning Documents?** [✓ Y] N

(If yes we must obtain it)

**Prepared by:**

**Geographic Location of Service Area** (obtain service area map)

### 2. Demographics/Water Use

*Historic Water Use*

| Year | Population | Water Use, af | $^3/_4$ -in Domestic Taps (optional) |
|---|---|---|---|
| 1987 | | | |
| 1988 | | | |
| 1989 | | | |
| 1990 | 20,000 | 2800 | |
| 1991 | 20,000 | 3100 | |
| 1992 | 20,000 | 2900 | |
| 1993 | 20,000 | 2900 | |
| 1994 | 20,000 | 2900 | |
| 1995 | 20,000 | 2900 | |
| 1996 | 20,000 | 3100 | |

*Projected Water Use*

| Year | Population | Water Use, af | $^3/_4$ -in Domestic Taps (optional) |
|---|---|---|---|
| 2000 | 21400 | 3300 | |
| 2010 | 28400 | 4400 | |
| 2020 | 35400 | 5500 | |
| 2040 | 35400 | | |

**Major industrial or other uses other than domestic**

DRAFT

# SOUTHEASTERN COLORADO WATER CONSERVANCY DISTRICT

## Arkansas River Basin Water Storage and Future Needs Assessment

WATER SYSTEM SURVEY (Compiled by BWR)

| 3. Estimated Monthly Water Use | |
|---|---|
| | as a percent of total annual use,% |
| JAN | |
| FEB | |
| MAR | |
| APR | |
| MAY | |
| JUN | |
| JUL | |
| AUG | |
| SEP | |
| OCT | |
| NOV | |
| DEC | |
| **TOTAL** | **100%** |

Notes:

DRAFT

# SOUTHEASTERN COLORADO WATER CONSERVANCY DISTRICT
## Arkansas River Basin Water Storage and Future Needs Assessment
WATER SYSTEM SURVEY (Compiled by BWR)

### 4. Sources of Water

*Surface Water*

**Sources** GROUNDWATER RIGHTS SUPPLEMENTED BY FRY-ARK WATER VIA FVA PIPELINE

**Point of Diversion** (for larger municipalities attach map, if available)

Location

Capacity

*Ground Water*

**Sources**

Tributary

Nontributary

Number of Wells

**Combined Annual Flow Rate** (from decrees or based on conveyance capacity)

(May only be available as an annual total)

| | gpm | cfs | af |
|---|---|---|---|
| JAN | | | |
| FEB | | | |
| MAR | | | |
| APR | | | |
| MAY | | | |
| JUN | | | |
| JUL | | | |
| AUG | | | |
| SEP | | | |
| OCT | | | |
| NOV | | | |
| DEC | | | |
| **TOTAL ANNUAL** | | | |

DRAFT

# SOUTHEASTERN COLORADO WATER CONSERVANCY DISTRICT

## Arkansas River Basin Water Storage and Future Needs Assessment

WATER SYSTEM SURVEY (Compiled by BWR)

### 5. Firm Yield

**District Managers may not have this information, attorneys and/ or consulting engineers may need to be contacted**

| | |
|---|---|
| **Monthly Average Firm Yield for 1966-1995** | **af** |
| JAN | |
| FEB | |
| MAR | |
| APR | |
| MAY | |
| JUN | |
| JUL | |
| AUG | |
| SEP | |
| OCT | |
| NOV | |
| DEC | |
| TOTAL ANNUAL 6400 AF /YR | |

Firm yield can estimated from:

- Response of water rights during critical dry year
- Potential volume limitation per decree or well permit
- Ability to augment out of priority depletions

Consulting Engineer or Attorney

ENGINEER : WW WHEELER

### 6. Future Water Planning

Estimated future yield of existing water rights ____________af/yr

Conditional Water Rights

Direct flow/wells

Storage

DRAFT

# SOUTHEASTERN COLORADO WATER CONSERVANCY DISTRICT

## Arkansas River Basin Water Storage and Future Needs Assessment

WATER SYSTEM SURVEY (Compiled by BWR)

### 7. Raw Water Storage

Total Vol. in af 5963 AF

Type:

Fry-Ark 5963 AF

If and When

Shared

Owned

### 8. Raw Water Conveyance

Type:

Pipeline

Canal

Estimated Raw Water Conveyance Losses

### 9. Treatment Plant Capacity

Type

Capacity

Also:

1. Attach copies of relevant tables and text from master plans, or water resource planning documents.
2. Compare data found in reports to data obtained from contacting entity via telephone or previous survey.

Notes:

# SECURITY

W. W. Wheeler and Associates, Inc.
Water Resources Engineers

June 9, 1998

Mr. Dick Westmore
GEI Consultants, Inc.
6950 South Potomac Street, Suite 200
Englewood, Colorado 80112

**Re: #122 - Southeastern District**
**Storage Needs Assessment**
**Security Water District**

Dear Dick:

We understand that the Security Water District has previously provided information concerning the yield of Security's water rights. You should be aware that Security is concerned about future increases in its water requirements, the technical feasibility of providing artificial recharge in the Widefield Aquifer, and water quality in the Widefield Aquifer. The effective yield of Security's water rights, without the infusion of additional high-quality water, may be substantially less than expected. Therefore, Security is interested in discussing its participation in a future water supply project that would provide additional water from Pueblo Reservoir. This project would presumably require the use of storage capacity in Pueblo Reservoir. We do not have any information concerning the future volume of water that may be required by Security.

We hope this information is adequate for your present needs. Please call if you have any questions or comments.

Very truly yours,

W. W. WHEELER & ASSOCIATES, INC.

Gary B Thompson

Gary B. Thompson, P.E.

GBT:fq
cc: Joe Cantrell
Steve Monson
M:\603\980609.WES

3700 South Inca Street Englewood, Colorado 80110 (303) 761-4130 FAX (303) 761-2802

RECEIVED
SEP - 1996
Southeastern Colorado Water
Conservancy District

# Survey of Water Users
# in the
# Southeastern Colorado Water Conservancy District

Please take a few minutes to fill out this important survey. It will assist the Southeastern Colorado Water Conservancy District in assessing the future demand for Fryingpan-Arkansas Project water and storage space. If you have questions or comments regarding this survey, you can call Steve Arveschoug (719-544-2040). **Please complete and return the survey to the District in the enclosed envelope before Monday, September 23, 1996.** Your cooperation is appreciated.

---

Name of Organization Security Water District
Contact Person Joe M. Cantrell Phone (719)392-3475

User Group—Municipal ✓ Agricultural____ Industrial_____
Recreation____ Other_____

What is your primary source of supply? (surface water rights, ground water rights, or leased water, please describe)
Ground Water Rights – 2000 af.

Do you have a raw-water storage system? Yes_____ No ✓
(Please describe your existing water storage system, rights.)

Do you currently request Fryingpan-Arkansas Project Water? (If yes, please describe your existing use, amount and purpose, of Project Water)
1646 Acreft. – Residential supply

Have you used Fry-Ark Project IF-and-When storage space for the storage of your own water rights? Yes______ No ✓

## Municipal Population and Irr. Acreage Water/Storage Demand Projections

List your projected use of water and Project water (acre-feet).

-5500

| Year | Population | Irr. acreage | Water Use | Storage Use | Proj. Water Use |
|---|---|---|---|---|---|
| Current | 16,000 | 0 | 1646 | 6500 | 1646 |
| 2000 | 19000 | 0 | 1646 | 6500 | 1646 |
| 2010 | 22000 | 0 | 1646 | 6500 | 1646 |
| 2020 | 25000 | 0 | 1646 | 6500 | 1646 |

PROJECT DON'T USE EXTRA YET

Please describe your projected future demand for Fry-Ark Project Water and Storage (include copies of any reports or studies which provide the basis for your projections).

We are adding service to about 150 houses per year

## Water Resource Planning Efforts

Do you currently have a water resource plan to meet future water/storage demands? Yes ✓ No______ If yes, do your plans include the construction of raw-water storage facilities? Yes______ No No

Please describe your current water resource planning efforts and any construction plans.

We have bought water shares and we are negotiating for water wells.

Would you be willing to participate in a cooperative effort to assess the future demands for water and storage in the Arkansas River Basin and the future need for Fry-Ark Project Water and storage.

Yes______ No________ Need more information ✓

Comments________________________________

DRAFT

# SOUTHEASTERN COLORADO WATER CONSERVANCY DISTRICT

## Arkansas River Basin Water Storage and Future Needs Assessment

WATER SYSTEM SURVEY (Compiled by BWR)

### 1. General Information

**Entity** SECURITY WATER DISTRICT

**Contact Name/District Manager** JOE CANTRELL

**Address** PO BOX 5156
COLORADO SPRINGS, CO 81008

**Phone No.** (719) 392-3475

**Fax No.** (719) 390-7252

**Primary Use** [✓ Municipal] Agricultural Industrial Recreational Other

**Master Plan or other Water Resource Planning Documents?** [✓ Y] N

(If yes we must obtain it)

**Prepared by:**

**Geographic Location of Service Area** (obtain service area map)

### 2. Demographics/Water Use

*Historic Water Use*

| Year | Population | Water Use, af | $^{3}/_{4}$ -in Domestic Taps (optional) |
|---|---|---|---|
| 1987 | | | |
| 1988 | | | |
| 1989 | | | |
| 1990 | 12 000 | 3110 | |
| 1991 | 12 500 | 3185 | |
| 1992 | 13 000 | 3278 | |
| 1993 | 13500 | 3489 | |
| 1994 | 14 000 | 3462 | |
| 1995 | 15 000 | 3096 | |
| 1996 | 16 000 | | 5500 |

*Projected Water Use*

| Year | Population | Water Use, af | $^{3}/_{4}$ -in Domestic Taps (optional) |
|---|---|---|---|
| 2000 | 19 000 | 4870 | |
| 2010 | 22 000 | 5630 | |
| 2020 | 25000 | 6400 | |
| 2040 | | | |

**Major industrial or other uses other than domestic**

# SOUTHEASTERN COLORADO WATER CONSERVANCY DISTRICT
## Arkansas River Basin Water Storage and Future Needs Assessment
WATER SYSTEM SURVEY (Compiled by BWR)

### 3. Estimated Monthly Water Use

| | as a percent of total annual use,% |
|---|---|
| JAN | |
| FEB | |
| MAR | |
| APR | |
| MAY | |
| JUN | |
| JUL | |
| AUG | |
| SEP | |
| OCT | |
| NOV | |
| DEC | |
| **TOTAL** | **100%** |

Notes:

LARGE PORTIONS OF DISTRICT ARE NOT METERED. ADDING METERS AND EXPECT USEAGE TO DECREASE FROM 0.65-0.60 AF/SFE TO 0.5 AF/SFE

BUILD 700-800 MORE HOMES UNTIL BUID OUT MAYBE 100 TAPS

5500 TAPS NOW × 2.8/SFE = 15400 PEOPLE (CLOSE TO REPORTED POPULATION)

ASSUME 0.5 AF/SFE (FROM JOE CANTRELL)

$5500 \text{ SFE} \times 0.5 \frac{\text{AF}}{\text{SFE}} = 2750 \text{ AF}$

# SOUTHEASTERN COLORADO WATER CONSERVANCY DISTRICT

## Arkansas River Basin Water Storage and Future Needs Assessment

WATER SYSTEM SURVEY (Compiled by B W R)

## 4. Sources of Water

### *Surface Water*

**Sources**

**Point of Diversion** (for larger municipalities attach map, if available)

Location

Capacity

### *Ground Water*

**Sources**

Tributary

Nontributary

Number of Wells

**Combined Annual Flow Rate** (from decrees or based on conveyance capacity)

(May only be available as an annual total)

| | gpm | cfs | af |
|---|---|---|---|
| JAN | | | |
| FEB | | | |
| MAR | | | |
| APR | | | |
| MAY | | | |
| JUN | | | |
| JUL | | | |
| AUG | | | |
| SEP | | | |
| OCT | | | |
| NOV | | | |
| DEC | | | |

**TOTAL ANNUAL**

200 AF/YR

# SOUTHEASTERN COLORADO WATER CONSERVANCY DISTRICT

## Arkansas River Basin Water Storage and Future Needs Assessment

WATER SYSTEM SURVEY (Compiled by GWR)

### 5. Firm Yield

**District Managers may not have this information, attorneys and/ or consulting engineers may need to be contacted**

| Monthly Average Firm Yield for 1966-1995 | af |
|---|---|
| JAN | |
| FEB | |
| MAR | |
| APR | |
| MAY | |
| JUN | |
| JUL | |
| AUG | |
| SEP | |
| OCT | |
| NOV | |
| DEC | |
| TOTAL ANNUAL 2200 AF + 1650 AF THROUGH FVA + UP TO 6500 AF OF PROJECT WATER FROM PUEBLO RESERVOIR | |

Firm yield can estimated from:

Response of water rights during critical dry year
Potential volume limitation per decree or well permit
Ability to augment out of priority depletions

Consulting Engineer or Attorney

### 6. Future Water Planning

Estimated future yield of existing water rights ____________ af/yr

Conditional Water Rights
Direct flow/wells

Storage

DRAFT

# SOUTHEASTERN COLORADO WATER CONSERVANCY DISTRICT

## Arkansas River Basin Water Storage and Future Needs Assessment

WATER SYSTEM SURVEY (Compiled by BWR)

### 7. Raw Water Storage

Total Vol. in af
6500 AF

Type:
Fry-Ark 6500 AF IN PUEBLO EXPECT TO TAKE ABOUT 1650 AF

If and When

Shared

Owned

### 8. Raw Water Conveyance

Type:
Pipeline

Canal

Estimated Raw Water Conveyance Losses

### 9. Treatment Plant Capacity

Type

Capacity

Also:

1. Attach copies of relevant tables and text from master plans, or water resource planning documents.
2. Compare data found in reports to data obtained from contacting entity via telephone or previous survey.

Notes:

**FOUNTAIN** – FOWLER

W. W. Wheeler and Associates, Inc.
Water Resources Engineers

June 9, 1998

Mr. Dick Westmore
GEI Consultants, Inc.
6950 South Potomac Street, Suite 200
Englewood, Colorado 80112

Re: **#603 - Southeastern District**
**Storage Needs Assessment**
**City of Fountain**

Dear Dick:

The purpose of this letter is to provide information concerning the present water supply available to the City of Fountain.

Fry-Ark Project Water. Fountain's delivery of Fry-Ark Project water is being phased-in, increasing by about 100 acre-feet per year. Beginning in the year 2003, Fountain will begin taking delivery of its full contact amount of 2,000 acre-feet, measured at the pumping station near Pueblo Reservoir. Pipeline leakage, if any, and backwash losses at the treatment plant are subtracted from the 2,000 acre-feet. The total loss is normally equal to several percent, with an expected maximum of five percent. Therefore, the minimum annual water delivery to Fountain will be equal to about 1,900 acre-feet.

Fry-Ark Project Return Flows. After an initial use of Fry-Ark Project water by Widefield, roughly 60 percent of the water returns to Fountain Creek in the form of treated sewage effluent and lawn irrigation return flows. This water is available for purchase, on an as-needed basis, for augmentation of water pumped from the wells used by Fountain. Fountain annually purchases the volume of return flows that it needs to meet its current water supply requirements.

Little Fountain Creek Pipeline. Fountain owns water rights at Keeton Reservoir on Little Fountain Creek, located in the foothills west of Fort Carson. Water released through the outlet works of the reservoir is piped across Fort Carson and discharged near Fountain Creek, near I-25. Pursuant to Fountain's augmentation plan decreed in Case No. W-4396, all water delivered through the pipeline is useable as a source to replace depletions associated with operation of Fountain's wells. The annual volume of water delivered through the pipeline is equal to an average of about 114 acre-feet per year.

Fountain Mutual Ditch. Fountain owns 386 shares of stock in the Fountain Mutual Irrigation Company that have been included in the court-approved augmentation plans. The estimated augmentation yield associated with Fountain's 386 shares is equal to about 270 acre-feet.

Stubbs and Miller Ditch. Fountain's augmentation plan includes 70 acre-feet per year of augmentation credit associated with the Stubbs and Miller Ditch water right. This water right is used as a supplemental source for augmentation of Fountain's wells.

Wells. Fountain presently operates four municipal wells, with a total combined capacity of about 2,650 gpm. Several additional wells are authorized for use in accordance with the augmentation plans, but these wells are not presently required to meet the existing municipal demand. The future well capacity may be approximately 3,550 gpm.

Theoretical Water Supply Yield. We estimate that a maximum municipal water demand of about 5,200 acre-feet can be met from the existing augmentation water rights. This demand includes 1,900 acre-feet from Fry-Ark Project water and 3,300 acre-feet from wells under Fountain's augmentation plan. This level of water supply represents an increase of roughly 3,200 acre-feet over the present water demand of 2,000 acre-feet.

Water Quality Considerations. The water quality of wells in the Fountain area is relatively poor in comparison with Fry-Ark Project water. The well water is relatively hard, with high dissolved solids content. Well water and Fry-Ark Project water are presently blended in Fountain's water system to achieve a water supply that is aesthetically pleasing. After Fountain maximizes its use of Fry-Ark Project water in the future, all new water supplies will be obtained from wells. The present percentage of well water in the municipal water system during July is equal to about 35 percent. Under the limits of Fountain's water rights, the percentage would increase to about 76 percent. We are uncertain whether these high percentages will be acceptable to Fountain's water customers. Water quality concerns may provide a limitation on the expansion of Fountain's well system. Therefore, the effective yield of Fountain's water rights, without the infusion of additional high-quality water, may be substantially less than 5,200 acre-feet. If, for example, the percentage of well water must be limited to a maximum of 60 percent because of water quality concerns, Fountain's present water supply would be capable of meeting a water demand of roughly 3,100 acre-feet (including 1,900 acre-feet of Fry-Ark Project water).

**Future Water Supply Project.** The City of Fountain is interested in discussing the participation in a future water supply project that would provide additional water from Pueblo Reservoir. This project would presumably require the use of storage capacity in Pueblo Reservoir. We do not have any information concerning the future volume of water that may be required by Fountain.

We hope this information is adequate for your present needs. Please call if you have any questions or comments.

Very truly yours,

W. W. WHEELER & ASSOCIATES, INC.

Gary B Thompson
Gary B. Thompson, P.E.

GBT:fq
cc: Ron Woolsey
M:\603\980609.WES

**W. W. Wheeler and Associates, Inc.**
**Water Resources Engineers**

3700 South Inca Street, Englewood, CO 80110
Phone (303) 761-4130 FAX (303) 761-2802

Confirmed Facsimile

RECEIVED
OCT 1 1996
Southeastern Colorado Water
Conservancy District

# FAX TRANSMITTAL

September 27, 1996

NUMBER OF PAGES INCLUDING THIS COVER LETTER: 5

ORIGINAL WILL FOLLOW BY MAIL

RE: #603 - Fountain

TO: Steve Arveschoug

FAX NO.: 1-719-543-8467

FROM: Gary Thompson

BY: Sandy

MESSAGE:

Enclosed is the survey for the City of Fountain. I will fax the survey for Widefield Homes Water Company on Monday.

```
W.W. Wheeler & Assoc      TEL:1-303-761-2802                  Sep 27 96   15:0

                          Transmit Confirmation Report

          No.                :  008
          Receiver           :  17195438467
          Transmitter        :  W.W. Wheeler & Assoc
          Date               :     Sep 27 96   15:01
          Time               :  02'05
          Mode               :     Norm
          Pages              :  05
          Result             :  OK
```

RECEIVED
OCT 1 1996
Southeastern Colorado Water
Conservancy District

# Survey of Water Users
# in the
# Southeastern Colorado Water Conservancy District

Please take a few minutes to fill out this important survey. It will assist the Southeastern Colorado Water Conservancy District in assessing the future demand for Fryingpan-Arkansas Project water and storage space. If you have questions or comments regarding this survey, you can call Steve Arveschoug (719-544-2040). **Please complete and return the survey to the District in the enclosed envelope before Monday, September 23, 1996.** Your cooperation is appreciated.

---

Name of Organization City of Fountain
Contact Person Ron Woolsey Phone 719-382-4158

User Group—Municipal x Agricultural____ Industrial____
Recreation____ Other____

What is your primary source of supply? (surface water rights, ground water rights, or leased water, please describe)

Ground water rights - municipal wells in the alluvial aquifer of Fountain Creek.

Do you have a raw-water storage system? Yes____ No X
(Please describe your existing water storage system, rights.)

Do you currently request Fryingpan-Arkansas Project Water? (If yes, please describe your existing use, amount and purpose, of Project Water)

Fountain has a contract for 2,000 acre-feet through the Fountain Valley Authority. In 1996, Fountain is taking delivery of 1,330± acre-feet.

Have you used Fry-Ark Project IF-and-When storage space for the storage of your own water rights? Yes____ No X

## Municipal Population and Irr. Acreage Water/Storage Demand Projections

List your projected use of water and Project water (acre-feet).

| Year | Population | Irr. acreage | Water Use | Storage Use | Proj. Water Use |
|---|---|---|---|---|---|
| Current | 12,000 | | 1,700 | 5,200± | 1,330 |
| 2000 | 15,000 | | 2,200 | 7,950.05 | 1,830 |
| 2010 | 25,000 | | 3,500 | 7,950.05 | 2,000 |
| 2020 | 41,000 | | 5,800 | 7,950.05 | 2,000 |

Please describe your projected future demand for Fry-Ark Project Water and Storage (include copies of any reports or studies which provide the basis for your projections).

Figures presented above are based on 5 percent per year population growth.

## Water Resource Planning Efforts

Do you currently have a water resource plan to meet future water/storage demands? Yes___x___ No______ If yes, do your plans include the construction of raw-water storage facilities? Yes______ No___X___

Please describe your current water resource planning efforts and any construction plans.

Drill additional municipal wells in the alluvial aquifer of Fountain Creek, using presently decreed sources of augmentation replacement water.

Would you be willing to participate in a cooperative effort to assess the future demands for water and storage in the Arkansas River Basin and the future need for Fry-Ark Project Water and storage.

Yes______ No________ Need more information___X___

Comments______________________________

DRAFT

# SOUTHEASTERN COLORADO WATER CONSERVANCY DISTRICT

## Arkansas River Basin Water Storage and Future Needs Assessment

WATER SYSTEM SURVEY (Compiled by BWR)

### 1. General Information

**Entity** CITY OF FOUNTAIN

**Contact Name/District Manager** RON WOOLSEY

**Address** 116 SOUTH MAIN
FOUNTAIN, CO 80817

**Phone No.** (719) 382-9158

**Fax No.** ( ) -

**Primary Use** [✓ Municipal] Agricultural Industrial Recreational Other

**Master Plan or other Water Resource Planning Documents?** [✓ Y] N
(If yes we must obtain it)
**Prepared by:**

**Geographic Location of Service Area** (obtain service area map)

### 2. Demographics/Water Use

*Historic Water Use*

| Year | Population | Water Use, af | $^{3}/_{4}$-in Domestic Taps (optional) |
|---|---|---|---|
| 1987 | | | |
| 1988 | | | |
| 1989 | | | |
| 1990 | | | |
| 1991 | | | |
| 1992 | | | |
| 1993 | | | |
| 1994 | | | |
| 1995 | | | |
| 1996 | 12000 | 1700 | |

*Projected Water Use*

| Year | Population | Water Use, af | $^{3}/_{4}$-in Domestic Taps (optional) |
|---|---|---|---|
| 2000 | 15,000 | 2200 | |
| 2010 | 25,000 | 3500 | |
| 2020 | 41,000 | 5800 | |
| 2040 | | | |

**Major industrial or other uses other than domestic**

# SOUTHEASTERN COLORADO WATER CONSERVANCY DISTRICT

## Arkansas River Basin Water Storage and Future Needs Assessment

WATER SYSTEM SURVEY (Compiled by BWR)

### 3. Estimated Monthly Water Use

| | as a percent of total annual use,% |
|---|---|
| JAN | |
| FEB | |
| MAR | |
| APR | |
| MAY | |
| JUN | |
| JUL | |
| AUG | |
| SEP | |
| OCT | |
| NOV | |
| DEC | |
| **TOTAL** | **100%** |

Notes:

# SOUTHEASTERN COLORADO WATER CONSERVANCY DISTRICT

## Arkansas River Basin Water Storage and Future Needs Assessment

WATER SYSTEM SURVEY (Compiled by BWR)

### 4. Sources of Water

*Surface Water*

**Sources** GROUND WATER AND FVA CONTRACT FOR 2000 AF TAKE ±1330 AF

**Point of Diversion** (for larger municipalities attach map, if available)

Location

Capacity

*Ground Water*

**Sources**

Tributary WELLS IN FOUNTAIN CREEK

Nontributary

Number of Wells

**Combined Annual Flow Rate** (from decrees or based on conveyance capacity)

(May only be available as an annual total)

| | gpm | cfs | af |
|---|---|---|---|
| JAN | | | |
| FEB | | | |
| MAR | | | |
| APR | | | |
| MAY | | | |
| JUN | | | |
| JUL | | | |
| AUG | | | |
| SEP | | | |
| OCT | | | |
| NOV | | | |
| DEC | | | |
| **TOTAL ANNUAL** | | | |

DRAFT

## SOUTHEASTERN COLORADO WATER CONSERVANCY DISTRICT

### Arkansas River Basin Water Storage and Future Needs Assessment

WATER SYSTEM SURVEY (Compiled by BWR)

### 5. Firm Yield

**District Managers may not have this information, attorneys and/ or consulting engineers may need to be contacted**

| | |
|---|---|
| **Monthly Average Firm Yield for 1966-1995** | **af** |
| JAN | |
| FEB | |
| MAR | |
| APR | |
| MAY | |
| JUN | |
| JUL | |
| AUG | |
| SEP | |
| OCT | |
| NOV | |
| DEC | |
| TOTAL ANNUAL | ~ 2000 AF |

Firm yield can estimated from:
- Response of water rights during critical dry year
- Potential volume limitation per decree or well permit
- Ability to augment out of priority depletions

Consulting Engineer or Attorney

### 6. Future Water Planning

Estimated future yield of existing water rights ____________ af/yr

Conditional Water Rights

Direct flow/wells

Storage UpTo 7950 AF

## SOUTHEASTERN COLORADO WATER CONSERVANCY DISTRICT

### Arkansas River Basin Water Storage and Future Needs Assessment

WATER SYSTEM SURVEY (Compiled by BWR)

| **7. Raw Water Storage** |
|---|
| Total Vol. in af |
| Type:<br>Fry-Ark<br>If and When<br>Shared<br>Owned |

| **8. Raw Water Conveyance** |
|---|
| Type:<br>Pipeline<br>Canal |
| Estimated Raw Water Conveyance Losses |

| **9. Treatment Plant Capacity** |
|---|
| Type |
| Capacity |

Also:

1. Attach copies of relevant tables and text from master plans, or water resource planning documents.
2. Compare data found in reports to data obtained from contacting entity via telephone or previous survey.

Notes:

# PUEBLO

# Survey of Water Users
# in the
# Southeastern Colorado Water Conservancy District

Please take a few minutes to fill out this important survey. It will assist the Southeastern Colorado Water Conservancy District in assessing the future demand for Fryingpan-Arkansas Project water and storage space. If you have questions or comments regarding this survey, you can call Steve Arveschoug (719-544-2040). **Please complete and return the survey to the District in the enclosed envelope before Monday, September 23, 1996.** Your cooperation is appreciated.

---

Name of Organization Board of Water Works of Pueblo, Colorado

Contact Person Alan Hamel - Executive Director Phone (719) 584-0221

User Group—Municipal X Agricultural ____ Industrial ____
Recreation ____ Other ____

What is your primary source of supply? (surface water rights, ground water rights, or leased water, please describe)

Surface water rights from the Arkansas River.

Do you have a raw-water storage system? Yes X No ____
(Please describe your existing water storage system, rights.)

See Attachment A.

Do you currently request Fryingpan-Arkansas Project Water? (If yes, please describe your existing use, amount and purpose, of Project Water)

No - but we would like to explain some conditions that may change that in the very near future. See Attachment B.

Have you used Fry-Ark Project IF-and-When storage space for the storage of your own water rights? Yes X No ____

## Municipal Population and Irr. Acreage Water/Storage Demand Projections

List your projected use of water and Project water (acre-feet).

| Year | Population | Irr. acreage | Water Use | Storage Use | Proj. Water Use |
|---|---|---|---|---|---|
| Current | 102,000 | -0- | | | |
| 2000 | 111,000 | -0- | | | |
| 2010 | 125,000 | -0- | | | |
| 2020 | 140,000 | -0- | | | |

Please describe your projected future demand for Fry-Ark Project Water and Storage (include copies of any reports or studies which provide the basis for your projections).

But, Pueblo has not completed an engineering study of future needs for storage space in Fry-Ark facilities.

## Water Resource Planning Efforts

Do you currently have a water resource plan to meet future water/storage demands? Yes x No ______ If yes, do your plans include the construction of raw-water storage facilities? Yes x No ______

Please describe your current water resource planning efforts and any construction plans.

See Attachment C.

Would you be willing to participate in a cooperative effort to assess the future demands for water and storage in the Arkansas River Basin and the future need for Fry-Ark Project Water and storage.

Yes x No ______ Need more information ______

Comments See Attachment D.

# SURVEY OF WATER USERS
# IN THE
# SOUTHEASTERN COLORADO WATER CONSERVANCY DISTRICT

## ATTACHMENT A

*QUESTION:*
Do you have a raw-water storage system? Yes __X__ No _____
(Please describe your existing water storage system, rights.)

*ANSWER:*
The Board of Water Works of Pueblo, Colorado, (the Board) is the sole owner of Clear Creek Reservoir. Clear Creek has a capacity of approximately 11,500 af. The Board uses Clear Creek to store transmountain water diverted into the Arkansas River Basin by the Columbine, Ewing, and Wurtz ditches. This water is stored in Clear Creek by exchange as decreed in Case # 84CW177.

Clear Creek also has a 1902 storage decree for 9,400 af and a 1910 Decree for 2,038 af. This right allows the Board to store east slope water coming into the reservoir any time the call on the Arkansas River is junior to this date. This occurs during the Winter Water Storage Program and during flood events on the Arkansas River.

The Board also owns 5,000 af of permanent storage space in Turquoise Reservoir. This space can be used o store west slope water from the Busk Ivanhoe System and Homestake water obtained through an greement which the Board has with Aurora.

The Board also owns 11,476 shares of Twin Lakes stock. This ownership in the Twin Lakes Company entitles the Board to store approximately 11,500 af of water in permanent space in Twin Lakes Reservoir.

The Board is also entitled to use "if and when" storage space in Pueblo Reservoir whenever it is available. The Board uses this space to store any water which cannot be held at one of the higher elevation reservoirs in the Leadville area.

## ATTACHMENT B

*QUESTION:*
Do you currently request Fryingpan-Arkansas Project Water? (If yes, please describe your existing use, amount and purpose, of Project Water).

*ANSWER:*
The Board of Water Works of Pueblo, Colorado, (the Board) uses Clear Creek Reservoir and its 11,500 af of storage space as its drought year backup supply. In the fall the storage level is brought down to around the 9,000 af level in preparation for the winter storage season. At Clear Creek Reservoir, the Winter Storage Program usually produces around 2,000 af of water. By spring the reservoir is full again.

## ATTACHMENT E

Raw water pumped to Public Service Company's Comanche Power Plant.

| | Water Pumped (acre feet) |
|---|---|
| Current year | Not available |
| 1995 | 6601 |
| 1994 | 6111 |
| 1993 | 6701 |
| 1992 | 7158 |
| 1991 | 7187 |
| 1990 | 8133 |
| 1985 | 7734 |
| 1980 | 7186 |

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# SOUTHEASTERN COLORADO WATER CONSERVANCY DISTRICT

## Arkansas River Basin Water Storage and Future Needs Assessment

WATER SYSTEM SURVEY (Compiled by BWR)

### 1. General Information

**Entity** BOARD OF WATER WORKS OF PUEBLO, COLORADO

**Contact Name/District Manager** ALAN HAMEL

**Address** P.O. BOX 400
PUEBLO, CO 81002

**Phone No.** (719) 584-0221

**Fax No.** ( ) -

**Primary Use** [✓ Municipal] Agricultural Industrial Recreational Other

**Master Plan or other Water Resource Planning Documents?** [✓ Y] N
(If yes we must obtain it)
**Prepared by:**

**Geographic Location of Service Area** (obtain service area map)

### 2. Demographics/Water Use

*Historic Water Use*

| Year | Population | Water Use, af | $^3/_4$ -in Domestic Taps (optional) |
|---|---|---|---|
| 1987 | | | |
| 1988 | | | |
| 1989 | | | |
| 1990 | 98 640 | 24,752 | |
| 1991 | 98 741 | 26,051 | |
| 1992 | 99 302 | 25,831 | |
| 1993 | 100 456 | 25,456 | |
| 1994 | 100 700 | 25,601 | |
| 1995 | 102 310 | 24,703 | |
| 1996 | | | |

*Projected Water Use*

| Year | Population | Water Use, af | $^3/_4$ -in Domestic Taps (optional) |
|---|---|---|---|
| 2000 | 111 000 | 28 344 | |
| 2010 | 125 000 | 31 924 | |
| 2020 | 140000 | 35 755 | |
| 2040 | | | |

**Major industrial or other uses other than domestic**

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# SOUTHEASTERN COLORADO WATER CONSERVANCY DISTRICT

## Arkansas River Basin Water Storage and Future Needs Assessment

WATER SYSTEM SURVEY (Compiled by BWR)

| 3. Estimated Monthly Water Use | |
|---|---|
| | as a percent of total annual use,% |
| JAN | |
| FEB | |
| MAR | |
| APR | |
| MAY | |
| JUN | |
| JUL | |
| AUG | |
| SEP | |
| OCT | |
| NOV | |
| DEC | |
| **TOTAL** | **100%** |

Notes:

DRAFT

# SOUTHEASTERN COLORADO WATER CONSERVANCY DISTRICT

## Arkansas River Basin Water Storage and Future Needs Assessment

WATER SYSTEM SURVEY (Compiled by BWR)

## 4. Sources of Water

*Surface Water*

**Sources** ARKANSAS RIVER TRANSMOUNTAIN DIVERSION

**Point of Diversion** (for larger municipalities attach map, if available)

Location TOWN OF PUEBLO

Capacity 82 cfs

*Ground Water*

**Sources**

Tributary

Nontributary

Number of Wells

**Combined Annual Flow Rate** (from decrees or based on conveyance capacity)

(May only be available as an annual total)

| | gpm | cfs | af |
|---|---|---|---|
| JAN | | | |
| FEB | | | |
| MAR | | | |
| APR | | | |
| MAY | | | |
| JUN | | | |
| JUL | | | |
| AUG | | | |
| SEP | | | |
| OCT | | | |
| NOV | | | |
| DEC | | | |
| **TOTAL ANNUAL** | DIRECT FLOW 82 cfs | | |

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# SOUTHEASTERN COLORADO WATER CONSERVANCY DISTRICT

## Arkansas River Basin Water Storage and Future Needs Assessment

WATER SYSTEM SURVEY (Compiled by BWR)

### 5. Firm Yield

**District Managers may not have this information, attorneys and/ or consulting engineers may need to be contacted**

**Monthly Average Firm Yield for 1966-1995** **af**

JAN

FEB

MAR

APR

MAY

JUN

JUL

AUG

SEP

OCT

NOV

DEC

TOTAL ANNUAL 74,032 AF + 19,750 AF REUSE OF TRANS-MT. DIVERSION + 59,975 AF OF STORAGE

Firm yield can estimated from:

Response of water rights during critical dry year
Potential volume limitation per decree or well permit
Ability to augment out of priority depletions

Consulting Engineer or Attorney

### 6. Future Water Planning

Estimated future yield of existing water rights ____________af/yr

Conditional Water Rights

Direct flow/wells

Storage

DRAFT

# SOUTHEASTERN COLORADO WATER CONSERVANCY DISTRICT

## Arkansas River Basin Water Storage and Future Needs Assessment

WATER SYSTEM SURVEY (Compiled by BWR)

### 7. Raw Water Storage

Total Vol. in af
59,975 AF

Type:
Fry-Ark
TURQOISE RESERVOIR 5000 AF
FRY-ARK 31200 AF

If and When

Shared
TWIN LAKES 12 275 AF
CLEAR CREEK RESERVOIR 11 500 AF

Owned

### 8. Raw Water Conveyance

Type:
Pipeline

Canal

Estimated Raw Water Conveyance Losses

### 9. Treatment Plant Capacity

Type

Capacity

Also:

1. Attach copies of relevant tables and text from master plans, or water resource planning documents.
2. Compare data found in reports to data obtained from contacting entity via telephone or previous survey.

Notes:

## BOARD OF WATER WORKS OF PUEBLO, COLORADO

319 West Fourth Street - P.O. Box 400 - Pueblo, Colorado 81002

FAX MACHINE NUMBER: (719) 584-0222

DATE: 12/16/97

TIME: 1:00 pm

FAX #: 303-662-8750

TO: Dick Westmore - GEI

FROM: Bud O'Hara - Pueblo Water Works -

SUBJECT: Comments on Storage Needs Assessment.

COMMENTS:

Dick - I only had pages 5, 6, 7, & 8.

Total number of pages transmitted (including cover sheet): 5

If there are any problems with transmission, please call:

Bud O'Hara
(name)

at (719) 584-0236

### 2.2.1.8 *Widefield Water and Sanitation District (WSD)*

The Widefield WSD has two sources of water -- ground water and Fry-Ark Project supplies. Currently, 1500 af of Project water and 1600 af of ground water is provided to customers within the Widefield WSD. In the future, the full allocation of Project water (1500 af), reuse of Project water return flows, ground water (both existing and new wells), and artificial recharge facilities will be used to meet water demands.

### 2.2.1.9 *Pueblo Board of Water Works*

MAYBE SAY - "ARE SELDOM"

THIS OCCURED

Water service to the City of Pueblo and several adjacent water users is provided by the Board of Water Works of Pueblo, Colorado (Pueblo Water Board). The adjacent users include an area located west of City Park and the Industrial Park near the Pueblo Airport. Virtually all of the water supplied by the Pueblo Water Board originates in the Arkansas Basin from senior water rights. The Pueblo Water Board's "Northside" water rights on the Arkansas ~~only have been~~ called out, and then only in part, during the 1977 and 1982 drought periods. Clear Creek Reservoir (11,500 af) in the Upper Basin stores transmountain water diverted by the Columbine, Ewing, and Wurtz Ditches. A storage right of 5,000 af in Turquoise Reservoir is available for transmountain water from the Bush-Ivanhoe System and the Homestake Project ~~(by agreement with Aurora)~~.

WATER WHICH IS OBTAINED THROUGH AN

AS WELL AS ITS NATIVE EAST SLOPE DECREES.

Water resources include:

| | |
|---|---|
| Direct Flow Rights<br>(Up to 145 af per day - Arkansas River) | 52,925 af/yr |
| Storage Rights | |
| Clear Creek Reservoir | 11,500 |
| West Slope Exchange | 9,400 |
| East Slope (1902) | 2,038 |
| ~~Ark~~ (1910) | |
| FRY~~[illegible]~~ PROJECT WATER - - - - | 31,200 |
| Turquoise Reservoir | 5,000 |
| Twin Lakes Reservoir | ~~11,500~~ 12,275 |
| Pueblo (If and When) | ~~5,000~~ 3,000 |
| TOTAL | ~~44,438 af~~ |

ONLY ADD ONE OF THESE INTO THE TOTAL.

THIS TOTAL IS INCORRECT. WHAT DOES IT INDICATE? STORAGE SPACE AVAILABLE?

DICK, - CAN WE WORD THIS ANOTHER WAY? I'M NOT SURE HOW, BUT LET'S DISCUSS IT. THANKS -

WHAT ALL DOES THIS # INCLUDE?

~~Pueblo does not have a master plan for future water supply.~~ Currently, the Pueblo Water Board has sufficient developed water supplies (102,000 af) to meet the needs of approximately 370,000 people, based on per capita use of 250 gpcd. This per capita use consists of 188 gpcd residential and 62 gpcd commercial/industrial use and is based on 1975-89 data. (In 1995, per capita use was 243 gpcd.) The current service area population is approximately ~~102,000~~ 103,500 persons. To date, Pueblo has not needed to use Fry-Ark supplies to meet any portion of its water demands. Studies of water leasing potentials have been made to assess availability of water for base and potential markets for surplus supplies. Pueblo has stored up to 5,000 af in Pueblo Reservoir ("if and when" account). Depending on requirements for rehabilitation of Clear Creek Dam, Pueblo may request project water in the near future.

THE 1995-B&V REPORT SHOWS 216gpcd

The Pueblo Water Board will be preparing a water conservation plan to meet State requirements. All customers in the service area are metered, and system losses are estimated to be 7 percent, based on leak detection and related studies.

In addition to demands within its service area, the Pueblo Water Board has supplied from ~~6,111~~ 5,100 to ~~8,133~~ 11,300 af per year to the Comanche Power Plant, owned by Public Service Company of Colorado. Over the years, Pueblo Water Board has evaluated its storage needs, and in ~~1981~~ 1967 requested the USBR to provide dedicated storage of ~~20,000~~ 17,000 af in Fry-Ark localities. The USBR indicated that no additional storage space was available in Fry-Ark reservoirs. The Pueblo Water Board believes that 10,000 to 20,000 af of storage in the Arkansas Basin would be extremely beneficial. This would primarily be "carryover" storage to facilitate regulation of both east and west slope supplies for use during drought periods. During recent wet years, some of the water available for diversion on the West Slope has not been diverted because no storage space was available. A ~~10,000~~ 28,000 af potential reservoir on West Tennessee Creek and enlargement of Clear Creek Reservoir have been identified as options, but have not been studied in detail.

REFER TO THE TWO ATTACHED LETTERS -

*(More systems to be added.)*

### 2.2.1.10 *Public Service Company of Colorado (PSCo)*

PSCo requires approximately 9,000 to 10,000 af/yr of water for cooling and other uses at its Comanche Generating Station. Up to 10,000 af/yr may be needed by the year 2010. PSCo currently leases water from the Pueblo Water Board. At present, the minimum delivery obligation is 7,300 af/yr, but by 2010 Pueblo's obligation to PSCo will decline to 4,800 af/yr. Water is pumped from the Arkansas River to the

# A RESOLUTION INSTRUCTING THE STAFF OF THE BOARD OF WATER WORKS TO NEGOTIATE WITH THE U.S. BUREAU OF RECLAMATION FOR A TENTATIVE CONTRACT FOR WATER STORAGE.

WHEREAS, the Board of Water Works of Pueblo, Colorado has caused a study to be made by Black & Veatch, and Elliot & Associates, to determine the future storage requirements for the Water Works, and

WHEREAS, the Report of said study dated September 7, 1967 recommends that the Board purchase 7,000 acre-feet of storage in the Arkansas-Fryingpan project and further recommends that the Board ask for an option to purchase additional storage in the Fryingpan-Arkansas project up to a maximum amount of 10,000 acre-feet.

And assuming that proper negotiations can be made with the Bureau of Reclamation for acquiring the necessary storage,

THEREFORE, BE IT RESOLVED That the staff of the Board of Water Works be instructed to negotiate with the Bureau, a tentative contract for acquiring storage as recommended in the Black & Veatch and Elliot & Associates Report. Said tentative contract to be later submitted to the Board of Water Works for its consideration and approval.

ADOPTED AND APPROVED as of this 3rd day of October, 1967.

BOARD OF WATER WORKS of the
CITY OF PUEBLO

By
President

ATTEST:

Secretary

[illegible]

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION
FRYINGPAN-ARKANSAS PROJECT OFFICE
P.O. BOX 515
PUEBLO, COLORADO 81002

IN REPLY REFER TO: P-400

OCT 19 1967

Mr. Foster S. Burba, Executive Director
Board of Water Works of Pueblo
Pueblo, Colorado 81002

Dear Mr. Burba:

Thank you for sending the summary of your future population and water demand studies for Pueblo by Black and Veatch and the copy of the resolution approved by your Board October 3, 1967.

The Board's resolution requesting a total of 17,000 acre-feet (7,000 firm immediately and 10,000 firm on option) of storage capacity in the Fryingpan-Arkansas Project gives us the required basis to negotiate with the Board of Water Works for a service contract. Also, we will want to start discussions with the Board regarding the acquisition of Clear Creek Reservoir, which the project will require in connection with the development of the Project power system.

In order to initiate and move forward toward a satisfactory agreement, we will immediately proceed with gathering of information and data as the basis for such a contract. However, before we can present you with a definite draft of contract, it will be necessary that our plan for negotiations with your Board have the tentative approval of our Regional Director and the Commissioner of Reclamation.

In the meantime, we will keep you informed of our progress and may want to meet with the Board for informal discussions before we are ready with a draft form of contract.

Sincerely yours,

J. L. Ogilvie
J. L. Ogilvie
Project Manager

10-20-67
copies to Ward, Elliot, & Pike

# PUEBLO WEST

# Survey of Water Users
# in the
# Southeastern Colorado Water Conservancy District

Please take a few minutes to fill out this important survey. It will assist the Southeastern Colorado Water Conservancy District in assessing the future demand for Fryingpan-Arkansas Project water and storage space. If you have questions or comments regarding this survey, you can call Steve Arveschoug (719-544-2040). **Please complete and return the survey to the District in the enclosed envelope before Monday, September 23, 1996.** Your cooperation is appreciated.

---

Name of Organization PUEBLO WEST METROPOLITAN DISTRICT
Contact Person RICH HAYES Phone ______

User Group—Municipal XX Agricultural ____ Industrial ____
Recreation ____ Other ____

What is your primary source of supply? (surface water rights, ground water rights, or leased water, please describe)

SURFACE

Do you have a raw-water storage system? Yes XX No ______
(Please describe your existing water storage system, rights.)

Do you currently request Fryingpan-Arkansas Project Water? (If yes, please describe your existing use, amount and purpose, of Project Water)

NO

Have you used Fry-Ark Project IF-and-When storage space for the storage of your own water rights? Yes ______ No XX

## Municipal Population and Irr. Acreage Water/Storage Demand Projections

List your projected use of water and Project water (acre-feet).

Projected +

| Year | Population | Irr. acreage | Water Use | Storage Use | Proj. Water Use |
|---|---|---|---|---|---|
| Current | 9,500 | | Municipal | | 1700 AcFt |
| 2000 | 14,350 | | " | | 2680 " |
| 2010 | 28,350 | | " | | 4885 " |
| 2020 | 41,850 | | " | | 7815 " |

Please describe your projected future demand for Fry-Ark Project Water and Storage (include copies of any reports or studies which provide the basis for your projections).

500Af, WRC Engineering

## Water Resource Planning Efforts

Do you currently have a water resource plan to meet future water/storage demands? Yes______ No xx If yes, do your plans include the construction of raw-water storage facilities? Yes______ No______

Please describe your current water resource planning efforts and any construction plans.

Reuse water, purchase shares or project water

Would you be willing to participate in a cooperative effort to assess the future demands for water and storage in the Arkansas River Basin and the future need for Fry-Ark Project Water and storage.

Yes XX No______ Need more information______

Comments______

DRAFT

# SOUTHEASTERN COLORADO WATER CONSERVANCY DISTRICT

## Arkansas River Basin Water Storage and Future Needs Assessment

WATER SYSTEM SURVEY (Compiled by BWR)

### 1. General Information

**Entity** PUEBLO WEST METROPOLITAN DISTRICT

**Contact Name/District Manager** RICH HAYES

**Address** PO BOX 7005
PUEBLO WEST CO 81007

**Phone No.** ~~(719)547-2000~~

**Fax No.** (719)547-3554 FAX: (719) 547-2857

**Primary Use** [✓ Municipal] Agricultural Industrial Recreational Other

**Master Plan or other Water Resource Planning Documents?** Y [✓ N]

(If yes we must obtain it) REFER TO REUSE AND EXCHANGE PLAN

Prepared by:

**Geographic Location of Service Area** (obtain service area map)

### 2. Demographics/Water Use

*Historic Water Use*

| Year | Population | Water Use, af | $^3/_4$ -in Domestic Taps (optional) |
|---|---|---|---|
| 1987 | | | |
| 1988 | | | |
| 1989 | | | |
| 1990 | 4595 | 1294 | |
| 1991 | 4838 | 1363 | |
| 1992 | 5076 | 1369 | |
| 1993 | 5557 | 1471 | |
| 1994 | 6527 | 1560 | |
| 1995 | 7862 | 1561 | |
| 1996 | 9500 | 1700 | |

*Projected Water Use*

| Year | Population | Water Use, af | $^3/_4$ -in Domestic Taps (optional) |
|---|---|---|---|
| 2000 | ~~14350~~ | 3784 | |
| 2010 | ~~28350~~ | 7476 | |
| 2020 | ~~41850~~ | 11035 | |
| 2040 | USE AUGMENTATION PLAN POPULATION DATA | | |

**Major industrial or other uses other than domestic**

DRAFT

# SOUTHEASTERN COLORADO WATER CONSERVANCY DISTRICT

## Arkansas River Basin Water Storage and Future Needs Assessment

WATER SYSTEM SURVEY (Compiled by BWR)

### 3. Estimated Monthly Water Use

| | as a percent of total annual use,% |
|---|---|
| JAN | |
| FEB | |
| MAR | |
| APR | |
| MAY | |
| JUN | |
| JUL | |
| AUG | |
| SEP | |
| OCT | |
| NOV | |
| DEC | |
| **TOTAL** | **100%** |

Notes:

# SOUTHEASTERN COLORADO WATER CONSERVANCY DISTRICT

## Arkansas River Basin Water Storage and Future Needs Assessment

WATER SYSTEM SURVEY (Compiled by BWR)

## 4. Sources of Water

*Surface Water*

**Sources** TRANSMOUNTAIN AND TRIBUTARY SURFACE WATER
5766 SHARES

**Point of Diversion** (for larger municipalities attach map, if available)

Location PUMP STATION AT PUEBLO RESERVOIR

Capacity

*Ground Water*

**Sources**

Tributary

Nontributary DAKOTA SANDSTONE PHYSICALLY TAKE 2400 AF
UP TO 7956 AF FULL RIGHTS

Number of Wells 18 USE 13 WELLS

**Combined Annual Flow Rate** (from decrees or based on conveyance capacity)

(May only be available as an annual total)

| | | | |
|---|---|---|---|
| | gpm | cfs | af |
| JAN | | | |
| FEB | | | |
| MAR | | | |
| APR | | | |
| MAY | | | |
| JUN | | | |
| JUL | | | |
| AUG | | | |
| SEP | | | |
| OCT | | | |
| NOV | | | |
| DEC | | | |
| **TOTAL ANNUAL** | | | |

DRAFT

# SOUTHEASTERN COLORADO WATER CONSERVANCY DISTRICT

## Arkansas River Basin Water Storage and Future Needs Assessment

WATER SYSTEM SURVEY (Compiled by BWR)

### 5. Firm Yield

**District Managers may not have this information, attorneys and/ or consulting engineers may need to be contacted**

| **Monthly Average Firm Yield for 1966-1995** | **af** |
|---|---|
| JAN | |
| FEB | |
| MAR | |
| APR | |
| MAY | |
| JUN | |
| JUL | |
| AUG | |
| SEP | |
| OCT | |
| NOV | |
| DEC | |
| TOTAL ANNUAL | 13,690 AF/YR (7100 AF/YR) |

Firm yield can estimated from:

- Response of water rights during critical dry year
- Potential volume limitation per decree or well permit
- Ability to augment out of priority depletions

Consulting Engineer or Attorney

### 6. Future Water Planning

Estimated future yield of existing water rights ____________ af/yr

Conditional Water Rights

Direct flow/wells

Storage

DRAFT

# SOUTHEASTERN COLORADO WATER CONSERVANCY DISTRICT

## Arkansas River Basin Water Storage and Future Needs Assessment

WATER SYSTEM SURVEY (Compiled by BWR)

### 7. Raw Water Storage

Total Vol. in af

Type:

Fry-Ark

If and When

Shared TWIN LAKES 5766 SHARES
LAKE MEREDITH 263 SHARES

Owned 99.6 AF TO STORE RETURN FLOWS FOR EXCHANGE TO PUEBLO

### 8. Raw Water Conveyance

Type:

Pipeline

Canal

Estimated Raw Water Conveyance Losses

### 9. Treatment Plant Capacity

Type

Capacity

Also:

1. Attach copies of relevant tables and text from master plans, or water resource planning documents.
2. Compare data found in reports to data obtained from contacting entity via telephone or previous survey.

Notes:

jPueblo West Metropolitan District
WATER AND WASTEWATER
20 Palmer Lake Dr.
Pueblo West, CO
81007
Confidential

**facsimile transmittal**

**To:** Dick Westmore **Fax:** 303-779-5653

**From:** Rich Hayes **Date:** 12/11/97

**Re:** Population Projections **Pages:** 2

**CC:** Kirk Relford

☐ Urgent ☑ For Review ☐ Please Comment ☐ Please Reply ☐ Please Recycle

Dear Dick:

Attached are projections that Staff has compiled on number of water taps for Pueblo West. As you are probably aware, Pueblo West is receiving most of the growth in Pueblo County. For Budgeting purposes, we are estimating 650 new taps per year. The data that I am sending to you does not break down the size of the of the taps. Included in the 1997 of total of 4,390 taps, are 780 1-inch, 36 1¼-inch, 7 2-inch, 11 3-inch, and 1 4-inch meters.

If you need more information, Please let me know.

Thanks,

Rich Hayes
Superintendent of Water and Wastewater

Post-it™ brand fax transmittal memo 7671 # of pages ▸ 2

To Dave Bumberger
From D. Westmore
Co.
Co.
Dept.
Phone #
Fax # 719-592-1126
Fax #

## *PUEBLO WEST GROWTH - 1970 TO PRESENT*

| YEAR | # HOUSES BUILT | CUMULATIVE TOTAL | ANNUAL GROWTH | **GROWTH RATE | EST. RESIDENTS(X2.6) |
|---|---|---|---|---|---|
| 1970 | 12 | 12 | | 0.3% | |
| 1971 | 79 | 91 | 658.3% | 2.1% | 233 |
| 1972 | 139 | 230 | 152.7% | 3.8% | 589 |
| 1973 | 199 | 429 | 86.5% | 5.4% | 1098 |
| 1974 | 128 | 557 | 29.8% | 3.5% | 1426 |
| 1975 | 128 | 685 | 23.0% | 3.5% | 1754 |
| 1976 | 78 | 763 | 11.4% | 2.1% | 1953 |
| 1977 | 54 | 817 | 7.1% | 1.5% | 2092 |
| 1978 | 45 | 862 | 5.5% | 1.2% | 2207 |
| 1979 | 91 | 953 | 10.6% | 2.5% | 2440 |
| 1980 | 35 | 988 | 3.7% | 0.9% | 2529 |
| 1981 | 27 | 1015 | 2.7% | 0.7% | 2598 |
| 1982 | 31 | 1046 | 3.1% | 0.8% | 2678 |
| 1983 | 21 | 1067 | 2.0% | 0.6% | 2732 |
| 1984 | 59 | 1126 | 5.5% | 1.6% | 2883 |
| 1985 | 91 | 1217 | 8.1% | 2.5% | 3116 |
| 1986 | 114 | 1331 | 9.4% | 3.1% | 3407 |
| 1987 | 106 | 1437 | 8.0% | 2.9% | 3679 |
| 1988 | 108 | 1545 | 7.5% | 2.9% | 3955 |
| 1989 | 84 | 1629 | 5.4% | 2.3% | 4170 |
| 1990 | 73 | 1702 | 4.5% | 2.0% | 4357 |
| 1991 | 90 | 1792 | 5.3% | 2.4% | 4588 |
| 1992 | 88 | 1880 | 4.9% | 2.4% | 4813 |
| 1993 | 239 | 2119 | 12.7% | 6.5% | 5425 |
| 1994 | 358 | 2477 | 16.9% | 9.7% | 6341 |
| 1995 | 496 | 2973 | 20.0% | 13.4% | 7611 |
| 1996 | 727 | 3700 | 24.5% | 19.6% | 9472 |
| 1997 | 690 | 4390 | 18.6% | 18.6% | 11238 |

**AS % OF 1996 TOTAL

Prepared by D. Higgins and D. Dall 12/11/97

2040-1990 = 50
(50 x 234) + 4800 = 16500
@ 2040

# CHAPTER IV

# HISTORICAL WATER USES AND WASTEWATER FLOWS

## 4.1 Population and Tap Growth

The historical population growth within PWMD as reported in the census data from the U.S. Bureau of the Census is as follows:

| Year | Population |
|---|---|
| 1980 | 2493 |
| 1990 | 4800 |

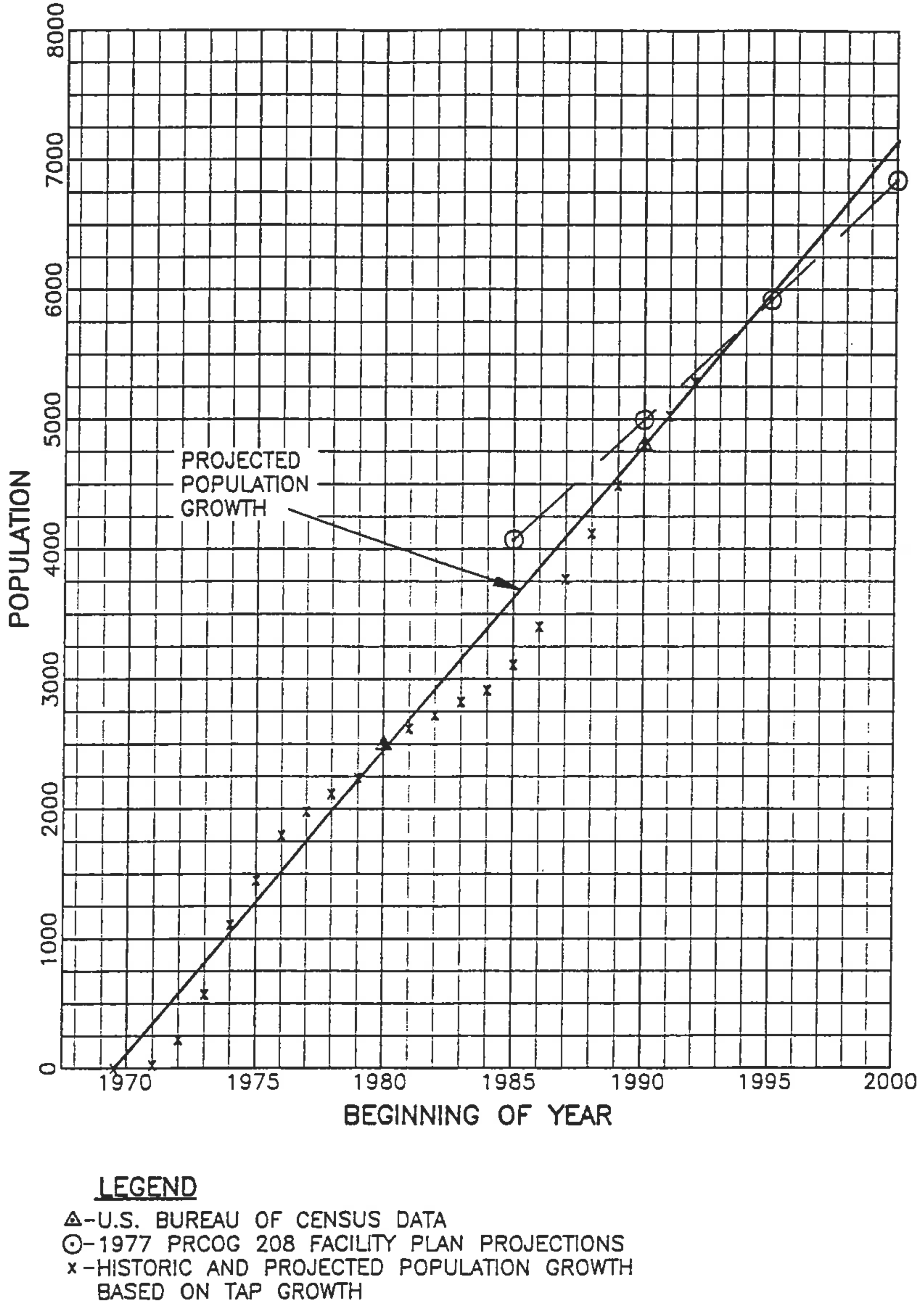
From these records, the population increased at an average rate of approximately 231 persons per year during the 1980 to 1990 period. From the District's inception in 1969, the population has increased at an average rate of approximately 234 persons per year. A more detailed analysis of population growth trends is presented in Chapter V.

Presented in Table-4 is the reported number of water taps the District has served since it's inception. The average growth in water taps from 1969 to present is about 79 taps per year.

## 4.2 Water Uses

Historical data of water uses for the District area is available from the year 1982 to 1991. However, for the years 1982 through 1985, only a limited amount of data is available. From 1986 through 1991, a more detailed accounting of water usage has been kept. Specifically, records of treatment plant inflow, treatment plant production, and backwash water, which is delivered to the Golf Course Pond, are not available or are unreliable prior to 1986. Therefore, for the purposes of this study, only post-1985 water use data is utilized in the subject analysis.

Presented in Table-5 is a summary of the water usage data from 1986 - 1991. Utilizing this data, the average yearly raw water pumped at the Arkansas River from 1986-1991 (6-years) was about 364.8 million gallons (mg). For this same period, the average yearly raw water received at the Water Treatment Plant (WTP) was about 361.1 mg. Therefore, the unaccounted raw water from Pueblo Reservoir to the WTP was approximately 3.7 mg per year or about 1.0 percent of the total average raw water diverted at Pueblo Reservoir. There are no known leaks in the raw water transmission line which would explain the calculated water loss. However, the margin of error in the three meters used to balance water usage may explain this one percent discrepancy. Diversions to PWMD are officially measured at the Arkansas River. Therefore, to obtain a mass balance for modelling purposes, either the raw water diversion to the golf course or to the water treatment plant needs to be adjusted. Since, as will be seen below, the metered WTP outflow equalled the metered WTP inflows (within one tenth



1611- . FIGURE7.DWG 05-28-92

WRC

**PUEBLO WEST**
**METROPOLITAN DISTRICT**

HISTORIC AND PROJECTED
PWMD POPULATION

FIGURE
7

# CHAPTER V

# PROJECTED POPULATION, WATER TAPS, WATER USE, AND WASTEWATER FLOWS

## 5.1 Projected Population and Water Taps

Population growth within PWMD has been fairly consistent over the past 22 years. Presented in Figure-7 are the 1980 and 1990 U.S. Bureau of the Census (BC) data for PWMD. Also shown are the 1977 Pueblo Regional Council of Governments (PRCOG) 208 Facility Plan population projections. The BC data indicates a growth of 237 people per year up to 1980, 231 people per year from 1980 to 1990, and an overall average of 234 people per year. The PRCOG study projected an increase of 185 people per year from 1985 through 2000.

Another indicator of population growth is the growth in water taps. Presented in Table-4 is the historic number of total water taps and residential water taps for PWMD. Utilizing the census data, the number of persons per residential water tap at the end of 1979 was 2.79 and at the end of 1989 was 3.13. With this data, presented on Figure-7 is the PWMD population estimates for 1969 through 1991. For 1969 through 1979, 2.79 persons per residential tap was used. From 1980 through 1989, the number of persons per residential tap was incrementally increased from 2.79 to 3.13 persons per residential tap. For 1990 and 1991, 3.13 persons per residential tap was used.

A review of Figure-7 shows that, although there have been minor fluctuations in population growth, the overall PWMD population growth has approximated a straight line growth pattern with the best fit occurring in the last three years. Based on this information, we believe that the future growth pattern of PWMD is best represented by the current growth level of 234 persons per year which matches the overall population growth from the inception of the District. The original projected ultimate population for PWMD of 65,000 persons with a total of 18938 residential lots gives an estimated population of about 3.43 persons per lot. This is higher than typical single family residential areas and could be feasible since several lots within PWMD are duplexes, fourplexes, and other multi-family units. However, for the purposes of this study, we have assumed a buildout population of 59,276 persons based on 18,938 residential taps and 3.13 persons per residential tap.

Based on a growth of 234 persons per year and an ultimate population of 59,276 persons, buildout is expected to occur in the year 2222. This represents an overall buildout time period of 253 years from 1969 or 231 years from 1991.

The distribution of future growth used to predict future return flows is based on the current growth distribution patterns within PWMD. For example, those areas which have experienced faster historic growth are assumed to continue this growth until full buildout (less than 253 years). Those areas experiencing slower growth are modelled at their respective historic growth rate but are adjusted (if necessary) to obtain buildout in 253 years.

## 5.2 Projected Water Use and Wastewater Returns

Water uses in the PWMD depend on the zoning established in 1969 which includes residential, commercial, industrial, and golf course land uses as well as other miscellaneous land uses (i.e. churches, schools, parks, and equestrian and recreation centers). The best predictor of future water use (and wastewater flows) for PWMD is the current water use (and wastewater flows) as long as the composition of future development is expected to match the existing development composition. For PWMD, the existing composition of developed residential lots as related to total developed lots is about 94.7 percent. At full build-out, the expected composition of residential lots to the total number of lots within PWMD is about 95.3 percent. Since the existing and future composition of PWMD is expected to change very little as evidenced above, and since PWMD is almost exclusively residential development, the existing water use and wastewater flows are used to estimate future water demands and wastewater flows.

## 5.3 Projected In-house Water Use

242 G/UNIT ÷ 3.13 = 77.3 GCD

Average in-house water usage is estimated from the historic winter water usage for the months of December, January, February, and March. For the 1986-1991 period, the winter water usage averaged about 242 gallons per tap per day. Using an average number of residential, commercial, and industrial taps for 1986-1991 of 1493, the total average yearly in-house water use in the PWMD was 131.9 mg. Projected in-house water usage for the purposes of this study is assumed to be 242 gallons per tap per day.

## 5.4 Outside Irrigation Consumptive Use

Determination of return flows from outside irrigation for this study was based on the extensive irrigation return flow studies completed for the City of Colorado Springs in Division 2 Water Court Case Nos. 89CW36, 84CW202, 84CW203, and 86CW118; for Arapahoe Water and Sanitation District (AWSD) in Division 1 Water Court Case No. 86CW388, and for the Cottonwood Water and Sanitation District (CWSD) in Division 1 Water Court No. 81CW142. In these cases, estimates and measurements were made for spray application losses, application rates, surface runoff, deep percolation, potential and actual consumptive use, and losses due to trees and shrubs. Based on a review of these estimates and measurements, as well as our field observations of irrigation within PWMD, the following parameters were adopted for use in this study:

?

NO ESTIMATES OF ACREAGES?

| | |
|---|---|
| Spray application losses | 5% |
| Other outside use losses | 3% |
| Application runoff | 2% |

SLOPING ?

Potential irrigation consumptive use was computed using the Modified Blaney-Criddle method assuming irrigation occurs from March 15th through November 15th. Effective precipitation (less than 1" per day intensity) was estimated as 90 percent of actual average precipitation or 0.71 feet per year. Growth coefficients for lawn grass utilized in the AWSD analysis were utilized for this study. Based on these parameters, the potential consumptive use requirement was computed to be 3.49 feet per year.

GRASS AMOUNT NOT KNOWN

## 5.5 Projected Outside Water Use

Outside water use is computed by subtracting the delivered in-house water from the total water delivery. Thus, for 1986-1991, the average outside water use within PWMD was 239.9 mg - 131.9 mg = 108.0 mg per year (331.4 A.F per year). The total existing irrigated area within the PWMD is not currently available. Therefore, for modelling purposes, we have assumed that typical water application rates approximate the potential consumptive use requirement minus the effective precipitation or 2.78 feet per year. Given that 10 percent of the water delivered to outside uses is not considered effective rigation, the gross amount of water delivered to outside uses estimated to be 2.78/0.9 = 3.09 feet r year.

CAN BE MSRD

90% EFFICIENCY ?

Utilizing this rate, the estimated 1986-1991 average irrigated area within PWMD was assumed to be 331.4/3.09 or about 107 acres. Based on field observations, allocation of outside water use for modelling purposes was assumed using the following guidelines:

1. Irrigated area for the commercial and industrial land use areas is about 10% of the total lot area or 3424 square feet per commercial lot and 10,881 square feet per industrial lot.

2. Residential irrigated area per lot served by septic systems is about 70% of the amount of irrigated area per residential lot in the sewered area. The resulting irrigated areas for residential lots is about 3,100 square feet per residential sewered lot and 2,170 square feet per residential non-sewered lot.

TOO LOOSE

## 5.6 Projected Golf Course Irrigation

The average annual water supplied to the golf course (from the golf course pond) has historically (1986-1991) been about 94.4 mg for an estimated 125 acres of irrigation. This reduces to an average water application of 2.32 acre-feet per acre per year. Based on our experience and the computed potential irrigation consumptive use, this water use figure appears low.

Discussions with PWMD personnel has revealed that golf course water usage in the past 6 years (especially 1986, 1987, and 1988) has not been representative of the golf course water usage occurring prior to 1986. This is mainly due to poor golf course management which allowed several previously grassed areas to be dried up. These areas are expected to or have been regrassed after changes were made in the golf course management. Therefore, for modelling purposes, the golf course water application rate is assumed to equal the potential irrigation consumptive use less the estimated 90% effective precipitation factor as previously discussed. The resulting water supply (before losses) rate of 3.09 feet per year yields a yearly water requirement of 386.3 acre-feet (125.9 mg) for 125 acres. This rate is used for future golf course water supply projections.

90% EFFICIENT ?

## 5.7 Irrigation Return Flows

Deep percolation of irrigation water is determined utilizing the following equations:

DOES THIS APPLY?

1.6 −.5 = 1.

1.6 For $\frac{AW}{PCU} \le 160\%$ $DP = AW\,(0.342)\,[(AW/PCU)-0.504]$ = 1.05 AF/AC

160 = 62 ½ % EFFICIENT

For $\frac{AW}{PCU} > 160\%$ $DP = [(AW/PCU)-100]/(AW/PCU)$ = (1.6 − 1.0) ÷ 1.6 = .375

where: DP = Deep Percolation (A.F.)
AW = Applied Water (A.F.)
PCU = Potential Consumptive Use (A.F.)

This equation was derived from lysimeter studies completed for the previously mentioned AWSD and CWSD cases. In addition, a one percent loss of the deep percolation inflow was assessed to account for tree canopy effects.

## 5.8 Wastewater Flows and Returns

Wastewater returns within PWMD are generated from two sources: Septic absorption systems and the Wastewater Treatment Plant (WWTP). For 1986-1991, an average of 67.3 percent of the total in-house supplied water was used in areas served by the sanitary sewer system. Therefore, for 1986-1991, the in-house water use in the sanitary sewered area averaged about 88.7 mg per year. Given the average 1986-1991 wastewater treatment facility inflows of 85.8 mg per year, the in-house consumptive water use in PWMD, ignoring infiltration and inflows, averaged 3.3 percent of the total water supplied. Past inflow and infiltration studies have indicated that inflows and infiltration (if any) represent a very small portion of the total wastewater flows. However, no current measurements of inflow or infiltration have been made. Therefore, for modelling purposes, we have assumed an average in-house consumptive use of five percent.

For the septic system areas, total return flow to the groundwater system is estimated to be 85 percent of the water supplied to said area for in-house use. This allows for a 15 percent in-house use and septic system loss.

## 5.9 Projected Full Buildout Water Use and Wastewater Flows

The projected full buildout annual water use and wastewater flows are as follows:

A. Water Use

Raw water diversions from Arkansas River = 9528 A.F.
Raw water deliveries to Golf Course = 394 A.F.
Treated raw water = 9134 A.F.
Sewered area in-house use = 1970 A.F.
Septic system area in-house use = 3417 A.F.
Outside uses deliveries = 3691 A.F.

B. Wastewater flows

Septic systems returns = 2904 A.F.
WWTP inflow = 1871 A.F.
WWTP outflow = 1853 A.F.

# ST. CHARLES MESA

RECEIVED
SEP 9 1996
Southeastern Colorado Water
Conservancy District

# Survey of Water Users
# in the
# Southeastern Colorado Water Conservancy District

Please take a few minutes to fill out this important survey. It will assist the Southeastern Colorado Water Conservancy District in assessing the future demand for Fryingpan-Arkansas Project water and storage space. If you have questions or comments regarding this survey, you can call Steve Arveschoug (719-544-2040). **Please complete and return the survey to the District in the enclosed envelope before Monday, September 23, 1996.** Your cooperation is appreciated.

---

Name of Organization St. Charles Mesa Water District
Contact Person Lee W. Simpson Phone (719)542-4380

User Group—Municipal x Agricultural____ Industrial____
Recreation____ Other____

What is your primary source of supply? (surface water rights, ground water rights, or leased water, please describe)

Surface - 87%
Ground - 13%

Do you have a raw-water storage system? Yes x No ____
(Please describe your existing water storage system, rights.)

Two (2) reservoirs 600 AF 90 AF

Do you currently request Fryingpan-Arkansas Project Water? (If yes, please describe your existing use, amount and purpose, of Project Water)

Yes. Buy approximately 300 AF per year. Use some during winter storage.
Try to maintain 1800 AF in project storage.

Have you used Fry-Ark Project IF-and-When storage space for the storage of your own water rights? Yes____ No x

## Arkansas Valley Pipeline

Are you aware of the Fry-Ark Project's originally proposed Arkansas Valley Pipeline? Yes_X__ No______ If yes, would you have an interest in taking another look at the cost/benefits of such a treated-water delivery system?

Comments ____ Yes. It may be that the Safe Drinking Water Act and Water Quality Standards would cause potential participants to take another serious look.

## Any additional comments?

St. Charles Mesa Water District has an investment in the 1979 Allocation Principals. The Allocation Principals have worked for 17 years. The District would probably not support any changes.

Thank you for your help!

DRAFT

# SOUTHEASTERN COLORADO WATER CONSERVANCY DISTRICT

## Arkansas River Basin Water Storage and Future Needs Assessment

WATER SYSTEM SURVEY (Compiled by BWR)

### 1. General Information

**Entity** ST. CHARLES MESA WATER DISTRICT

**Contact Name/District Manager** LEE W. SIMPSON

**Address**

**Phone No.** (719) 542 - 4380

**Fax No.** (719) 542 - 4862

**Primary Use** [✓ Municipal] Agricultural Industrial Recreational Other

**Master Plan or other Water Resource Planning Documents?** Y N

(If yes we must obtain it)

**Prepared by:**

**Geographic Location of Service Area** (obtain service area map)

### 2. Demographics/Water Use

*Historic Water Use*

| Year | Population | Water Use, af | $^3/_4$ -in Domestic Taps (optional) |
|---|---|---|---|
| 1987 | | | |
| 1988 | | | |
| 1989 | | | |
| 1990 | 9456 | 1699 | |
| 1991 | 9549 | 1889 | |
| 1992 | 9672 | 1821 | |
| 1993 | 9807 | 1879 | |
| 1994 | 9942 | 2079 | |
| 1995 | 10140 | 1999 | |
| 1996 | 10263 | 2020 | |

*Projected Water Use*

| Year | Population | Water Use, af | $^3/_4$ -in Domestic Taps (optional) |
|---|---|---|---|
| 2000 | 10743 | 3008 | |
| 2010 | 11943 | 3345 | |
| 2020 | 13143 | 3681 | |
| 2040 | | | |

**Major industrial or other uses other than domestic**

# SOUTHEASTERN COLORADO WATER CONSERVANCY DISTRICT

## Arkansas River Basin Water Storage and Future Needs Assessment

WATER SYSTEM SURVEY (Compiled by BWR )

| 3. Estimated Monthly Water Use | |
|---|---|
| | as a percent of total annual use,% |
| JAN | |
| FEB | |
| MAR | |
| APR | |
| MAY | |
| JUN | |
| JUL | |
| AUG | |
| SEP | |
| OCT | |
| NOV | |
| DEC | |
| **TOTAL** | **100%** |

Notes:

DRAFT

# SOUTHEASTERN COLORADO WATER CONSERVANCY DISTRICT

## Arkansas River Basin Water Storage and Future Needs Assessment

WATER SYSTEM SURVEY (Compiled by BWR)

### 4. Sources of Water

*Surface Water*

**Sources** SURFACE 87 %
GROUND WATER 13 %

+10% Bessemer Ditch. (?)

**Point of Diversion** (for larger municipalities attach map, if available)

Location ST. CHARLES RIVER 600 AF
COTTONWOOD CREEK IN BUENAVISTA 1040 AF

Capacity

*Ground Water*

**Sources** WELLS

Tributary

Nontributary

Number of Wells

**Combined Annual Flow Rate** (from decrees or based on conveyance capacity)

(May only be available as an annual total)

| | gpm | cfs | af |
|---|---|---|---|
| JAN | | | |
| FEB | | | |
| MAR | | | |
| APR | | | |
| MAY | | | |
| JUN | | | |
| JUL | | | |
| AUG | | | |
| SEP | | | |
| OCT | | | |
| NOV | | | |
| DEC | | | |
| **TOTAL ANNUAL** | | | |

DRAFT

# SOUTHEASTERN COLORADO WATER CONSERVANCY DISTRICT

## Arkansas River Basin Water Storage and Future Needs Assessment

WATER SYSTEM SURVEY (Compiled by BWR)

### 5. Firm Yield

**District Managers may not have this information, attorneys and/ or consulting engineers may need to be contacted**

| Monthly Average Firm Yield for 1966-1995 | af |
|---|---|
| JAN | |
| FEB | |
| MAR | |
| APR | |
| MAY | |
| JUN | |
| JUL | |
| AUG | |
| SEP | |
| OCT | |
| NOV | |
| DEC | |
| TOTAL ANNUAL | |

Firm yield can estimated from:

- Response of water rights during critical dry year
- Potential volume limitation per decree or well permit
- Ability to augment out of priority depletions

Consulting Engineer or Attorney

### 6. Future Water Planning

Estimated future yield of existing water rights ____________ af/yr

Conditional Water Rights

Direct flow/wells

Storage
RESERVOIR ENLARGEMENT (ST. CHARLES RESERVOIR)
TRANSFER BESSEMER SHARES TO MUNICIPAL USE

DRAFT

# SOUTHEASTERN COLORADO WATER CONSERVANCY DISTRICT

## Arkansas River Basin Water Storage and Future Needs Assessment

WATER SYSTEM SURVEY (Compiled by BWR)

### 7. Raw Water Storage

Total Vol. in af

Type:

Fry-Ark TRY TO MAINTAIN 1800 AF IN STORAGE

If and When

Shared

Owned 690 AF

### 8. Raw Water Conveyance

Type:

Pipeline

Canal

Estimated Raw Water Conveyance Losses

### 9. Treatment Plant Capacity

Type

Capacity

Also:

1. Attach copies of relevant tables and text from master plans, or water resource planning documents.
2. Compare data found in reports to data obtained from contacting entity via telephone or previous survey.

Notes:

December 2, 1997

RE
DEC 1997
South
C

Tom Simpson
Water Resource Manager
Southeastern Colorado Water Conservancy District
P.O. Box 440
Pueblo, Colorado

Re: Draft Report Section 2.2.1.14

Dear Tom:

Please consider wording the above referenced section as follows:

*2.2.1.14 St. Charles Mesa Water District (WD)*

Current population within the service area of the St. Charles Mesa WD is approximately 10,300 persons. Water use is approximately 2020 af/yr. Surface water accounts for 87 percent of the supply. The District has two raw water storage reservoirs, totaling 690 af, with plans to enlarge one reservoir to 1200 af. Water sources include shallow wells, shares in the Bessemer Ditch, water rights from the St. Charles River, water rights from Cottonwood Creek (Buena Vista) and the Blende Townsite water rights from the Arkansas River. The District buys 300 to 350 af/yr of Fry-Ark Project Water. Over the long term, the St. Charles Mesa Water District will probably increase its use of Project water subject to availability to 2700 af/yr by the year 2020.

Ⓙ

Sincerely,

Lee W. Simpson

Lee W. Simpson,
District Manager.

LWS/sj

1397 Aspen Road / Pueblo, Colorado 81006-1633 / Phone (719) 542-4380 / Fax (719) 542-4862

# CROWLEY COUNTY

RECEIVED
SEP 23 1996
Southeastern Colorado Water
Conservancy District

# Survey of Water Users
# in the
# Southeastern Colorado Water Conservancy District

Please take a few minutes to fill out this important survey. It will assist the Southeastern Colorado Water Conservancy District in assessing the future demand for Fryingpan-Arkansas Project water and storage space. If you have questions or comments regarding this survey, you can call Steve Arveschoug (719-544-2040). **Please complete and return the survey to the District in the enclosed envelope before Monday, September 23, 1996.** Your cooperation is appreciated.

---

Name of Organization CROWLEY COUNTY
Contact Person CAROL MUMM Phone (719) 267-3248

User Group—Municipal X Agricultural____ Industrial____
Recreation____ Other____

What is your primary source of supply? (surface water rights, ground water rights, or leased water, please describe)
Our primary source of supply is leased water. Crowley County has available upon call surface water rights These surface rights are currently leased to area farmers

Do you have a raw-water storage system? Yes X No ____
(Please describe your existing water storage system, rights.)
Twin Lakes if needed.

Do you currently request Fryingpan-Arkansas Project Water? (If yes, please describe your existing use, amount and purpose, of Project Water)
Yes, Crowley County leases 750 acre-feet of project water to augment their wells. This water is used in the County water system.

Have you used Fry-Ark Project IF-and-When storage space for the storage of your own water rights? Yes X No____

## Municipal Population and Irr. Acreage Water/Storage Demand Projections

List your projected use of water and Project water (acre-feet).

| Year | Population | Irr. acreage | Water Use | Storage Use | Proj. Water Use |
|---|---|---|---|---|---|
| Current | 4302 | | Municipal | 1088 | 750 AF |
| 2000 | 4400 | | Municipal | 2000 | 800 AF |
| 2010 | 4500 | | Municipal | 2250 | 850 AF |
| 2020 | 5000 | | Municipal | 2500 | 900 AF |

Please describe your projected future demand for Fry-Ark Project Water and Storage (include copies of any reports or studies which provide the basis for your projections).

Crowley County has started to grow. We have an increased number of new housing units within the county and all rental property is full. The projects above show a steady county growth pattern.

## Water Resource Planning Efforts

Do you currently have a water resource plan to meet future water/storage demands? Yes______ No__X__ If yes, do your plans include the construction of raw-water storage facilities? Yes______ No______

Please describe your current water resource planning efforts and any construction plans.

Lake Meredith & Lake Henry are situated within Crowley County. There is a possibility of storage in the lakes if an upstream trade is available. Also Twin Lakes is another option for storage.

Would you be willing to participate in a cooperative effort to assess the future demands for water and storage in the Arkansas River Basin and the future need for Fry-Ark Project Water and storage.

Yes______ No______ Need more information__X__

Comments______

DRAFT

# SOUTHEASTERN COLORADO WATER CONSERVANCY DISTRICT

## Arkansas River Basin Water Storage and Future Needs Assessment

WATER SYSTEM SURVEY (Compiled by JM R)

## 1. General Information

**Entity** CROWLEY COUNTY

**Contact Name/District Manager** CAROL MUMM

**Address** 110 EAST SIXTH STREET
ORDWAY, CO 81063

**Phone No.** (719) 267-3248

**Fax No.** (719) 267-4608

**Primary Use** [✓ Municipal] Agricultural Industrial Recreational Other

**Master Plan or other Water Resource Planning Documents?** Y [✓ N]

(If yes we must obtain it)

**Prepared by:**

**Geographic Location of Service Area** (obtain service area map)

## 2. Demographics/Water Use

*Historic Water Use*

| Year | Population | Water Use, af | 3/4 -in Domestic Taps (optional) |
|---|---|---|---|
| 1987 | | 435 | |
| 1988 | | 573 | |
| 1989 | | 539 | |
| 1990 | 3196 | 483 | |
| 1991 | 3152 | 527 | |
| 1992 | 3268 | 552 | |
| 1993 | 3348 | 544 | |
| 1994 | 3431 | 597 | |
| 1995 | 3483 | 625 | |
| 1996 | 3595 | 598 | |

*Projected Water Use*

| Year | Population | Water Use, af | 3/4 -in Domestic Taps (optional) |
|---|---|---|---|
| 2000 | 4609 | 778 | |
| 2010 | 5000 | 939 | |
| 2020 | 5500 | 1099 | |
| 2040 | 6000 | 1260 | |

**Major industrial or other uses other than domestic**

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# SOUTHEASTERN COLORADO WATER CONSERVANCY DISTRICT

## Arkansas River Basin Water Storage and Future Needs Assessment

WATER SYSTEM SURVEY (Compiled by JMR)

### 3. Estimated Monthly Water Use

| | as a percent of total annual use,% |
|---|---|
| JAN | |
| FEB | |
| MAR | |
| APR | |
| MAY | |
| JUN | |
| JUL | |
| AUG | |
| SEP | |
| OCT | |
| NOV | |
| DEC | |
| **TOTAL** | **100%** |

Notes: CROWLE COUNTY WHOLESALES WATER TO

1. CROWLEY COUNTY WATER ASSOCIATION
2. 96 PIPELINE
3. TOWN OF ORDWAY
4. TOWN of CROWLEY.

THE MAIN SYSTEM LINES RUN FROM 2 MILES SW OF UINEY SPRINGS TO 2 MILES EAST OF ORDWAY FROM THE ARKANSAS RIVER TO 12 MILES NORTH OF THE ARKANSAS RIVER

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# SOUTHEASTERN COLORADO WATER CONSERVANCY DISTRICT

## Arkansas River Basin Water Storage and Future Needs Assessment

WATER SYSTEM SURVEY (Compiled by JMR)

### 4. Sources of Water

*Surface Water*

**Sources**

**Point of Diversion** **(for larger municipalities attach map, if available)**

Location

Capacity

*Ground Water*

**Sources**

Tributary ARKANSAS RIVER

Nontributary

Number of Wells 5

**Combined Annual Flow Rate** (from decrees or based on conveyance capacity)

(May only be available as an annual total)

| | gpm | cfs | af |
|---|---|---|---|
| JAN | | | |
| FEB | | | |
| MAR | | | |
| APR | | | |
| MAY | | | |
| JUN | | | |
| JUL | | | |
| AUG | | | |
| SEP | | | |
| OCT | | | |
| NOV | | | |
| DEC | | | |
| **TOTAL ANNUAL** | | | |

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# SOUTHEASTERN COLORADO WATER CONSERVANCY DISTRICT

## Arkansas River Basin Water Storage and Future Needs Assessment

WATER SYSTEM SURVEY (Compiled by JMR)

## 5. Firm Yield

**District Managers may not have this information, attorneys and/ or consulting engineers may need to be contacted**

| | |
|---|---|
| **Monthly Average Firm Yield for 1966-1995** | **af** |
| JAN | |
| FEB | |
| MAR | |
| APR | |
| MAY | |
| JUN | |
| JUL | |
| AUG | |
| SEP | |
| OCT | |
| NOV | |
| DEC | |
| TOTAL ANNUAL | 644 AF/YR |

Firm yield can estimated from:

- Response of water rights during critical dry year
- Potential volume limitation per decree or well permit
- Ability to augment out of priority depletions

Consulting Engineer or Attorney

## 6. Future Water Planning

Estimated future yield of existing water rights ____________af/yr

Conditional Water Rights

Direct flow/wells

Storage

# SOUTHEASTERN COLORADO WATER CONSERVANCY DISTRICT

## Arkansas River Basin Water Storage and Future Needs Assessment

WATER SYSTEM SURVEY (Compiled by ____________)

### 7. Raw Water Storage

Total Vol. in af
12 4 8 AF (PUEBLO RESERVOIR)

Type:
Fry-Ark 950 AF

If and When

Shared

* ONLY F NO OTHER WATER IS AVAILABLE

Owned *TWIN LAKES 507.4 AF COLORADO CANAL 507.74 AF

### 8. Raw Water Conveyance

Type:
Pipeline

Canal

Estimated Raw Water Conveyance Losses

### 9. Treatment Plant Capacity

Type

Capacity

Also:

1. Attach copies of relevant tables and text from master plans, or water resource planning documents.
2. Compare data found in reports to data obtained from contacting entity via telephone or previous survey.

Notes:

# ORDWAY

DRAFT

# SOUTHEASTERN COLORADO WATER CONSERVANCY DISTRICT

## Arkansas River Basin Water Storage and Future Needs Assessment

WATER SYSTEM SURVEY (Compiled by BWR)

### 1. General Information

**Entity** TOWN OF ORDWAY

**Contact Name/District Manager** GEORGE JOHNSON

**Address** ORDWAY WATER DEPARTMENT
315 MAIN
ORDWAY, CO 81063

**Phone No.** (719) 267 - 3135

**Fax No.** ( ) -

**Primary Use** [✓ Municipal] Agricultural Industrial Recreational Other

**Master Plan or other Water Resource Planning Documents?** Y N
(If yes we must obtain it)
**Prepared by:**

**Geographic Location of Service Area** (obtain service area map)

### 2. Demographics/Water Use

*Historic Water Use*

| Year | Population | Water Use, af | $^3/_4$ -in Domestic Taps (optional) |
|---|---|---|---|
| 1987 | | | |
| 1988 | | | |
| 1989 | | | |
| 1990 | | | |
| 1991 | | | |
| 1992 | | | |
| 1993 | | | |
| 1994 | | | |
| 1995 | | | |
| 1996 | | | |

*Projected Water Use*

| Year | Population | Water Use, af | $^3/_4$ -in Domestic Taps (optional) |
|---|---|---|---|
| 2000 | | | |
| 2010 | | | |
| 2020 | | | |
| 2040 | | | |

**Major industrial or other uses other than domestic**

DRAFT

# SOUTHEASTERN COLORADO WATER CONSERVANCY DISTRICT

## Arkansas River Basin Water Storage and Future Needs Assessment

WATER SYSTEM SURVEY (Compiled by BWR)

| 3. Estimated Monthly Water Use | |
|---|---|
| | as a percent of total annual use,% |
| JAN | |
| FEB | |
| MAR | |
| APR | |
| MAY | |
| JUN | |
| JUL | |
| AUG | |
| SEP | |
| OCT | |
| NOV | |
| DEC | |
| **TOTAL** | 100% |

Notes: PURCHASE WATER FROM CROWLEY COUNTY WATER

WATER PUMPED BY ORDWAY ENTERS SYSTEM AND IS DEDUCTED FROM WATER DELIVERED BY CROWLEY COUNTY

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# SOUTHEASTERN COLORADO WATER CONSERVANCY DISTRICT

## Arkansas River Basin Water Storage and Future Needs Assessment

WATER SYSTEM SURVEY (Compiled by BWR)

### 4. Sources of Water

*Surface Water*

**Sources**

"VERY LITTLE" "SMALL BACKUP SYSTEM"

**Point of Diversion** (for larger municipalities attach map, if available)

Location

Capacity

*Ground Water*

**Sources**

Tributary

Nontributary ALLUVIAL WELLS AT HORSE CREEK

Number of Wells

**Combined Annual Flow Rate** (from decrees or based on conveyance capacity)

(May only be available as an annual total)

| | gpm | cfs | af |
|---|---|---|---|
| JAN | | | |
| FEB | | | |
| MAR | | | |
| APR | | | |
| MAY | | | |
| JUN | | | |
| JUL | | | |
| AUG | | | |
| SEP | | | |
| OCT | | | |
| NOV | | | |
| DEC | | | |
| **TOTAL ANNUAL** | | | |

# SOUTHEASTERN COLORADO WATER CONSERVANCY DISTRICT
## Arkansas River Basin Water Storage and Future Needs Assessment
WATER SYSTEM SURVEY (Compiled by BWR)

## 5. Firm Yield

**District Managers may not have this information, attorneys and/ or consulting engineers may need to be contacted**

| | |
|---|---|
| **Monthly Average Firm Yield for 1966-1995** | **af** |
| JAN | |
| FEB | |
| MAR | |
| APR | |
| MAY | |
| JUN | |
| JUL | |
| AUG | |
| SEP | |
| OCT | |
| NOV | |
| DEC | |
| TOTAL ANNUAL ~90 AF | |

Firm yield can estimated from:
- Response of water rights during critical dry year
- Potential volume limitation per decree or well permit
- Ability to augment out of priority depletions

Consulting Engineer or Attorney

## 6. Future Water Planning

Estimated future yield of existing water rights ___________af/yr

Conditional Water Rights
Direct flow/wells

Storage

SOUTHEASTERN COLORADO WATER CONSERVANCY DISTRICT
Arkansas River Basin Water Storage and Future Needs Assessment
WATER SYSTEM SURVEY (Compiled by BWR)

| 7. Raw Water Storage |
|---|
| Total Vol. in af |
| Type:<br>Fry-Ark<br>If and When<br>Shared<br>Owned |

| 8. Raw Water Conveyance |
|---|
| Type:<br>Pipeline<br>Canal |
| Estimated Raw Water Conveyance Losses |

| 9. Treatment Plant Capacity |
|---|
| Type |
| Capacity |

Also:

1. Attach copies of relevant tables and text from master plans, or water resource planning documents.
2. Compare data found in reports to data obtained from contacting entity via telephone or previous survey.

Notes:

# FOWLER

RECEIVED
SEP 2[illegible] 1996
Southeastern Colorado Water Conservancy District

# Survey of Water Users
# in the
# Southeastern Colorado Water Conservancy District

Please take a few minutes to fill out this important survey. It will assist the Southeastern Colorado Water Conservancy District in assessing the future demand for Fryingpan-Arkansas Project water and storage space. If you have questions or comments regarding this survey, you can call Steve Arveschoug (719-544-2040). **Please complete and return the survey to the District in the enclosed envelope before Monday, September 23, 1996.** Your cooperation is appreciated.

---

Name of Organization TOWN OF FOWLER
Contact Person KEVIN HAGERMAN Phone 719-263-4461

User Group—Municipal X Agricultural____ Industrial____
Recreation____ Other____

What is your primary source of supply? (surface water rights, ground water rights, or leased water, please describe)

GROUND WATER RIGHTS

Do you have a raw-water storage system? Yes____ No X
(Please describe your existing water storage system, rights.)

Do you currently request Fryingpan-Arkansas Project Water? (If yes, please describe your existing use, amount and purpose, of Project Water)

NO

Have you used Fry-Ark Project IF-and-When storage space for the storage of your own water rights? Yes X No____

## Municipal Population and Irr. Acreage Water/Storage Demand Projections

List your projected use of water and Project water (acre-feet).

| Year | Population | Irr. acreage | Water Use | Storage Use | Proj. Water Use |
|---|---|---|---|---|---|
| Current | 1183 | | 370 | 304.88 | 304.88 |
| 2000 | 1195 | | 330 | 380 | 380 |
| 2010 | 2000 | | 385 | 385 | 385 |
| 2020 | 2010 | | 385 | 385 | 285 |

Please describe your projected future demand for Fry-Ark Project Water and Storage (include copies of any reports or studies which provide the basis for your projections).

AS POPULATION & DEMAND INCREASE, OUR NEED OF AUGMENTATION WATER WILL ALSO INCREASE. THE TOWN HAS NO STORAGE SPACE & HAS NO PLANS TO BUILD STORAGE SPACE IN THE FUTURE.

## Water Resource Planning Efforts

Do you currently have a water resource plan to meet future water/storage demands? Yes_______ No X If yes, do your plans include the construction of raw-water storage facilities? Yes______ No______

Please describe your current water resource planning efforts and any construction plans.

Would you be willing to participate in a cooperative effort to assess the future demands for water and storage in the Arkansas River Basin and the future need for Fry-Ark Project Water and storage.

Yes______ No________ Need more information X

Comments________________________

# SOUTHEASTERN COLORADO WATER CONSERVANCY DISTRICT

## Arkansas River Basin Water Storage and Future Needs Assessment

WATER SYSTEM SURVEY (Compiled by BWR)

### 1. General Information

**Entity** TOWN OF FOWLER

**Contact Name/District Manager** KEVIN HAGERMAN

**Address** 101 EAST SANTA FE
FOWLER, CO 81039

**Phone No.** (719) 263-4461

**Fax No.** (719) 263-5845

**Primary Use** [✓ Municipal] Agricultural Industrial Recreational Other

**Master Plan or other Water Resource Planning Documents?** Y [✓ N]
(If yes we must obtain it)
**Prepared by:**

**Geographic Location of Service Area** (obtain service area map)

### 2. Demographics/Water Use

*Historic Water Use*

| Year | Population | Water Use, af | $^3/_4$ -in Domestic Taps (optional) |
|---|---|---|---|
| 1987 | | | |
| 1988 | | | |
| 1989 | | | |
| 1990 | 1154 | 352 | |
| 1991 | 1154 | 361 | |
| 1992 | 1154 | 310 | |
| 1993 | 1154 | 310 | |
| 1994 | 1173 | | |
| 1995 | 1173 | 370 | |
| 1996 | 1183 | 370 | |

*Projected Water Use*

| Year | Population | Water Use, af | $^3/_4$ -in Domestic Taps (optional) |
|---|---|---|---|
| 2000 | 1195 | 380 | |
| 2010 | 2000 | 385 | |
| 2020 | 2010 | 385 | |
| 2040 | | | |

**Major industrial or other uses other than domestic**

# SOUTHEASTERN COLORADO WATER CONSERVANCY DISTRICT

## Arkansas River Basin Water Storage and Future Needs Assessment

WATER SYSTEM SURVEY (Compiled by BwR)

| 3. Estimated Monthly Water Use | |
|---|---|
| | as a percent of total annual use,% |
| JAN | |
| FEB | |
| MAR | |
| APR | |
| MAY | |
| JUN | |
| JUL | |
| AUG | |
| SEP | |
| OCT | |
| NOV | |
| DEC | |
| TOTAL | 100% |

Notes:

DRAFT

# SOUTHEASTERN COLORADO WATER CONSERVANCY DISTRICT

## Arkansas River Basin Water Storage and Future Needs Assessment

WATER SYSTEM SURVEY (Compiled by BWR)

## 4. Sources of Water

### *Surface Water*

**Sources**

**Point of Diversion** (for larger municipalities attach map, if available)

Location

Capacity

### *Ground Water*

**Sources**

Tributary

Nontributary

Number of Wells

7 WELLS 5 ACTIVE NON POTABLE

**Combined Annual Flow Rate** (from decrees or based on conveyance capacity)

(May only be available as an annual total)

| | gpm | cfs | af |
|---|---|---|---|
| JAN | | | |
| FEB | | | |
| MAR | | | |
| APR | | | |
| MAY | | | |
| JUN | | | |
| JUL | | | |
| AUG | | | |
| SEP | | | |
| OCT | | | |
| NOV | | | |
| DEC | | | |
| **TOTAL ANNUAL** | | | |

# SOUTHEASTERN COLORADO WATER CONSERVANCY DISTRICT

## Arkansas River Basin Water Storage and Future Needs Assessment

WATER SYSTEM SURVEY (Compiled by BWR)

### 5. Firm Yield

District Managers may not have this information, attorneys and/ or consulting engineers may need to be contacted

| Monthly Average Firm Yield for 1966-1995 | af |
|---|---|
| JAN | |
| FEB | |
| MAR | |
| APR | |
| MAY | |
| JUN | |
| JUL | |
| AUG | |
| SEP | |
| OCT | |
| NOV | |
| DEC | |
| TOTAL ANNUAL ~ 60 AF | |

Firm yield can estimated from:

- Response of water rights during critical dry year
- Potential volume limitation per decree or well permit
- Ability to augment out of priority depletions

Consulting Engineer or Attorney

WATER STUDY COMPLETED LAST YEAR

### 6. Future Water Planning

Estimated future yield of existing water rights ____________ af/yr

Conditional Water Rights

Direct flow/wells

Storage

WATER SYSTEM SURVEY (Compiled by BWR)

## 7. Raw Water Storage

Total Vol. in af

Type:
Fry-Ark 230 AF IN PUEBLO

If and When

Shared

Owned

## 8. Raw Water Conveyance

Type:
Pipeline

Canal

Estimated Raw Water Conveyance Losses

## 9. Treatment Plant Capacity

Type

Capacity

Also:

1. Attach copies of relevant tables and text from master plans, or water resource planning documents.
2. Compare data found in reports to data obtained from contacting entity via telephone or previous survey.

Notes:

# Φ GEI Consultants, Inc.

# FAX

5660 Greenwood Plaza Blvd., Suite 202
Englewood, CO 80111-2418

Tel. (303) 779-5565
Fax (303) 779-5653

DATE 8/20/97

PROPOSAL/ PROJECT NO. 97411

Task Code 1020

NO. OF PAGES 7 (including this page)

TO: KEVEN HAGERMAN

FAX NO. (719) 263 - 5845

FROM: BRAD RASTALL

MESSAGE: THANK YOU FOR ANSWERING MY QUESTIONS WHEN I CALLED. ATTACHED IS A COPY OF THE SECWCD SURVEY, AND A LIST OF QUESTIONS I HAVE CONCERNING FOWLER'S WATERUSE. PLEAS CALL IF YOU HAVE ANY QUESTIONS

PLEASE LET US KNOW IF THE TRANSMISSION IS UNSATISFACTORY
** THANK YOU **

We need the following information to complete the Arkansas River Basin Water Storage and Future Needs Assessment for the SECWCD

1. Please confirm water use (in acre-feet), and population projections, as shown on page 2 of the SECWCD survey (attached).
2. Does water use include both irrigation and municipal?
3. Please provide an estimate of annual firm yield from the springs, and the irrigation wells.

**Town of Fowler**
P.O. Box 98 -- 101 E. Santa Fe Ave.
FOWLER, COLORADO 81039-1198

719-263-4461

## FAX TRANSMITTAL

TO: BRAD RASTALL 8-22-97

FAX #: 303-779-5655

TELEPHONE #:

FROM: KEVIN HAGEMAN

FAX #: 719-263-5845

TELEPHONE #: 719-263-4461

PAGES (INCLUDING COVER SHEET): 4

MESSAGES:

I HOPE THIS WILL WORK.

KEVIN.

We need the following information to complete the Arkansas River Basin Water Storage and Future Needs Assessment for the SECWCD

1. Please confirm water use (in acre-feet), and population projections, as shown on page 2 of the SECWCD survey (attached).
2. Does water use include both irrigation and municipal?
3. Please provide an estimate of annual firm yield from the springs, and the irrigation wells.

1. THE FIGURES LISTED WERE TAKEN FROM THE FORM USED TO APPLY FOR PROJECT WATER. WHERE THEY GOT THESE FIGURES I DON'T KNOW. THE '95 FIGURE I PULLED TOGETHER USING RECORDS FROM OUR WELL ASSOCIATION. 1996 WAS AN ESTIMATE ON MY PART. I CAN ONLY ASSUME THAT THE FIGURES FROM '90 to '93 SHOULD HAVE BEEN 370.

2. THE 370 FIGURE FOR '95 & '96 DOES <u>NOT</u> INCLUDE POTABLE WATER. POTABLE WATER CONSUMPTION FLUCTUATES THROUGHOUT THE YEAR BUT THE AVERAGE STAYS PRETTY CONSTANT FROM YR TO YR. AT APPROX: 90 A.F./YR. WE DO NOT AUGMENT FOR THIS POTABLE SUPPLY.

3. SEE ATTACHED PAGE. THIS IS A LISTING OF TOWNS WATER WELLS.

## Project Storage Space Use Trends

List your current and historic use of Project storage space for your own (non-Project) water. (acre-feet)

| | Amt. of Stored Water (af) | Facility(s) |
|---|---|---|
| Current Yr | 304.88 | |
| 1995 | ? | |
| 1994 | ? | |
| 1993 | 360.43 | |
| 1992 | 395.41 | |
| 1991 | 435.00 | |
| 1990 | 324.00 | |
| 1985 | 0 | |
| 1980 | 0 | |

## Water Use Trends,

List your historic use of water for municipal or agricultural use, and your historic use of Project water (acre-feet).

| | Population | Irr. Acreage | Water Use | | Proj. Water Use |
|---|---|---|---|---|---|
| Current Yr. | 1184 | | 370 | | 0 |
| 1995 | 1173 | | 370 | | 0 |
| 1994 | 1173 | | ? | | 0 |
| 1993 | 1154 | | 10 | 310 | 0 |
| 1992 | 1154 | | 10 | 310 | 0 |
| 1991 | 1154 | | 61 | 361 | 0 |
| 1990 | 1154 | | 52 | 352 | 0 |
| 1985 | | | | | |
| 1980 | | | | | |

PLEASE CONFIRM.

THESE FIGURES ARE THE BEST I CAN COME UP WITH USING THE FILES I HAVE.

## B. Water Supply Sources

The Town owns water rights to a variety of sources, which include the North Springs, Hammond Springs, and several alluvial wells in the Arkansas Basin. Currently, the spring sources are used for the soft water system, while the alluvial wells supply the hard water system. The Town has water rights to seven shallow wells, five of which are currently used as sources for the hard water system. The Town's water sources and capacities are summarized as follows:

**TABLE 1 - WATER SOURCE INVENTORY**

| Source | Location | Case No. | Permit No. | Decreed Capacity (GPM) | Current Production Capacity (GPM) |
|---|---|---|---|---|---|
| North Springs | North of Town | W-2939 | | 72 | 56 |
| Hammond Springs | Golf Course | 79CW186 | | 220 | 40 |
| Well No. 1 | W. of Sewage Lagoons | W-3051 | 0756-R | 1300 | 1300 |
| Well No. 2 | Swimming Pool | W-3051 | 0757-R | 350 | 350 |
| Well No. 3 | Behind Library | W-3051 | 0758-R | 250 | 0 |
| Well No. 4 | Tank Site | W-3051 | 0759-R | 250 | 220 |
| Well No. 5 | Tank Site | W-3051 | 0760-R-R | 176.4 | 150 |
| Well No. 6 | Harrimans | W-3051 | 0761-R | 450 | 450 |
| Well No. 7 | Cemetery | W-3051 | 0013R | 500 | 500 |
| Tyler Well | Golf Course | 781 | 11623-R | 120 | 0 |
| Irrigation Well | Golf Course | W-2420 | 13142-F | 666 | 400 |

155 AF

POTABLE

POTABLE

3116 gpm
= 5030 AF

# ROCKY FORD – MAY VALLEY

RECEIVED
OCT 1996
Southeastern Colorado Water Conservancy District

# Survey of Water Users in the Southeastern Colorado Water Conservancy District

Please take a few minutes to fill out this important survey. It will assist the Southeastern Colorado Water Conservancy District in assessing the future demand for Fryingpan-Arkansas Project water and storage space. If you have questions or comments regarding this survey, you can call Steve Arveschoug (719-544-2040). **Please complete and return the survey to the District in the enclosed envelope before Monday, September 23, 1996.** Your cooperation is appreciated.

---

Name of Organization City of Rocky Ford
Contact Person Darryl L. Schulz Phone 719-254-7414

User Group—Municipal ✓ Agricultural____ Industrial____
Recreation____ Other____

What is your primary source of supply? (surface water rights, ground water rights, or leased water, please describe)

ground water (2) well near Arkansas River
Catlin Canal - surface Water rights
Rocky Ditch - Surface water rights

Do you have a raw-water storage system? Yes____ No ✓
(Please describe your existing water storage system, rights.)

Do you currently request Fryingpan-Arkansas Project Water? (If yes, please describe your existing use, amount and purpose, of Project Water)

Augmentation - 150 af.

Have you used Fry-Ark Project IF-and-When storage space for the storage of your own water rights? Yes____ No ✓

## Municipal Population and Irr. Acreage Water/Storage Demand Projections

List your projected use of water and Project water (acre-feet).

| Year | Population | Irr. acreage | Water Use | Storage Use | Proj. Water Use |
|---|---|---|---|---|---|
| Current | 4400 | 100 | 120 | | 50 |
| 2000 | 4800 | 100 | 120 | | 50 |
| 2010 | 5800 | 110 | 130 | | 50 |
| 2020 | 6800 | 110 | 140 | | 50 |

Please describe your projected future demand for Fry-Ark Project Water and Storage (include copies of any reports or studies which provide the basis for your projections).

augmentation

## Water Resource Planning Efforts

Do you currently have a water resource plan to meet future water/storage demands? Yes ✓ No______ If yes, do your plans include the construction of raw-water storage facilities? Yes______ No______

Please describe your current water resource planning efforts and any construction plans.

use well water and Catlin Canal first
If the population gets close to 6000, evaluate
how we increase available water.

Would you be willing to participate in a cooperative effort to assess the future demands for water and storage in the Arkansas River Basin and the future need for Fry-Ark Project Water and storage.

Yes______ No______ Need more information ✓

Comments______

DRAFT

# SOUTHEASTERN COLORADO WATER CONSERVANCY DISTRICT

## Arkansas River Basin Water Storage and Future Needs Assessment

WATER SYSTEM SURVEY (Compiled by BWR)

### 1. General Information

**Entity** CITY OF ROCKY FORD

**Contact Name/District Manager** DARRYL L. SCHULZ

**Address** 203 SOUTH MAIN
ROCKY FORD, CO 80911

**Phone No.** (719) 254-7414

**Fax No.** ( ) -

**Primary Use** [✓ Municipal] Agricultural Industrial Recreational Other

**Master Plan or other Water Resource Planning Documents?** [✓ Y] N
(If yes we must obtain it)
**Prepared by:**

**Geographic Location of Service Area** (obtain service area map)

### 2. Demographics/Water Use

*Historic Water Use*

| Year | Population | Water Use, af | ¾ -in Domestic Taps (optional) |
|---|---|---|---|
| 1987 | | | |
| 1988 | | | |
| 1989 | | | |
| 1990 | 4162 | 1200 | |
| 1991 | 4230 | | |
| 1992 | 4221 | | |
| 1993 | 4256 | | |
| 1994 | 4283 | | |
| 1995 | 4344 | 1500 | |
| 1996 | 4400 | | |

*Projected Water Use*

| Year | Population | Water Use, af | ¾ -in Domestic Taps (optional) |
|---|---|---|---|
| 2000 | 4800 | | |
| 2010 | 5800 | | |
| 2020 | 6800 | | |
| 2040 | | | |

**Major industrial or other uses other than domestic**

DRAFT

# SOUTHEASTERN COLORADO WATER CONSERVANCY DISTRICT

## Arkansas River Basin Water Storage and Future Needs Assessment

WATER SYSTEM SURVEY (Compiled by BWR )

### 3. Estimated Monthly Water Use

| | as a percent of total annual use,% |
|---|---|
| JAN | |
| FEB | |
| MAR | |
| APR | |
| MAY | |
| JUN | |
| JUL | |
| AUG | |
| SEP | |
| OCT | |
| NOV | |
| DEC | |
| **TOTAL** | **100%** |

Notes:

# SOUTHEASTERN COLORADO WATER CONSERVANCY DISTRICT

## Arkansas River Basin Water Storage and Future Needs Assessment

WATER SYSTEM SURVEY (Compiled by BWR)

### 4. Sources of Water

*Surface Water*

**Sources** CATLIN CANAL 2025 AF/YR
ROCKY FORD DITCH 520 AF/YR

**Point of Diversion** (for larger municipalities attach map, if available)

Location

Capacity

*Ground Water*

**Sources**

Tributary

Nontributary 2385 AF/YR

Number of Wells 2

**Combined Annual Flow Rate** (from decrees or based on conveyance capacity)

(May only be available as an annual total)

| | gpm | cfs | af |
|---|---|---|---|
| JAN | | | |
| FEB | | | |
| MAR | | | |
| APR | | | |
| MAY | | | |
| JUN | | | |
| JUL | | | |
| AUG | | | |
| SEP | | | |
| OCT | | | |
| NOV | | | |
| DEC | | | |
| **TOTAL ANNUAL** | | | |

DRAFT

# SOUTHEASTERN COLORADO WATER CONSERVANCY DISTRICT

## Arkansas River Basin Water Storage and Future Needs Assessment

WATER SYSTEM SURVEY (Compiled by BWR)

### 5. Firm Yield

**District Managers may not have this information, attorneys and/ or consulting engineers may need to be contacted**

| | |
|---|---|
| **Monthly Average Firm Yield for 1966-1995** | **af** |
| JAN | |
| FEB | |
| MAR | |
| APR | |
| MAY | |
| JUN | |
| JUL | |
| AUG | |
| SEP | |
| OCT | |
| NOV | |
| DEC | |
| TOTAL ANNUAL | |

Firm yield can estimated from:

Response of water rights during critical dry year
Potential volume limitation per decree or well permit
Ability to augment out of priority depletions

Consulting Engineer or Attorney

### 6. Future Water Planning

Estimated future yield of existing water rights ____________af/yr

Conditional Water Rights
Direct flow/wells

Storage

DRAFT

# SOUTHEASTERN COLORADO WATER CONSERVANCY DISTRICT

## Arkansas River Basin Water Storage and Future Needs Assessment

WATER SYSTEM SURVEY (Compiled by BWR )

| 7. Raw Water Storage |
|---|
| Total Vol. in af |
| Type:<br>Fry-Ark<br>If and When<br>Shared<br>Owned |

| 8. Raw Water Conveyance |
|---|
| Type:<br>Pipeline<br>Canal |
| Estimated Raw Water Conveyance Losses |

| 9. Treatment Plant Capacity |
|---|
| Type |
| Capacity |

Also:

1. Attach copies of relevant tables and text from master plans, or water resource planning documents.
2. Compare data found in reports to data obtained from contacting entity via telephone or previous survey.

Notes:

**LaJUNTA**

RECEIVED
SEP 2 1996
Southeastern Colorado Water
Conservancy District

# Survey of Water Users
# in the
# Southeastern Colorado Water Conservancy District

---

Please take a few minutes to fill out this important survey. It will assist the Southeastern Colorado Water Conservancy District in assessing the future demand for Fryingpan-Arkansas Project water and storage space. If you have questions or comments regarding this survey, you can call Steve Arveschoug (719-544-2040). **Please complete and return the survey to the District in the enclosed envelope before Monday, September 23, 1996.** Your cooperation is appreciated.

---

Name of Organization City of La Junta
Contact Person Joe A Kelley Phone 719 384-7358

User Group—Municipal X Agricultural____ Industrial_____
Recreation____ Other_____

What is your primary source of supply? (surface water rights, ground water rights, or leased water, please describe)

Wells - Arkansas River alluvium

Do you have a raw-water storage system? Yes_____ No X
(Please describe your existing water storage system, rights.)

Do you currently request Fryingpan-Arkansas Project Water? (If yes, please describe your existing use, amount and purpose, of Project Water)

Yes - 1500 acre feet - supplement well water rights

Have you used Fry-Ark Project IF-and-When storage space for the storage of your own water rights? Yes______ No X

## Municipal Population and Irr. Acreage Water/Storage Demand Projections

List your projected use of water and Project water (acre-feet).

| Year | Population | Irr. acreage | Water Use | Storage Use | Proj. Water Use |
|---|---|---|---|---|---|
| Current | 8040 | | 3000 | 1500 | 500 |
| 2000 | 8449 | | 3152 | 1575 | 1575 |
| 2010 | 9567 | | 3570 | 1785 | 1785 |
| 2020 | 10832 | | 4042 | 2021 | 2021 |

Please describe your projected future demand for Fry-Ark Project Water and Storage (include copies of any reports or studies which provide the basis for your projections).

Projected demand is to meet well pumping replacement water needs. Anticipated growth to 1¼% annually, based on trend of last decade.

## Water Resource Planning Efforts

Do you currently have a water resource plan to meet future water/storage demands? Yes________ No__X__ If yes, do your plans include the construction of raw-water storage facilities? Yes______ No______

Please describe your current water resource planning efforts and any construction plans.

Water resource plan is under development.

Would you be willing to participate in a cooperative effort to assess the future demands for water and storage in the Arkansas River Basin and the future need for Fry-Ark Project Water and storage.

Yes__X__ No__________ Need more information__________

Comments Need to evaluate cost.

DRAFT

# SOUTHEASTERN COLORADO WATER CONSERVANCY DISTRICT

## Arkansas River Basin Water Storage and Future Needs Assessment

WATER SYSTEM SURVEY (Compiled by BWR)

### 1. General Information

**Entity** CITY OF LA JUNTA

**Contact Name/District Manager** JOE A. KELLY

**Address** PO BOX 489
LAJUNTA, CO 81050

**Phone No.** (719) 384 - 7358

**Fax No.** ( ) -

**Primary Use** [✓ Municipal] Agricultural Industrial Recreational Other

**Master Plan or other Water Resource Planning Documents?** Y [✓ N]

(If yes we must obtain it) DEVELOPING WATER RESOURCE PLAN

**Prepared by:**

**Geographic Location of Service Area** (obtain service area map)

### 2. Demographics/Water Use

*Historic Water Use*

| Year | Population | Water Use, af | $^3/_4$ -in Domestic Taps (optional) |
|---|---|---|---|
| 1987 | | | |
| 1988 | | | |
| 1989 | | | |
| 1990 | | 2536 | |
| 1991 | | 2939 | |
| 1992 | 7601 | 3771 | |
| 1993 | 7658 | 3044 | |
| 1994 | 7742 | 3112 | |
| 1995 | 7876 | 2921 | |
| 1996 | 8040 | 3000 | |

*Projected Water Use*

| Year | Population | Water Use, af | $^3/_4$ -in Domestic Taps (optional) |
|---|---|---|---|
| 2000 | 8449 | 3152 | |
| 2010 | 9567 | 3570 | |
| 2020 | 10832 | 4072 | |
| 2040 | | | |

**Major industrial or other uses other than domestic**

# SOUTHEASTERN COLORADO WATER CONSERVANCY DISTRICT

## Arkansas River Basin Water Storage and Future Needs Assessment

WATER SYSTEM SURVEY (Compiled by BWR)

### 3. Estimated Monthly Water Use

| | as a percent of total annual use,% |
|---|---|
| JAN | |
| FEB | |
| MAR | |
| APR | |
| MAY | |
| JUN | |
| JUL | |
| AUG | |
| SEP | |
| OCT | |
| NOV | |
| DEC | |
| **TOTAL** | **100%** |

Notes:

LAWN IRRIGATION AND PICKLE PLANT ACCOUNT FOR 1/10 OF IRRIGATION

DRAFT

# SOUTHEASTERN COLORADO WATER CONSERVANCY DISTRICT

## Arkansas River Basin Water Storage and Future Needs Assessment

WATER SYSTEM SURVEY (Compiled by BWR)

### 4. Sources of Water

*Surface Water*

**Sources**

**Point of Diversion** (for larger municipalities attach map, if available)

Location

Capacity

*Ground Water*

**Sources**

Tributary ALLUVIAL WELLS OF ARKANSAS RIVER REQUIRE AUGMENTS

Nontributary

Number of Wells 14

**Combined Annual Flow Rate** (from decrees or based on conveyance capacity)

(May only be available as an annual total)

| | gpm | cfs | af |
|---|---|---|---|
| JAN | | | |
| FEB | | | |
| MAR | | | |
| APR | | | |
| MAY | | | |
| JUN | | | |
| JUL | | | |
| AUG | | | |
| SEP | | | |
| OCT | | | |
| NOV | | | |
| DEC | | | |

**TOTAL ANNUAL** 16,000 AF - OUTPUT POTENTIAL, CAPACITY OF WELLS

# SOUTHEASTERN COLORADO WATER CONSERVANCY DISTRICT

## Arkansas River Basin Water Storage and Future Needs Assessment

WATER SYSTEM SURVEY (Compiled by BWR)

## 5. Firm Yield

**District Managers may not have this information, attorneys and/ or consulting engineers may need to be contacted**

| | |
|---|---|
| **Monthly Average Firm Yield for 1966-1995** | **af** |
| JAN | |
| FEB | |
| MAR | |
| APR | |
| MAY | |
| JUN | |
| JUL | |
| AUG | |
| SEP | |
| OCT | |
| NOV | |
| DEC | |
| TOTAL ANNUAL | 8789 AF (SEE FAX) |

Firm yield can estimated from:

- Response of water rights during critical dry year
- Potential volume limitation per decree or well permit
- Ability to augment out of priority depletions

Consulting Engineer or Attorney

## 6. Future Water Planning

Estimated future yield of existing water rights ____________af/yr

Conditional Water Rights

Direct flow/wells NO PLANS TO CONSTRUCT MORE WELLS

Storage "TRY TO OBTAIN PROJECT WATER."

WATER SYSTEM SURVEY (Compiled by BWR)

## 7. Raw Water Storage

Total Vol. in af 1500 AF

Type:

Fry-Ark 1500 AF (2923 SHARES FROM PUEBLO USED FOR AUGMENTATION)

If and When

Shared

Owned

## 8. Raw Water Conveyance

Type:

Pipeline

Canal

Estimated Raw Water Conveyance Losses

## 9. Treatment Plant Capacity

Type

Capacity

Also:

1. Attach copies of relevant tables and text from master plans, or water resource planning documents.
2. Compare data found in reports to data obtained from contacting entity via telephone or previous survey.

Notes:

# MEMORANDUM

**TO:** Brad Rastell, GEI

**FROM:** Joe A. Kelley, Director of Water and Wastewater

**SUBJECT:** Water firm yeild; City of La Junta

**DATE:** August 27, 1997

The City of La Junta has about 18,073 acre feet adjudicated in its well fields. We also own some Armend-Trout water rights on the Fort Lyon Canal as well as a few shares on the Catlin Canal. The City also has 2923 shares of Fryingpan project (Project) water which is typically used to augment our well pumping.

Based on rough calculations, the ***City's firm yeild at 8,789 acre feet***. In 1996, we pumped about 3,057 acre feet. The firm yeild is calculated based on the following assumptions:

1. A dry year is when we must fully augment our pumping using Project water. It assumes our wells are in priority November through March.
2. Full Project water shares are available.
3. Percent consumption and percent return flows remain as they are now.
4. City pumping remains proportional by month.

Calculations are included on the following page. If you have further questions, please call.

18,073 x 5/12 = 7530

| | | |
|---|---|---|
| Total pumped | 3057 | |
| Augmented Pumping | 2327 | during months not in priority |
| WWTP return | -961 | during months not in priority |
| Irrigation return | -349 | during months not in priority |
| Augmentation required | 1017 | during months not in priority |
| % augementation required | 44% | during months not in priority |
| | | |
| Project water available | 2923 | |
| Non-priority pumping available | 6691 | Project water divided by % augmentation required |
| Annual increase potential | 2.87 | Maximum pumping allowable/augmented pumping |
| | | |
| Total allowable pumping | 8789 | annual pumping times increase potential |

2923/.437 = 6689

6691 = 2923/ % Aug
0.44
1/0.44 = 2.27

1017/2327 = 43.7%

3057 x 2.27 = 6948

3057 x .44

1345

8789
3057
5732 ?

3,000

3057- 2327 = 730 AF

# BENTS FORT

DRAFT

# SOUTHEASTERN COLORADO WATER CONSERVANCY DISTRICT
## Arkansas River Basin Water Storage and Future Needs Assessment
WATER SYSTEM SURVEY (Compiled by BWR)

### 1. General Information

**Entity** BENTS FORT

**Contact Name/District Manager** GARY JONES

**Address** PO BOX 305
LAJUNTA, CO 81050

**Phone No.** (719) 384 - 7405

**Fax No.** ( ) -

**Primary Use** [✓ Municipal] Agricultural Industrial Recreational Other

**Master Plan or other Water Resource Planning Documents?** Y N
(If yes we must obtain it)
**Prepared by:**

**Geographic Location of Service Area** (obtain service area map)

### 2. Demographics/Water Use

*Historic Water Use*

| Year | Population | Water Use, af | $^{3}/_{4}$-in Domestic Taps (optional) |
|---|---|---|---|
| 1987 | | | |
| 1988 | | | |
| 1989 | | | |
| 1990 | | | |
| 1991 | | | |
| 1992 | | | |
| 1993 | | | |
| 1994 | | | |
| 1995 | | 90 | |
| 1996 | 1400 | 123 | 385 ACTIVE 65 INACTIVE |

*Projected Water Use*

| Year | Population | Water Use, af | $^{3}/_{4}$-in Domestic Taps (optional) |
|---|---|---|---|
| 2000 | | | |
| 2010 | | | |
| 2020 | | | |
| 2040 | | | |

**Major industrial or other uses other than domestic**

# SOUTHEASTERN COLORADO WATER CONSERVANCY DISTRICT
## Arkansas River Basin Water Storage and Future Needs Assessment
WATER SYSTEM SURVEY (Compiled by BWR)

| 3. Estimated Monthly Water Use | |
|---|---|
| | as a percent of total annual use,% |
| JAN | |
| FEB | |
| MAR | |
| APR | |
| MAY | |
| JUN | |
| JUL | |
| AUG | |
| SEP | |
| OCT | |
| NOV | |
| DEC | |
| **TOTAL** | **100%** |

Notes: CURRENTLY ADDING 2 NEW WELLS TO SYSTEM AND COMPLETING CONSTRUCTION OF 180,000 GALLON TANK

# SOUTHEASTERN COLORADO WATER CONSERVANCY DISTRICT

## Arkansas River Basin Water Storage and Future Needs Assessment

WATER SYSTEM SURVEY (Compiled by BWR)

## 4. Sources of Water

### *Surface Water*

**Sources**

**Point of Diversion** **(for larger municipalities attach map, if available)**

Location

Capacity

### *Ground Water*

**Sources**

Tributary

Nontributary

Number of Wells 4 DAKOTA/CHEYENNE WELLS (72 GPM)

**Combined Annual Flow Rate** (from decrees or based on conveyance capacity)

(May only be available as an annual total)

| | gpm | cfs | af |
|---|---|---|---|
| JAN | | | |
| FEB | | | |
| MAR | | | |
| APR | | | |
| MAY | | | |
| JUN | | | |
| JUL | | | |
| AUG | | | |
| SEP | | | |
| OCT | | | |
| NOV | | | |
| DEC | | | |
| **TOTAL ANNUAL** | | | |

# SOUTHEASTERN COLORADO WATER CONSERVANCY DISTRICT

## Arkansas River Basin Water Storage and Future Needs Assessment

WATER SYSTEM SURVEY (Compiled by BWR)

### 5. Firm Yield

**District Managers may not have this information, attorneys and/ or consulting engineers may need to be contacted**

| | |
|---|---|
| **Monthly Average Firm Yield for 1966-1995** | **af** |
| JAN | |
| FEB | |
| MAR | |
| APR | |
| MAY | |
| JUN | |
| JUL | |
| AUG | |
| SEP | |
| OCT | |
| NOV | |
| DEC | |
| TOTAL ANNUAL | |

Firm yield can estimated from:

- Response of water rights during critical dry year
- Potential volume limitation per decree or well permit
- Ability to augment out of priority depletions

Consulting Engineer or Attorney

### 6. Future Water Planning

Estimated future yield of existing water rights ____________af/yr

Conditional Water Rights

Direct flow/wells 20-40 NEW TAPS

STORAGE ADEQUATE

Storage

DRAFT

# SOUTHEASTERN COLORADO WATER CONSERVANCY DISTRICT

## Arkansas River Basin Water Storage and Future Needs Assessment

WATER SYSTEM SURVEY (Compiled by BWR)

### 7. Raw Water Storage

Total Vol. in af TANKS → 0.29 MG TOTAL STORAGE

Type:
Fry-Ark

If and When

Shared

Owned

### 8. Raw Water Conveyance

Type:
Pipeline

Canal

Estimated Raw Water Conveyance Losses

### 9. Treatment Plant Capacity

Type

Capacity

Also:

1. Attach copies of relevant tables and text from master plans, or water resource planning documents.
2. Compare data found in reports to data obtained from contacting entity via telephone or previous survey.

Notes:

# LAS ANIMAS

RECEIVED
SEP [illegible] 1996
Southeastern Colorado Water Conservancy District

# Survey of Water Users in the Southeastern Colorado Water Conservancy District

Please take a few minutes to fill out this important survey. It will assist the Southeastern Colorado Water Conservancy District in assessing the future demand for Fryingpan-Arkansas Project water and storage space. If you have questions or comments regarding this survey, you can call Steve Arveschoug (719-544-2040). **Please complete and return the survey to the District in the enclosed envelope before Monday, September 23, 1996.** Your cooperation is appreciated.

---

Name of Organization: City of Las Animas

Contact Person: Bill Jackson Phone: (719) 456-2571

User Group—Municipal x Agricultural ____ Industrial ____
Recreation ____ Other ____

What is your primary source of supply? (surface water rights, ground water rights, or leased water, please describe)

Primary supply from 7 (seven) hard water wells

Do you have a raw-water storage system? Yes X No ____
(Please describe your existing water storage system, rights.)

Have 2,250,000 gallons finish water system allocation of Municipal pool storage in Pueblo Reservior which averages 1,097 acre feet per year

Do you currently request Fryingpan-Arkansas Project Water? (If yes, please describe your existing use, amount and purpose, of Project Water)

Yes, 300 acre feet for augmentation water at present

Have you used Fry-Ark Project IF-and-When storage space for the storage of your own water rights? Yes ____ No X

## Municipal Population and Irr. Acreage Water/Storage Demand Projections

List your projected use of water and Project water (acre-feet).

| Year | Population | Irr. acreage | Water Use | Storage Use | Proj. Water Use |
|---|---|---|---|---|---|
| Current | 2,675 | | 600 acre ft | | 300 acre ft |
| 2000 | 3,000 | | 800 acre ft | | 600 acre ft |
| 2010 | 3,900 | | 1,000 acre ft | | 900 acre ft |
| 2020 | 4,500 | | 1,200 acre ft | | 1,100 acre ft |

Please describe your projected future demand for Fry-Ark Project Water and Storage (include copies of any reports or studies which provide the basis for your projections).

The City plan to continue to purchase project water for use as augmentation water to satisfy the state approved augmentation plan

## Water Resource Planning Efforts

Do you currently have a water resource plan to meet future water/storage demands? Yes X No ______ If yes, do your plans include the construction of raw-water storage facilities? Yes ______ No X

Please describe your current water resource planning efforts and any construction plans.

Would you be willing to participate in a cooperative effort to assess the future demands for water and storage in the Arkansas River Basin and the future need for Fry-Ark Project Water and storage.

Yes X No ______ Need more information ______

Comments ______

DRAFT

# SOUTHEASTERN COLORADO WATER CONSERVANCY DISTRICT

## Arkansas River Basin Water Storage and Future Needs Assessment

WATER SYSTEM SURVEY (Compiled by BWR)

### 1. General Information

**Entity** LAS ANIMAS

**Contact Name/District Manager** DOUG SANDERSON

**Address** PO BOX 468
LAS ANIMAS CO 81054

**Phone No.** (719) 456-2571

**Fax No.** ( ) -

**Primary Use** [✓ Municipal] Agricultural Industrial Recreational Other

**Master Plan or other Water Resource Planning Documents?** Y N

(If yes we must obtain it)

**Prepared by:**

**Geographic Location of Service Area** (obtain service area map)

### 2. Demographics/Water Use

*Historic Water Use*

| Year | Population | Water Use, af | $^3/_4$ -in Domestic Taps (optional) |
|---|---|---|---|
| 1987 | | | |
| 1988 | | | |
| 1989 | | | |
| 1990 | | | |
| 1991 | | | |
| 1992 | | | |
| 1993 | 2500 | 450 | |
| 1994 | 2500 | 450 | |
| 1995 | 2500 | 539 | |
| 1996 | 2675 | 600 | |

*Projected Water Use*

| Year | Population | Water Use, af | $^3/_4$ -in Domestic Taps (optional) |
|---|---|---|---|
| 2000 | 3000 | 800 | |
| 2010 | 3900 | 1000 | |
| 2020 | 4500 | 1200 | |
| 2040 | | | |

**Major industrial or other uses other than domestic**

### #3. Estimated Monthly Water Use

| | as a percent of total annual use,% |
|---|---|
| JAN | |
| FEB | |
| MAR | |
| APR | |
| MAY | |
| JUN | |
| JUL | |
| AUG | |
| SEP | |
| OCT | |
| NOV | |
| DEC | |
| **TOTAL** | **100%** |

Notes: "ROUGH ESTIMATES" FROM JOHN RUSSELL

2200 GAL/MIN - 7 WELL CAPACITY WITH MIN. DRAWDOWN
1800 GAL/MIN - 7 WELL PUMP CAPACITY IN CRITICAL DRY YEAR
1900 GAL/MIN - MAXIMUM CAPACITY FOR NEW REVERSE OSMOSIS WATER TREATMENT PLANT

CONVERT TO AF/YR

3550 AF/YR -
2900 AF/YR - USE THIS NUMBER AS FIRM YIELD FOR WELLS
2260 AF/YR -

$$1800\ \text{gal/min} \times \frac{\text{ft}^3}{7.48\ \text{gal}} \times \frac{\text{AF}}{43560\ \text{ft}^3} \times 365(24)60\ \text{min/yr}$$

$$= 2903\ \text{AF/yr}\ ✓$$

DRAFT

# SOUTHEASTERN COLORADO WATER CONSERVANCY DISTRICT

## Arkansas River Basin Water Storage and Future Needs Assessment

WATER SYSTEM SURVEY (Compiled by BWR)

### 4. Sources of Water

*Surface Water*

**Sources**

**Point of Diversion** (for larger municipalities attach map, if available)

Location

Capacity

*Ground Water*

**Sources**

Tributary

Nontributary

Number of Wells 7 WELLS

**Combined Annual Flow Rate** (from decrees or based on conveyance capacity)

(May only be available as an annual total)

| | gpm | cfs | af |
|---|---|---|---|
| JAN | | | |
| FEB | | | |
| MAR | | | |
| APR | | | |
| MAY | | | |
| JUN | | | |
| JUL | | | |
| AUG | | | |
| SEP | | | |
| OCT | | | |
| NOV | | | |
| DEC | | | |
| **TOTAL ANNUAL** | | | |

DRAFT

# SOUTHEASTERN COLORADO WATER CONSERVANCY DISTRICT

## Arkansas River Basin Water Storage and Future Needs Assessment

WATER SYSTEM SURVEY (Compiled by BwR)

### 5. Firm Yield

**District Managers may not have this information, attorneys and/ or consulting engineers may need to be contacted**

| | |
|---|---|
| **Monthly Average Firm Yield for 1966-1995** | **af** |
| JAN | |
| FEB | |
| MAR | |
| APR | |
| MAY | |
| JUN | |
| JUL | |
| AUG | |
| SEP | |
| OCT | |
| NOV | |
| DEC | |
| TOTAL ANNUAL | |

Firm yield can estimated from:

- Response of water rights during critical dry year
- Potential volume limitation per decree or well permit
- Ability to augment out of priority depletions

Consulting Engineer or Attorney

### 6. Future Water Planning

Estimated future yield of existing water rights ____________ af/yr

Conditional Water Rights

Direct flow/wells

Storage

DRAFT

# SOUTHEASTERN COLORADO WATER CONSERVANCY DISTRICT

## Arkansas River Basin Water Storage and Future Needs Assessment

WATER SYSTEM SURVEY (Compiled by BWR)

### 7. Raw Water Storage

Total Vol. in af

Type:

Fry-Ark 1097 AF PUEBLO RESERVOIR

If and When

Shared

Owned

### 8. Raw Water Conveyance

Type:

Pipeline

Canal

Estimated Raw Water Conveyance Losses

### 9. Treatment Plant Capacity

Type

Capacity

Also:

1. Attach copies of relevant tables and text from master plans, or water resource planning documents.
2. Compare data found in reports to data obtained from contacting entity via telephone or previous survey.

Notes:

# LAMAR

G701.1

**HELTON & WILLIAMSEN, P.C.**
CONSULTING ENGINEERS IN WATER RESOURCES
384 INVERNESS DRIVE SOUTH, SUITE 144
ENGLEWOOD, COLORADO 80112
PHONE (303) 792-2161
FAX (303) 792-2165

# FAX TRANSMITTAL

**Date:** July 27, 1998 **Time:** 4:45 pm

**To:** Dick Westmore - GEI Consultants

**Fax No.** 662·8757

**From:** Tom Williamsen

**Message:** Dick: The City of Lamar's reported "Non-project firm yield" of 3500 af/yr is the well field yield if fully recharged. The value includes in-basin and Project water. The Non-Project yield of Lamar's Fort Bent Ditch water is about 1100 af annually. This assumes that the aquifer acts as a reservoir to balance the good and dry year diversions and that 30 percent of the delivery to the recharge area is evaporated, transpired or leaked back to the Arkansas River.

Lamar's Project water allocation may be a little misleading in that transit losses are charged to the releases between Pueblo and John Martin Reservoirs. Depending on river stage the transit losses can range from 5% to 50%. Normally Lamar runs the water down during favorable conditions so the losses have been at the lower end of the range. A footnote on each table may be in order which acknowledges that transit losses will reduce the actual yield of the Project water and such losses will vary depending on the city and the river conditions.

Thanks.

**Original will follow in the mail:** ___ Yes _x_ No

**Number of pages including this transmittal page:** _1_

LAMAR
COLORADO WATER/WASTEWATER
EXCELLENCE & PRIDE CITY WIDE

# MEMO

**TO: BRAD RASTALL**

**FROM: DANNIE MCMILLAN**

**DATE: NOVEMBER 7, 1997**

**RE: ADDITIONAL INFORMATION**

---

In regards to your recent fax the additional information is as follows:

1 - Firm yield (dry year yield) of Lamar's water system and rights.
350 af.

7,

2 - Population projections for 2000, 2010, 2020, and 2040.
Population projections - 2000 - 9000
2010 - 10,000
2020 - 10,300

3 - Projected project water use for 2000, 2010, 2020, and 2040. In past years you reported project water use at 1500 af/yr to 2500 af/yr. Will this increase?
Projected water use - 2000 - 2890 af
2010 - 3181 af
2020 - 3517 af
Yes, project water use will increase.

4 - Estimate of per capita water use in gallons per person per day.
293 gallons per person per day.

CITY OF LAMAR
102 EAST PARMENTER • LAMAR, COLORADO 81052-3299
719/336-2002 • FAX 719/336-4404

**HELTON & WILLIAMSEN, P.C.**
**CONSULTING ENGINEERS IN WATER RESOURCES**
384 INVERNESS DRIVE SOUTH, SUITE 115
ENGLEWOOD, COLORADO 80112
PHONE (303) 792-2161
FAX (303) 792-2165

# MEMORANDUM

January 9, 1998

TO: Dick Westmore

FROM: Tom Williamsen TW

SUBJECT: Description of the City of Lamar's municipal water system and water uses

The City of Lamar obtains its water supplies used for municipal purposes from a well field located about 3 miles southeast of Lamar in the Clay Creek watershed. Clay Creek is a tributary of the Arkansas River. The well field consists of 31 wells which discharge through a common pipeline to a 6 MG storage tank. The water flows by gravity from the tank through a master meter and treatment facility to the City's distribution system. Additionally, the City has some small capacity wells which are used to supply irrigation water to the cemetery and three small parks.

The City owns stock in the Fort Bent Ditch Company and has a decreed plan for augmentation which allows the City to use its Fort Bent Ditch water to recharge the Clay Creek aquifer. Additionally, the City uses its allocation of SECWCD project water for recharge purposes. Such water is conveyed from Pueblo Reservoir during favorable streamflow conditions, i.e., good quality and low losses, to John Martin Reservoir for re-regulation. Subsequently, this water is delivered through the Fort Bent Ditch to the recharge site. For 1975 through 1997, the City's municipal water usage averaged 2,339 acre-feet annually and ranged from 2,020 acre-feet in 1978 to 2,800 acre-feet in 1997.

Wastewater from in-building uses is treated by a multi-cell lagoon system which discharges to the Arkansas River about 3 miles northeast of the city.

The City recently completed a master plan for its water supply and distribution system. That report shows the present population as 8,440 and an annual growth rate of 0.5 percent since 1950. For planning purposes, the City uses an annual growth rate of 1 percent.

As described above, the City's project water is re-regulated in John Martin Reservoir. Each year Colorado's Division Engineer and Kansas' Water Commissioner must agree on the accounting for this water as there is no continuing storage account for this purpose. Accordingly, a permanent account or storage for re-regulation of Lamar's project water would be beneficial to the City.

Contact: Dannie McMillan (719) 336-2002

TAW/mlc

cc: Dannie McMillan

C:\G701\010598a.TAW

# TABLE 6.1
# WATER SUPPLY VS. WATER DEMAND
# CURRENT CONDITIONS

| Municipal Entity | Reported Non-Project Firm Yield | Fry-Ark Project Allocation [(1)] | Total Available Supply | Current Demand | Surplus/ Deficit | Fry-Ark Maximi-zation [(2)] |
|---|---|---|---|---|---|---|
| **Entities West of Pueblo** | | | | | | |
| Buena Vista | 2,809 | 29 | 2,838 | 728 | 2,110 | 73 |
| Salida | 2,240 | 195 | 2,435 | 2,911 | **(476)** | 488 |
| Chaffee County | | 69 | 69 | 2,497 | **(2,428)** | 173 |
| Canon City | 23,891 | 90 | 23,981 | 5,560 | 18,421 | 225 |
| Park Center | 1,131 | 40 | 1,171 | 854 | 317 | 100 |
| Florence | 4,835 | 9 | 4,844 | 1,707 | 3,137 | 23 |
| Penrose | 100 | 0 | 100 | 462 | **(362)** | 0 |
| Fremont County | | 14 | 14 | 50 | **(36)** | 35 |
| **Subtotal** | **35,006** | **446** | **35,452** | **14,769** | **20,683** | **1,115** |
| | | | | | | |
| **Pueblo Entities** | | | | | | |
| Pueblo West | 13,656 | 0 | 13,656 | 2,618 | 11,038 | 0 |
| Pueblo Board of Water Works | 74,032 | 0 | 74,032 | 26,357 | 47,675 | 0 |
| St. Charles Mesa | 1,640 | 270 | 1,910 | 1,920 | **(10)** | 675 |
| Pueblo County | | 32 | 32 | 294 | **(262)** | 80 |
| **Subtotal** | **89,328** | **302** | **89,630** | **31,189** | **58,441** | **755** |
| | | | | | | |
| **Fountain Valley Authority** [(3)] | | | | | | |
| Colorado Springs Utilities | 113,647 | 1,200 | 114,847 | 80,878 | 33,969 | 0 |
| Fountain | 3,300 | 1,600 | 4,900 | 1,761 | 3,139 | 4,000 |
| Security | 2,000 | 1,640 | 3,640 | 3,907 | **(267)** | 4,100 |
| Widefield | 2,975 | 1,500 | 4,475 | 3,069 | 1,406 | 3,750 |
| Stratmoor Hills | 770 | 601 | 1,371 | 861 | 510 | 1,503 |
| El Paso County | | 0 | 0 | 209 | **(209)** | 0 |
| **Subtotal** | **122,692** | **6,541** | **129,233** | **90,685** | **38,548** | **13,353** |
| | | | | | | |
| **Entities East of Pueblo** | | | | | | |
| Crowley County | 644 | 777 | 1,421 | 903 | 518 | 1,943 |
| Fowler | 155 | 49 | 204 | 371 | **(167)** | 123 |
| Rocky Ford | 2,385 | 30 | 2,415 | 1,392 | 1,023 | 75 |
| LaJunta | 5,854 | 300 | 6,154 | 2,999 | 3,155 | 750 |
| Bents Fort WA | 116 | 0 | 116 | 305 | **(189)** | 0 |
| Otero County | | 25 | 25 | 881 | **(856)** | 63 |
| Las Animas | 2,900 | 100 | 3,000 | 538 | 2,462 | 250 |
| Bent County | | 0 | 0 | 141 | **(141)** | 0 |
| Lamar | 3,500 | 2,100 | 5,600 | 2,770 | 2,830 | 5,250 |
| May Valley WA | 686 | 0 | 686 | 492 | 194 | 0 |
| Prowers and Kiowa Counties | | 24 | 24 | 549 | **(525)** | 60 |
| **Subtotal** | **16,240** | **3,405** | **19,645** | **11,341** | **8,304** | **8,513** |
| | | | | | | |
| **Total** | **263,266** | **10,694** | **273,960** | **147,984** | **125,976** | **23,735** |

(1) Based on average annual allocation for period 1993-1997.

(2) Assumes that 40% of Fry-Ark Project water is consumptively used.

(3) The average FVA allocation of Fry-Ark water was 10,313 af during 1993-1997. Delivered amounts to FVA entities in averaged 6547 af in the same period.

```
***************************
***   ACTIVITY REPORT   ***
***************************
```

TRANSMISSION OK

| | |
|---|---|
| TX/RX NO. | 5715 |
| CONNECTION TEL | 303 792 2165 |
| CONNECTION ID | HELTON WILLIAMSN |
| START TIME | 07/27 12:49 |
| USAGE TIME | 02'55 |
| PAGES | 4 |
| RESULT | OK |

# GEI Consultants, Inc.

# FAX

6950 S. Potomac Street, Suite 200
Englewood, CO 80112

Tel. (303) 662-0100
Fax (303) 662-8757

DATE 7/27/98

PROPOSAL/ PROJECT NO. 97411

NO. OF PAGES 4 (including this page)

Task Code

TO: Tom Williamsen

FAX NO.

FROM: Dick Westmore

MESSAGE: I asked Donnie McMillan to verify the yield in his letter but have not heard back. Can you find out. I guess we need to know the amount they can pump and augment using Ditch and Fry-Ark water. Can you do it quickly? Thanks,

Dick

**PLEASE LET US KNOW IF THE TRANSMISSION IS UNSATISFACTORY**
**** THANK YOU ****

---

## SERVICES

**Geotechnical Engineering**
- Site Evaluation
- Foundation Design
- Construction

**Forensic Engineering**
- Failure Investigation
- Litigation Support
- Construction Claim Analysis
- Expert Testimony

**Environmental Engineering**
- Process Engineering
- Site Evaluation
- Remediation
- Litigation Support

**Geohydrology & Hydrology**
- Water Supply Development and Protection
- Contaminated Ground Water Remediation
- Construction Dewatering
- Flood Routing Studies

**Dam Engineering**
- Site Studies
- Dam Design
- Inspection

**Air Quality**
- Operating Permits
- Emission Inventories
- Control Technology Engineering
- Measurements and Modeling

Φ GEI Consultants, Inc.

5660 Greenwood Plaza Blvd., Suite 202
Englewood, CO 80111-2418

Tel. (303) 779-5565
Fax (303) 779-5653

# FAX

DATE 11/3/97

PROPOSAL/ PROJECT NO. 97411

Task Code 3010

NO. OF PAGES 2 (including this page)

TO: DAN McMILLAN

FAX NO. (719) 336-4404

FROM: BRAD RASTALL

MESSAGE: I'VE ATTACHED A LIST OF ADDITIONAL INFORMATION WE NEED FROM LAMAR TO COMPLETE OUR STUDY. IF YOU HAVE ANY QUESTIONS PLEASE CALL ME.

PLEASE LET US KNOW IF THE TRANSMISSION IS UNSATISFACTORY
** THANK YOU **

## SERVICES

**Geotechnical Engineering**
- Site Evaluation
- Foundation Design
- Construction

**Environmental Engineering**
- Process Engineering
- Site Evaluation
- Remediation
- Litigation Support

**Dam Engineering**
- Site Studies
- Dam Design
- Inspection

**Forensic Engineering**
- Failure Investigation
- Litigation Support
- Construction Claim Analysis
- Expert Testimony

**Geohydrology & Hydrology**
- Water Supply Development and Protection
- Contaminated Ground Water Remediation
- Construction Dewatering
- Flood Routing Studies

**Air Quality**
- Operating Permits
- Emission Inventories
- Control Technology Engineering
- Measurements and Modeling

We need the following information to complete the Arkansas River Basin Water Storage and Future Needs Assessment for the SECWCD

1. Firm yield (dry year yield) of Lamar's water system and water rights.
2. Population projections for 2000, 2010, 2020, and 2040.
3. Projected project water use for 2000, 2010, 2020, and 2040. In past years you reported project water use at 1500 af/yr to 2500 af/yr. Will this increase?
4. Estimate of per capita water use in gallons per person per day.

# CITY OF LAMAR
# WATER DEPARTMENT

102 EAST PARMENTER
LAMAR CO 81052
719-336-2002
FAX 719-336-4404

TO: Brad Rastall

FIRM: GEI Consultants, Inc

ADDRESS:

FAX NUMBER: 303-779-5653

---

FROM: Dannie McMillan

DATE: 11-7-97

TIME: 10:53

We are sending you 2 pages, including this cover sheet. If you do not receive all pages or if you encounter any other difficulty, please phone (719) 336-2002 at your earliest convenience. Thank you.

SPECIAL INSTRUCTIONS:

**HELTON & WILLIAMSEN, P.C.**
**CONSULTING ENGINEERS IN WATER RESOURCES**
384 INVERNESS DRIVE SOUTH, SUITE 115
ENGLEWOOD, COLORADO 80112
PHONE (303) 792-2161
FAX (303) 792-2165

# MEMORANDUM

January 9, 1998

RECEIVED
JAN 13 1998
GEI CONSULTANTS, INC.
ENGLEWOOD, CO

TO: Dick Westmore

FROM: Tom Williamsen

SUBJECT: City of Lamar water records

Attached is a summary of the water usage by the City of Lamar. The values for 1997 are handwritten at the bottom of the sheet.

Also attached are some pages from the City's master plan which may be helpful to Dave Bamberger.

TAW/mlc

Enclosure

C:\G701\010998.TAW

# CITY OF LAMAR
# WATER USAGE
(values in acre-feet)

| Water Year (1) | Nov (2) | Dec (3) | Jan (4) | Feb (5) | Mar (6) | Apr (7) | May (8) | Jun (9) | Jul (10) | Aug (11) | Sep (12) | Oct (13) | Annual (14) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1975 | 113.1† | 106.5† | 86.6 | 80.6 | 102.0 | 152.1 | 218.6 | 210.2 | 301.0 | 282.7 | 209.4 | 187.3 | 2,050.1 |
| 1976 | 102.8 | 89.6 | 93.4 | 101.5 | 125.7 | 174.7 | 190.8 | 269.6 | 328.2 | 314.4 | 182.9 | 130.4 | 2,104.0 |
| 1977 | 110.3 | 95.2 | 93.1 | 96.1 | 121.7 | 134.0 | 168.1 | 253.4 | 316.2 | 228.1 | 251.0 | 166.6 | 2,033.8 |
| 1978 | 90.6 | 86.0 | 87.1 | 81.5 | 128.3 | 209.5 | 156.9 | 220.4 | 311.4 | 255.2 | 224.6 | 168.5 | 2,020.0 |
| 1979 | 92.7 | 90.1 | 103.3 | 87.5 | 106.4 | 175.1 | 198.1 | 237.0 | 259.1 | 285.7 | 244.6 | 180.4 | 2,060.0 |
| 1980 | 96.5 | 94.6 | 100.0 | 95.5 | 103.4 | 124.5 | 165.5 | 335.3 | 392.7 | 342.1 | 275.0 | 213.2 | 2,338.3 |
| 1981 | 125.9 | 109.0 | 111.3 | 112.7 | 116.1 | 237.4 | 209.9 | 342.2 | 373.8 | 294.1 | 268.8 | 194.7 | 2,495.9 |
| 1982 | 118.7 | 112.7 | 110.6 | 103.3 | 138.1 | 217.3 | 191.3 | 228.0 | 306.9 | 344.8 | 229.5 | 174.2 | 2,275.4 |
| 1983 | 132.2 | 110.6 | 113.9 | 99.5 | 115.7 | 136.7 | 197.0 | 239.7 | 412.3 | 424.6 | 298.3 | 192.7 | 2,473.2 |
| 1984 | 125.2 | 121.4 | 130.0 | 110.2 | 124.3 | 133.8 | 251.1 | 362.6 | 372.7 | 356.9 | 282.3 | 135.9 | 2,506.4 |
| 1985 | 123.5 | 118.8 | 119.2 | 113.9 | 149.2 | 212.3 | 238.6 | 369.8 | 360.6 | 359.5 | 248.6 | 175.5 | 2,589.5 |
| 1986 | 111.9 | 115.9 | 119.0 | 115.9 | 194.4 | 251.6 | 320.6 | 296.1 | 316.7 | 262.3 | 232.8 | 154.8 | 2,492.0 |
| 1987 | 109.2 | 108.7 | 114.2 | 98.8 | 132.1† | 167.6 | 217.7† | 286.0† | 344.8 | 411.8 | 231.1 | 190.2 | 2,412.2 |
| 1988 | 113.7 | 106.5† | 106.7 | 110.0 | 135.4 | 195.6 | 217.7† | 286.0† | 342.9† | 321.0† | 245.4† | 181.9† | 2,362.8 |
| 1989 | 125.0 | 109.5 | 112.0† | 101.3† | 132.1† | 178.9† | 217.7† | 286.0† | 342.9† | 321.0† | 245.4† | 181.9† | 2,353.7 |
| 1990 | 113.1† | 106.5† | 112.0† | 101.3† | 132.1† | 178.9† | 217.7† | 286.0† | 342.9† | 321.0 | 245.4† | 181.9† | 2,338.8 |
| 1991 | 113.1† | 106.5† | 119.0 | 104.6 | 129.4 | 187.9 | 250.5 | 299.4 | 366.2 | 275.8 | 246.9 | 207.1 | 2,406.4 |
| 1992 | 101.8 | 65.2 | 112.0† | 101.3† | 132.1† | 178.9† | 217.7† | 286.0† | 342.9† | 321.0† | 245.4† | 181.9† | 2,286.2 |
| 1993 | 113.1† | 106.5† | 132.0 | 103.2 | 117.0 | 159.9 | 172.2 | 255.4 | 348.4 | 232.1 | 215.8 | 178.4 | 2,134.0 |
| 1994 | 99.8 | 131.7 | 130.5 | 117.9 | 173.8 | 179.3 | 290.4 | 395.7 | 401.6 | 387.1 | 242.5 | 204.9 | 2,755.2 |
| 1995 | 124.3 | 124.9 | 128.6 | 126.2 | 165.5 | 166.1 | 168.2 | 265.6 | 373.6 | 442.7 | 301.5 | 210.3 | 2,597.5 |
| 1996 | 131.1 | 125.9 | 130.2 | 66.0 | 132.1† | 183.3 | 313.1 | 281.5 | 285.2 | 278.4 | 231.2 | 209.1 | 2,367.1 |
| Avg | 113.1 4.8 | 106.5 4.6 | 112.0 4.8 | 101.3 4.3 | 132.1 5.6 | 178.9 7.6 | 217.7 9.3 | 286.0 12.2 | 342.9 14.7 | 321.0 13.7 | 245.4 10.5 | 181.9 7.8 | 2,338.8 |
| Max | 132.2 | 131.7 | 132.0 | 126.2 | 194.4 | 251.6 | 320.6 | 395.7 | 412.3 | 442.7 | 301.5 | 213.2 | ~~2,755.2~~ |
| Min | 90.6 | 65.2 | 86.6 | 66.0 | 102.0 | 124.5 | 156.9 | 210.2 | 259.1 | 228.1 | 182.9 | 130.4 | 2,020.0 |

Note: 1) The October 1985 value was taken from "City of Lamar, Water Flow, 1975-85".
2) A † indicates data was unavailable and, therefore, the monthly average was used.

1997 135.0 137.2 135.3 117.2 177.4 209.0 294.6 381.5 445.0 271.0 286.0 210.5 2799.7

# CITY OF LAMAR
# WATER DEPARTMENT

**102 EAST PARMENTER**
**LAMAR CO 81052**
**719-336-2002**
**FAX 719-336-4404**

TO: Tom Williamson

FIRM: Helton & Williamson

ADDRESS:

FAX NUMBER: 303-792-2165

FROM: Dannie McMillan

DATE: 1-6-98

TIME: 10:53

We are sending you 5 pages, including this cover sheet. If you do not receive all pages or if you encounter any other difficulty, please phone (719) 336-2002 at your earliest convenience. Thank you.

SPECIAL INSTRUCTIONS:

# II. DESIGN CRITERIA

## A. Population Projections

The current population of Lamar is approximately 8,440. Since 1950, the City has experienced an annual growth rate of about 0.5%. The City's Comprehensive Plan, developed in 1985, projected the population of Lamar would reach 11,936 by 1995 and 14,707 by 2005. *However, it appears that projection was a bit* optimistic and that the actual rate of growth has continued to follow the historical trend. The growth in the number of taps served by the City for the period of 1980 to 1996 was 0.74% per year. Figure 1 is a graph of the historical and projected population of the City. For the purposes of this report, an annual growth rate of 1.0% has been used.

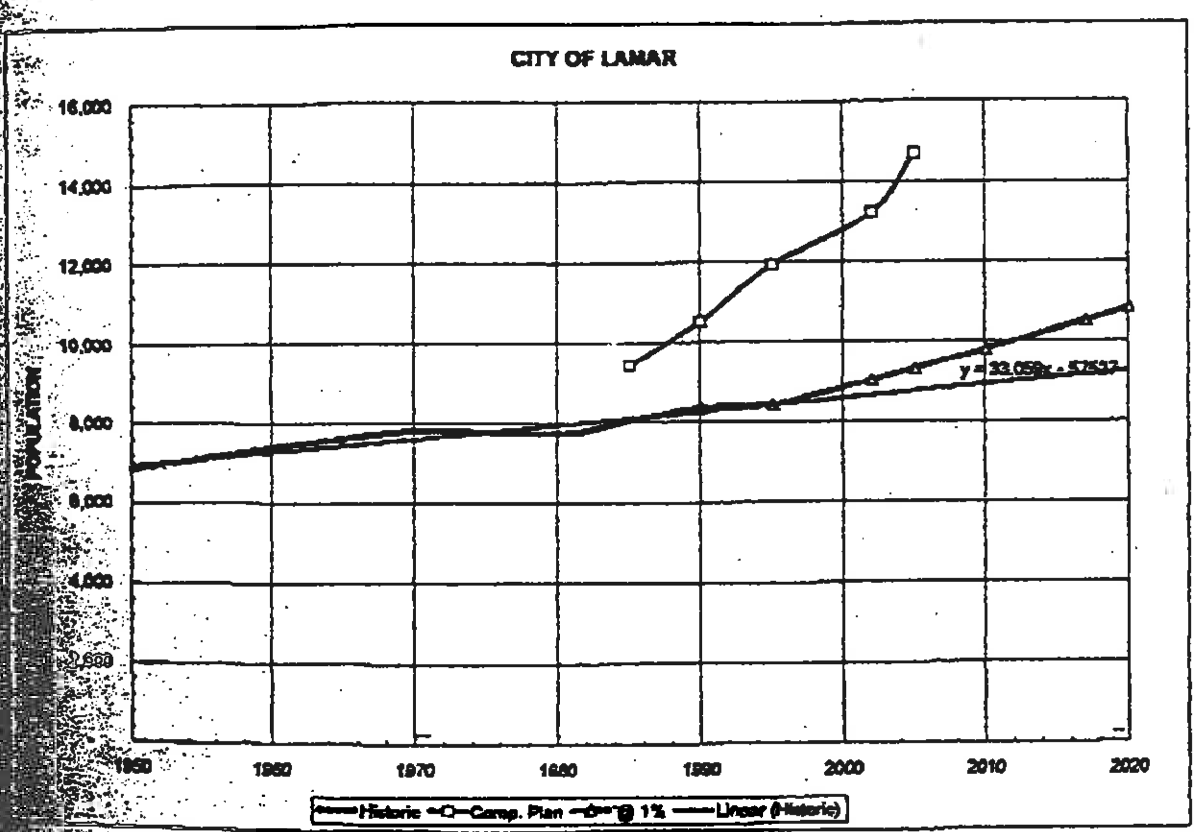


Figure 1

## B. Water Use

The characteristics of water use that are important in the design of a water system include the average-day demand, the maximum-day demand, the peak-hour demand, and the fire flows. The average-day demand is used primarily for water resource planning. The maximum-day demand is used to size the treatment plant, transmission lines, main pump stations, storage reservoirs, and the main distribution lines that deliver water from one reservoir to another. The peak-hour demands are used to size the distribution lines and booster pump stations that do not pump to a storage tank. Fire flows are also used in sizing the distribution lines as well as storage tanks. The average daily consumption is of importance for the management of the water system in that it is used to estimate the total annual usage and determine the adequacy of the raw water supply.

The highest annual volume of water used by the City occurred in 1994 with 903,000,000 gallons being delivered. The average number of taps served by the City during the year was 2,967 making the average-day demand 834 gallons per day per tap. With a population of 8,440, the average per capita consumption for 1994 was 293 gallons per day, which is high. The monthly water use for the past three years is shown in Figure 2.

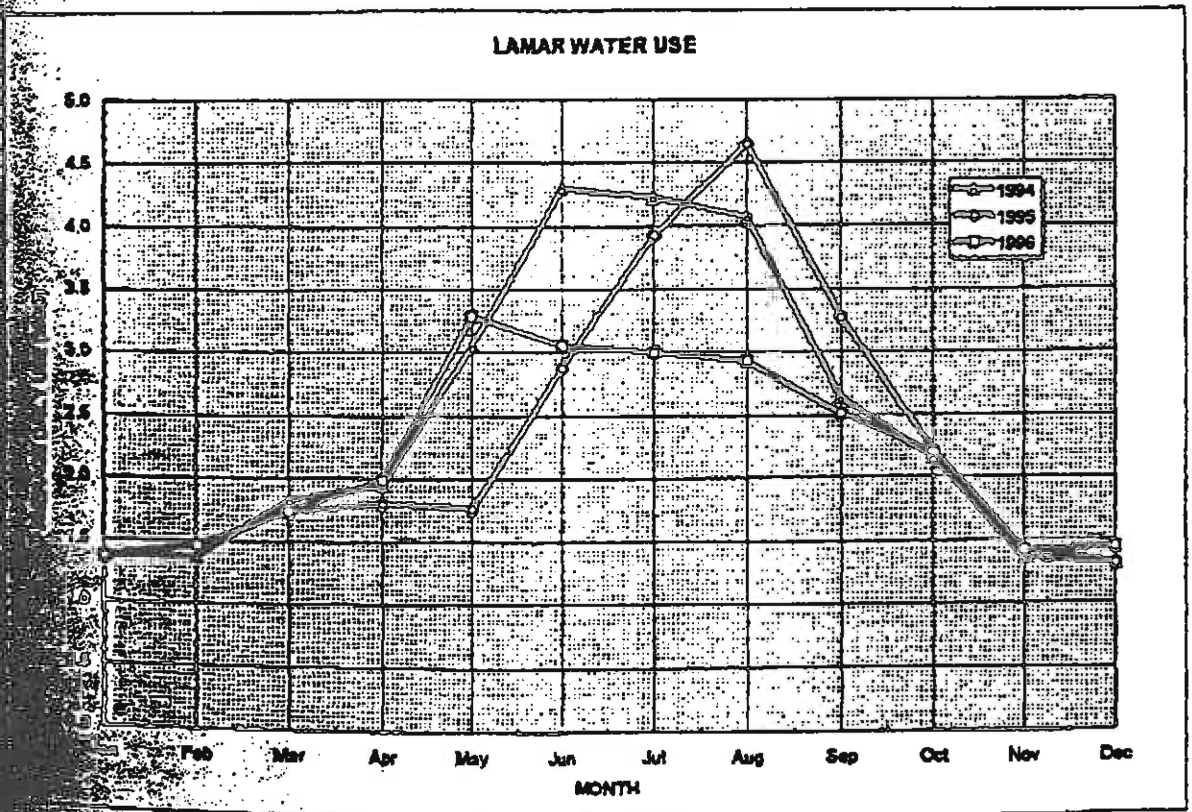


Figure 2

The maximum-day demand supplied by the City occurred in July of 1994 at 5.8 million gallons per day (MGD). Dividing this by the 2,967 taps served by the City derives an average demand on the maximum-day of 1,955 gallons per day. Dividing the maximum-day demand by the population derives an average maximum-day demand of 687 gallons per person per day. If the large users such as the industries and large commercial taps are subtracted from the total, the maximum-day demand is estimated to be 4.9 MGD. The average usage per tap is then 1,692 gallons per day per tap, and the maximum-day per capita consumption is 581 gallons. The 1,692 gallons per day demand is equal to an average flow rate of 1.17 gal/min per tap. This figure is typical of all systems we have investigated and has been used in the projection of the demands for the future taps.

The average-day was 834 gallons per day per tap. Dividing this into the 1,955 gallons per day for the maximum-day demand derives a ratio of the maximum-day to average-day of 2.34:1.0. This is close to the generally used ratio of 2.5:1.

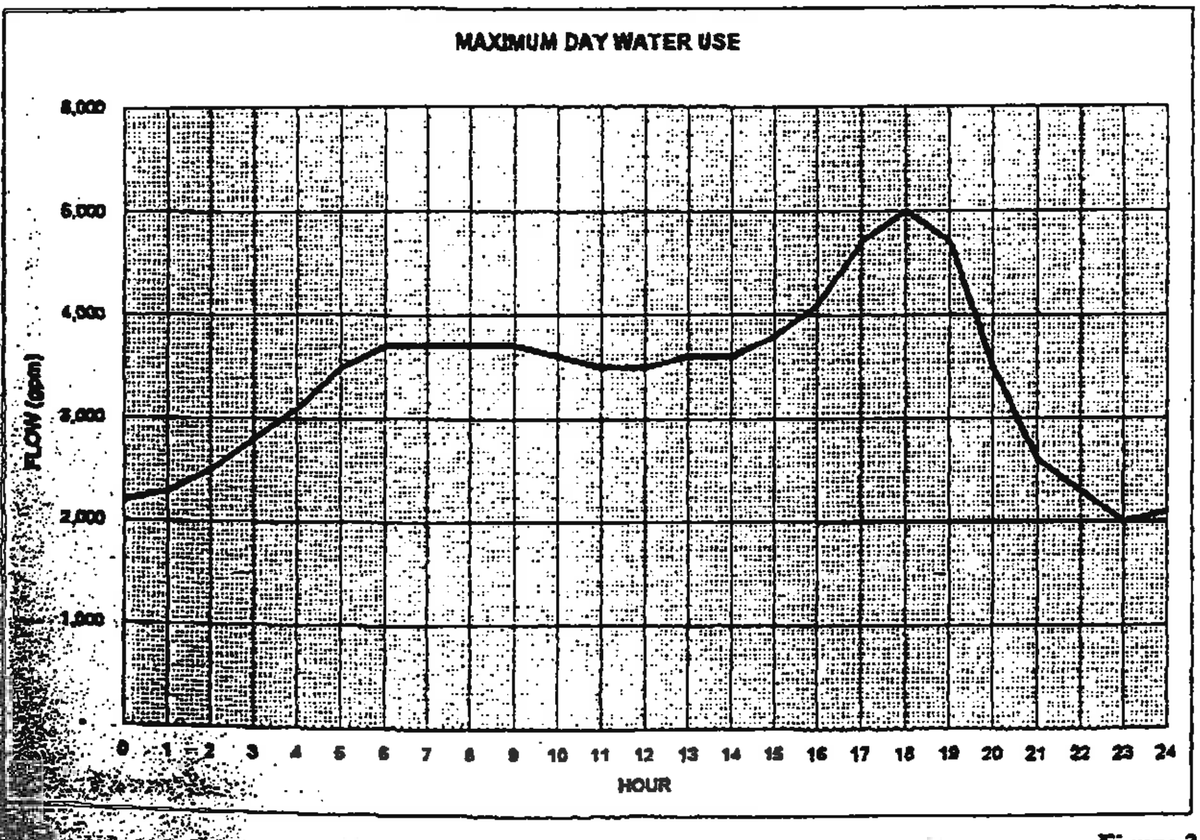


Figure 3

The hourly water demands measured at the chlorination station on June 20, 1994 are shown in Figure 3. This usage pattern is typical of most water systems and shows a distinct peak usage at 18:00 hours and a smaller peak in the morning. The minimum-use period occurs between 11:00 PM (23:00 Hours) and 2:00 AM.

The hourly usage is converted to a ratio between the instantaneous use and the average use over 24 hours as shown in Figure 4. As shown, the peak rate of use is 1.5 times the average for the day. This is exactly the figure used for typical systems. Also shown is a generic usage pattern as published by the AWWA. From this graph, it is apparent that the Lamar usage pattern closely follows the typical patterns. The ratios developed from this chart are used in the computer model as the basis for the extended period simulation.

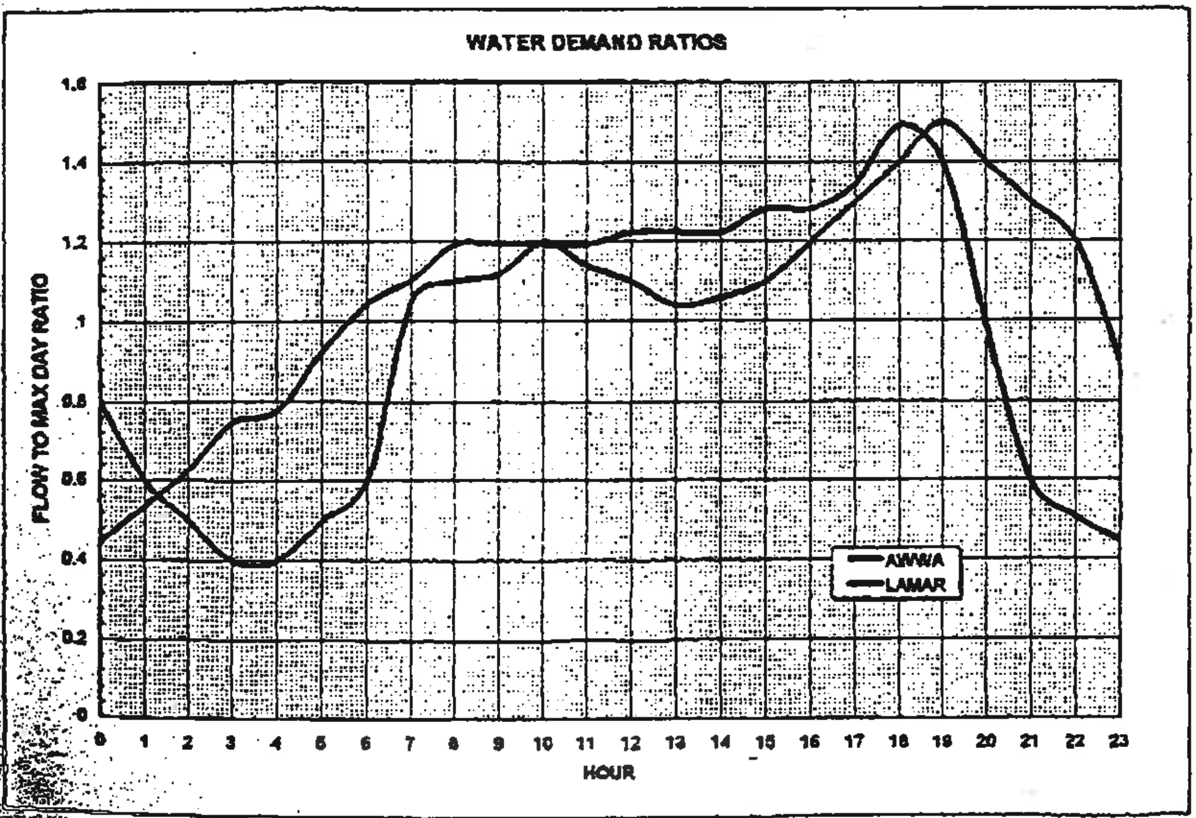


Figure 4

## C. Future Demands

Table 2 presents the projected maximum-day demand for the City. These projections are based on the following unit demands:

RECEIVED
SEP 27 1996
Southeastern Colorado Water
Conservancy District

# Survey of Water Users
# in the
# Southeastern Colorado Water Conservancy District

Please take a few minutes to fill out this important survey. It will assist the Southeastern Colorado Water Conservancy District in assessing the future demand for Fryingpan-Arkansas Project water and storage space. If you have questions or comments regarding this survey, you can call Steve Arveschoug (719-544-2040). **Please complete and return the survey to the District in the enclosed envelope before Monday, September 23, 1996.** Your cooperation is appreciated.

---

Name of Organization CITY OF LAMAR
Contact Person DANNIE MCMILLAN/CHRIS MILLER Phone 719-336-2002/ 719-336-43

User Group—Municipal X Agricultural ____ Industrial ____
Recreation ____ Other ____

What is your primary source of supply? (surface water rights, ground water rights, or leased water, please describe)
GROUND WATER RIGHTS

Do you have a raw-water storage system? Yes ____ No X
(Please describe your existing water storage system, rights.)

Do you currently request Fryingpan-Arkansas Project Water? (If yes, please describe your existing use, amount and purpose, of Project Water)
YES - RECHARGE WELLS AND AUGMENTATION

Have you used Fry-Ark Project IF-and-When storage space for the storage of your own water rights? Yes ____ No X

Fax 719-
336-4404

## Municipal Population and Irr. Acreage Water/Storage Demand Projections

List your projected use of water and Project water (acre-feet).

| Year | Population | Irr. acreage | Water Use | Storage Use | Proj. Water Use |
|---|---|---|---|---|---|
| Current | N/A | | | | |
| 2000 | | | | | |
| 2010 | | | | | |
| 2020 | | | | | |

Please describe your projected future demand for Fry-Ark Project Water and Storage (include copies of any reports or studies which provide the basis for your projections).

WATER AUGMENTATION FOR CITY WELLS, RECHARGE WATER FOR CITY WELLS

## Water Resource Planning Efforts

Do you currently have a water resource plan to meet future water/storage demands? Yes_______ No__x___ If yes, do your plans include the construction of raw-water storage facilities? Yes______ No______

Please describe your current water resource planning efforts and any construction plans.

Would you be willing to participate in a cooperative effort to assess the future demands for water and storage in the Arkansas River Basin and the future need for Fry-Ark Project Water and storage.

Yes__x___ No_________ Need more information__________

Comments

DRAFT

# SOUTHEASTERN COLORADO WATER CONSERVANCY DISTRICT

## Arkansas River Basin Water Storage and Future Needs Assessment

WATER SYSTEM SURVEY (Compiled by BWR)

### 1. General Information

**Entity** CITY OF LAMAR

**Contact Name/District Manager** DANNIE M.MILLIAN / CHRIS MILLER

**Address** 102 EAST PARMENTER STREET
LAMAR, CO 81052

**Phone No.** (719) 336-2002

**Fax No.** (719) 336-4376

**Primary Use** [✓ Municipal] Agricultural Industrial Recreational Other

**Master Plan or other Water Resource Planning Documents?** Y N
(If yes we must obtain it)
**Prepared by:**

**Geographic Location of Service Area** (obtain service area map)

### 2. Demographics/Water Use

*Historic Water Use*

| Year | Population | Water Use, af | $^3/_4$ -in Domestic Taps (optional) |
|---|---|---|---|
| 1987 | | | |
| 1988 | | | |
| 1989 | | | |
| 1990 | 8343 | 2355 | |
| 1991 | | 2353 | |
| 1992 | | | |
| 1993 | | 2145 | |
| 1994 | | 2772 | |
| 1995 | 8307 | 2604 | |
| 1996 | | | |

*Projected Water Use*

| Year | Population | Water Use, af | $^3/_4$ -in Domestic Taps (optional) |
|---|---|---|---|
| 2000 | | | |
| 2010 | | | |
| 2020 | | | |
| 2040 | | | |

**Major industrial or other uses other than domestic**

DRAFT

# SOUTHEASTERN COLORADO WATER CONSERVANCY DISTRICT

## Arkansas River Basin Water Storage and Future Needs Assessment

WATER SYSTEM SURVEY (Compiled by BWR )

### 3. Estimated Monthly Water Use

| | as a percent of total annual use,% |
|---|---|
| JAN | |
| FEB | |
| MAR | |
| APR | |
| MAY | |
| JUN | |
| JUL | |
| AUG | |
| SEP | |
| OCT | |
| NOV | |
| DEC | |
| TOTAL | 100% |

Notes:

DRAFT

# SOUTHEASTERN COLORADO WATER CONSERVANCY DISTRICT

## Arkansas River Basin Water Storage and Future Needs Assessment

WATER SYSTEM SURVEY (Compiled by B W R)

### 4 Sources of Water

*Surface Water*

**Sources**

**Point of Diversion** (for larger municipalities attach map, if available)

Location

Capacity

*Ground Water*

**Sources**

Tributary

Nontributary

Number of Wells

**Combined Annual Flow Rate** (from decrees or based on conveyance capacity)

(May only be available as an annual total)

| | gpm | cfs | af |
|---|---|---|---|
| JAN | | | |
| FEB | | | |
| MAR | | | |
| APR | | | |
| MAY | | | |
| JUN | | | |
| JUL | | | |
| AUG | | | |
| SEP | | | |
| OCT | | | |
| NOV | | | |
| DEC | | | |
| **TOTAL ANNUAL** | | | |

DRAFT

# SOUTHEASTERN COLORADO WATER CONSERVANCY DISTRICT

## Arkansas River Basin Water Storage and Future Needs Assessment

WATER SYSTEM SURVEY (Compiled by BWR)

### 5. Firm Yield

**District Managers may not have this information, attorneys and/ or consulting engineers may need to be contacted**

| Monthly Average Firm Yield for 1966-1995 | af |
|---|---|
| JAN | |
| FEB | |
| MAR | |
| APR | |
| MAY | |
| JUN | |
| JUL | |
| AUG | |
| SEP | |
| OCT | |
| NOV | |
| DEC | |
| TOTAL ANNUAL | |

Firm yield can estimated from:

- Response of water rights during critical dry year
- Potential volume limitation per decree or well permit
- Ability to augment out of priority depletions

Consulting Engineer or Attorney

T.E.C. PREPARED PLAN AND MODEL DRAFT REPORT

TOM ULLMAN
(970) 484-7477

### 6. Future Water Planning

Estimated future yield of existing water rights ____________af/yr

Conditional Water Rights

Direct flow/wells

Storage

## 7. Raw Water Storage

Total Vol. in af

Type:
Fry-Ark

If and When

Shared

Owned

## 8. Raw Water Conveyance

Type:
Pipeline

Canal

Estimated Raw Water Conveyance Losses

## 9. Treatment Plant Capacity

Type

Capacity

Also:

1. Attach copies of relevant tables and text from master plans, or water resource planning documents.
2. Compare data found in reports to data obtained from contacting entity via telephone or previous survey.

Notes:

# WATER AVAILABILITY FOR THE CITY OF LAMAR, COLORADO

COPY
X-CEPT
CLIPPED
SECTION
&
MAP

TECHNICAL ASSISTANCE PROJECT
TAP
ECONOMIC DEVELOPMENT ADMINISTRATION • U.S. DEPARTMENT OF COMMERCE

## Southern Colorado Economic Development District

REPORT PREPARED BY
W. W. WHEELER & ASSOCIATES, INC.
WATER RESOURCES ENGINEERS
ENGLEWOOD, COLORADO

# TABLE OF CONTENTS

## LIST OF TABLES AND FIGURES

# ABBREVIATIONS

Fry-Ark Project - Fryingpan-Arkansas Project

gpm - Gallons Per Minute

IBP - Iowa Beef Processor, Inc.

MG - Million Gallons

MGD - Million Gallons Per Day

mg/l - Milligrams Per Liter

psi - Pounds Per Square Inch

TDS - Total Dissoved Solids Concentration (the standard reference measure of salinity)

# INTRODUCTION

The purpose of this study was to investigate all feasible ways to supply additional water for municipal and industrial use by the City of Lamar, Colorado. Consideration was given to the present and anticipated water demands by Lamar, the various sources of water supply, water rights, storage, water quality, and treatment methods. Based on cost constraints and other considerations, various water supply alternatives were found to be more feasible than others. Options for development of additional water supplies for Lamar were set forth.

The City of Lamar is located near the southeastern corner of Colorado, about 110 miles east of Pueblo, and south of the Arkansas River. A General Area Map is included as Figure 1. The population of Lamar is about 9,000. There is a gradual, but definite, population growth trend. The climate is semiarid and marked with large daily temperature variations. Precipitation averages about 15 inches per year. Agriculture consists mainly of cattle-grazing on the dry plains, and irrigated farming near streams and in areas where well water is available.

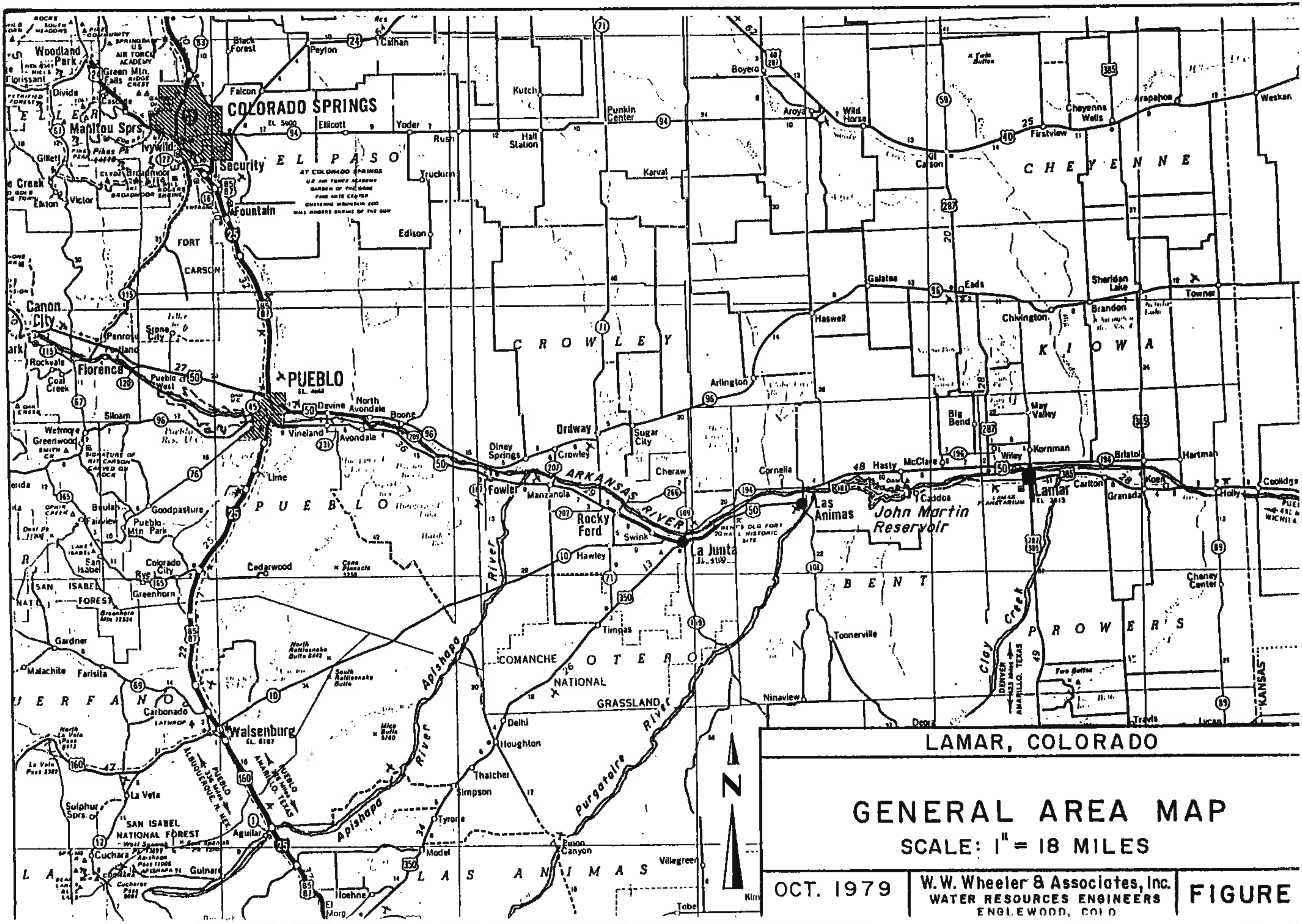
A map showing the locations of existing and proposed water supply features in the Lamar area that are discussed in this report is included as Figure 2.

Much of the investigation conducted by W. W. Wheeler and Associates, Inc, through August, 1979 was related to acquisition of a water supply for a proposed beef processing facility by Iowa Beef Processors (IBP) to be built near Lamar. The plant would have had an annual water requirement of 3,200 acre-feet of potable water. Since IBP planned to employ about 2,000 people, it was projected that the population of Lamar could triple over a period of several years as a result of the tremendous employment opportunities that would be created in the community. As a result, it was anticipated that the municipal water requirements at Lamar would quickly double or triple, exceeding the present capacity of the water supply.

In November, 1978, W. W. Wheeler and Associates, Inc. was asked to prepare a water supply plan for Lamar and IBP. The work included analysis of various water rights, preparation of a water supply plan, and preparation of information to be included in a plan of augmentation to be developed in conjunction with the law firm of Moses, Wittemyer, Harrison and Woodruff, P.C. This work continued through August, 1979, at which time IBP decided not to construct its plant near Lamar.

W. W. Wheeler and Associates, Inc. contracted with the Southern Colorado Economic Development District (SCEDD) in August, 1979 to perform the water study for the City of Lamar under EDA Grant Number 05-06-01854. The purpose of this report is to set forth the results of the water supply investigation under the SCEDD contract.

It is anticipated that the information presented in this report can be used by Lamar in planning for its future water supply needs. Even though a considerable amount of the engineering work was directly related to the proposed IBP industrial water requirement, the information provided in this report may be applied to other industries that may locate in Lamar. The information should be useful by the City of Lamar in planning for the development of additional municipal water supplies to serve the growing community.



## LAMAR, COLORADO

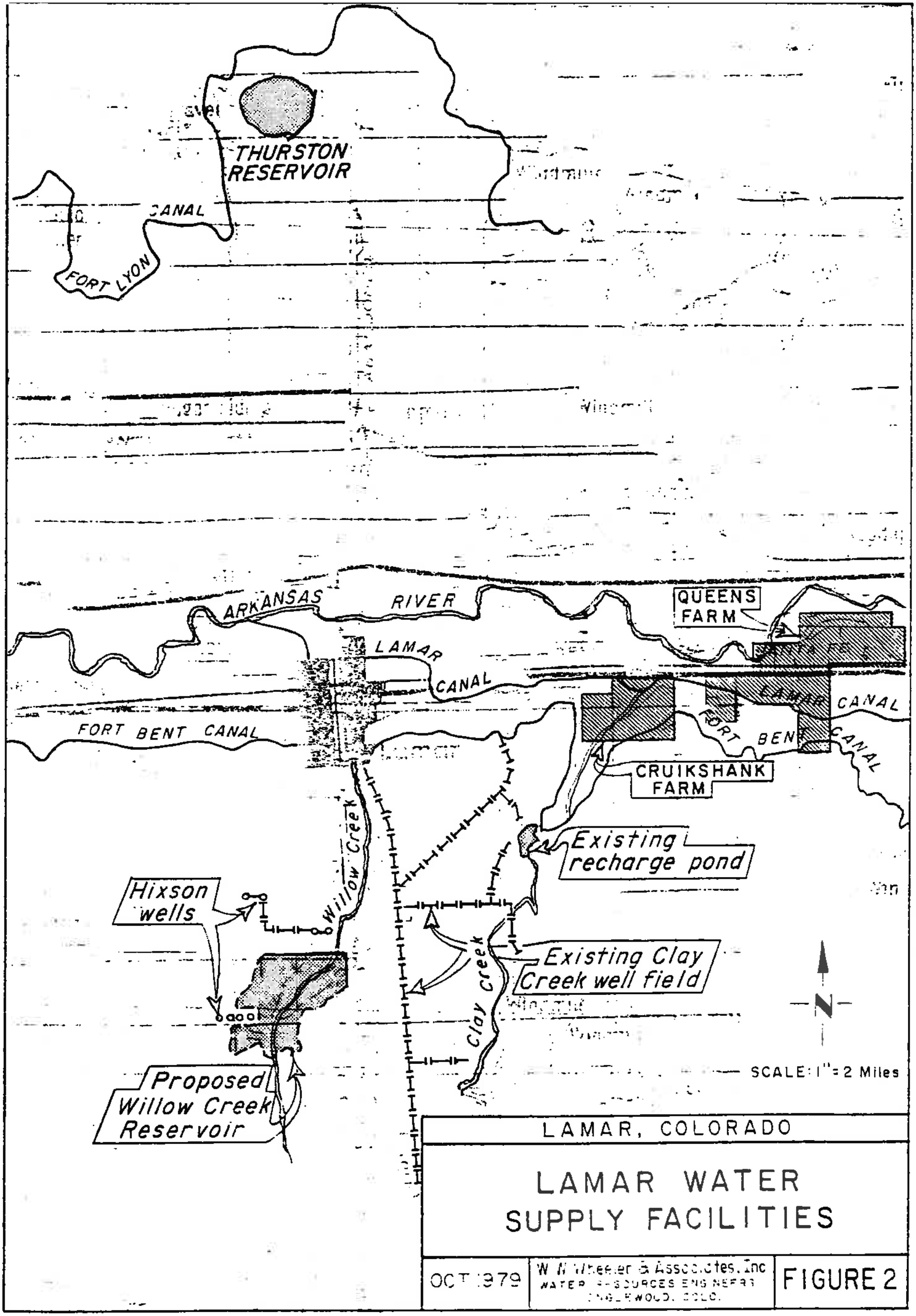
## GENERAL AREA MAP

SCALE: 1" = 18 MILES

OCT. 1979

W. W. Wheeler & Associates, Inc.
WATER RESOURCES ENGINEERS
ENGLEWOOD, COLO.

FIGURE



LAMAR, COLORADO

LAMAR WATER SUPPLY FACILITIES

OCT 1979

W. W. Wheeler & Associates, Inc
WATER RESOURCES ENGINEERS
ENGLEWOOD, COLO.

FIGURE 2

# SUMMARY OF FINDINGS AND RECOMMENDATIONS

1. Water production by the City of Lamar is estimated to be about 1,870 acre-feet per year to serve a population of about 8,500. Residential use, commercial use, and system losses are estimated to be 1,140, 406, and 324 acre-feet per year, respectively. Per capita use was estimated to be about 195 gallons per day, which is a fairly typical value for towns in the region. The total consumptive use of Lamar water production was estimated to be about 35 percent.

2. Based on population projections prepared by the Colorado Division of Planning for Prowers County, Lamar's population may double to about 18,000 by the year 2010. The corresponding municipal water requirement would be about 3,900 acre-feet per year. Population projections, however, are very uncertain.

3. Lamar's municipal water supply is presently obtained from 26 alluvial wells in the Clay Creek Aquifer. The firm yield of the aquifer is estimated to be about 1,900 acre-feet per year. A recharge program has been in effect since 1973, which has been effective in stabilizing water levels and increasing groundwater storage. The use of recharge may increase the firm yield of the aquifer to about 3,800 acre-feet per year. The present efficiency of the recharge program is about 70 percent.

4. The southern section of the Clay Creek well field produces about half of the total yield. The annual pumping cost for the entire system is about $32,000. An energy savings of several thousand dollars per year may be achieved through modified operation of the southern section. If additional wells are connected to the southern section, the 14-inch line to the storage tank should be replaced with a larger pipe.

5. Pumping of wells 10 through 15 should be increased to make use of the recharge water. Pumping should be maximized from wells 19 and 20 at the northern end of the system to reduce losses from the

aquifer. Water quality at these wells should be periodically monitored to insure that high salinity groundwater from the Arkansas River has not encroached.

6. Meters should be installed on the three pipelines entering the six million gallon storage tank so that the performance of the system can be monitored.

7. It is anticipated that Lamar will be allocated 9,350 acre-feet of storage capacity in Pueblo Reservoir for its three percent share of Fryingpan-Arkansas Project water. Lamar should not expect to realize more than about 1,800 acre-feet of firm yield at Pueblo Reservoir. Transportation losses of 7 to 50 percent may occur as water is delivered from Pueblo Reservoir to Lamar. Transportation losses can be minimized by delivering water during the months of higher runoff.

8. Eight deep Dakota formation wells on the Hixson Farm together may produce up to 1,600 acre-feet of water per year over a life of five to ten years.

9. The Cruikshank Farm water rights could be used to supplement Lamar's municipal water supply through a plan of augmentation. The firm annual yield of these rights is estimated to be 570 acre-feet which could be realized through the use of 500 acre-feet of storage.

10. The purchase of additional water rights should be most logically directed to the existing senior surface water rights in the Lamar area. The most valuable rights for use by Lamar are those that may be easily transferred without substantial reductions.

11. The TDS concentration of water produced from the Clay Creek Aquifer is about 700 mg/l, which is higher than the desirable level. The water is also very hard.

12. The quality of water in the Arkansas River varies seasonally, with TDS concentrations ranging from about 400 to 4,400 mg/l. The best water quality usually coincides with the periods when the river is high. Diversions to the recharge pond should only be made when water quality is at an acceptable level.

13. Disinfection is the only treatment necessary when Arkansas River water is used through recharge of the Clay Creek Aquifer. The use of surface water would require treatment consisting of coagulation, sedimentation, filtration, and chlorination.

14. Softening by the lime-soda ash method would entail very high chemical costs, fairly high operating costs, and sludge disposal problems.

15. Reverse osmosis desalination would require softening as a pretreatment. The energy, operation, maintenance, and brine disposal costs associated with desalination would be prohibitively high.

16. The use of recharge at the Clay Creek Aquifer appears to be the most economical way to increase the municipal water supply. The efficiency of the program could be improved by pumping recharge water to one or more additional recharge ponds to the south of the existing pond.

17. The Hixson wells could be useful for supplying water to Lamar for peaking purposes or during an interim period while more permanent facilities are being constructed. Since the yield and life of the wells is not very well defined, it may be more economical to purchase the water produced from the wells than to purchase the entire Hixson Farm.

18. Renewed consideration should be given to the eventual construction of Willow Creek Reservoir to be used for flood control, recreation, and the storage of water pumped from the Arkansas River. The feasibility of constructing the dam is contingent on financial participation by the U. S. Army Corps of Engineers.

19. Thurston Reservoir could potentially be enlarged to provide for storage of water pumped from the Arkansas River. The construction costs and continuing operating costs may be prohibitively high.

20. Construction of the Arkansas Valley Conduit is not considered to be feasible for Lamar unless substantially all of the communities east of Pueblo participate.

21. Ponds could be constructed on the Cruikshank or Queens farms for the storage of water diverted from the Arkansas River. Construction and operation costs may be lower than for the other storage facilities considered.

22. Consideration should be given to the eventual construction of a dual distribution system. The system could greatly extend the use of high quality Clay Creek Aquifer water at a cost much less than that of constructing and operating a desalination plant. However, use of high salinity water could result in death or damage to plants with a low salt tolerance.

23. The City of Lamar should consider the imposition of watering restrictions during critical dry periods or for the purpose of generally reducing water consumption.

24. Lamar's water supply plans should take into account current and long-term energy considerations related to the consumption of scarce, expensive, or potentially unavailable resources. Consideration should be given to the effects that proposed actions will have on the natural and human environment.

25. Judicial approval of a water rights transfer or plan of augmentation is an integral part of a water supply development program under Colorado water law.

# ARKANSAS VALLEY WATER SUPPLY

The headwaters of the Arkansas River originate above Leadville at elevations in excess of 14,000 feet. The river flows in a general southeasterly direction through mountainous areas to Canon City. Downstream from Canon City it meanders through the plains to the Kansas state line. Most of the dependable runoff in the basin is from snowmelt in the mountains upstream from Canon City. Flood flows generally originate from high intensity rainstorms in the plains tributaries and are not dependable for supplying irrigation requirements.

Irrigation in the Arkansas River Basin of Colorado began in the early 1860's by small individual enterprises. By the early 1900's all the dependable surface flows had been appropriated for direct use and/or storage. Snowmelt runoff normally diminishes rapidly in July, after which the lands under a majority of the canals suffer moderate to severe water shortages.

The average annual water supply available at Pueblo is approximately 1.2 million acre-feet. The demand for water downstream from Pueblo on the Arkansas River by irrigators and municipalities exceeds this available supply, especially in dry years. Conjunctive use of water is practiced in the Arkansas Valley. Wells are pumped to supplement the surface water supply.

Unfortunately, as the water supply of the Arkansas River and its alluvium is used and reused, the quality of the water deteriorates as one proceeds downstream. The average total dissolved solids content of the surface water at Pueblo is about 250 mg/l, but the water quality deteriorates to an average of more than 2000 mg/l, by the time the Arkansas River reaches the state line.

As a result of water shortages, the Southeastern Water Conservancy District, through assistance of the Bureau of Reclamation, succeeded in developing the Fryingpan-Arkansas Project. This project was designed and constructed to make an additional 80,000 acre-feet per year available for use in the Arkansas Valley. The source of most of this water is the Western Slope of Colorado. At this time construction for this project is nearly completed.

John Martin Dam, located upstream from Lamar, was constructed by the Corps of Engineers primarily for flood control, although some water is stored primarily for irrigation use.

Since almost the entire water supply was appropriated by early settlers in the valley for irrigation use, it becomes necessary for municipalities to purchase these more senior water rights. After these water rights are purchased, it is a Colorado water law requirement to make application to the water court to change the type and place of use of these water rights. Generally the more senior water rights will produce the most dependable source of water so municipalities usually purchase the most senior water rights unless they also have storage facilities to carry water over from wet years to dry years.

# ALTERNATE WATER SUPPLY DELIVERY SYSTEMS

A study was made of several water supply systems that could be used in providing water to the proposed Iowa Beef Processors facility and the City of Lamar. Several of the alternates were rejected as being infeasible for one or more reasons. Now that Iowa Beef no longer has plans to construct a plant near Lamar, the water supply requirements for Lamar have been changed considerably. Of primary importance is the fact that extensive facilities must no longer be constructed under a tight time schedule. Since Lamar's construction schedule is now more flexible, facilities that require longer lead times may be considered as feasible alternates. Depending on the future water requirements of Lamar, one or more of the following alternates may prove to be economical. Figure 2, enclosed in the back of this report, shows the locations of the proposed and existing facilities described herein.

## Clay Creek Recharge Program

As described in the section of this report entitled "Sources of Water Supply", the Clay Creek Aquifer is presently being recharged by diverting Arkansas River water into a 20 acre pond located behind the Clay Creek Dam. Recharge through the pond has stabilized water levels in the aquifer and has been effective in increasing groundwater storage. It is estimated that recharge can potentially double the firm yield of the aquifer from 1,900 acre-feet per year to a potential of 3,800 acre-feet per year. Lloyd Hershey indicates that recharge of the northern part of the Clay Creek Aquifer is being accomplished through the present system of operation with about 70 percent efficiency. The use of additional data and monitoring sites developed in 1979 may make it possible to increase the efficiency of the recharge program. Lloyd Hershey has recommended that a geological study be conducted to determine the potential for recharge in the south well field or other areas.

The use of recharge to increase groundwater storage in the Clay Creek Aquifer appears to be the most economical way to increase the municipal water supply. However, as the maximum storage potential of the aquifer is reached, it is anticipated that an unacceptably large amount of groundwater will be lost to leakage from the northern end of the aquifer. Additional water would be lost to consumptive use by vegetation as the water table rises near the surface in the vicinity of the existing stream channel. The cost of water rights required to make up for these losses could become substantial.

As Arkansas River diversions are mixed with water in the Clay Creek Aquifer, the overall salinity of the aquifer may be increased. Although little deterioration in water quality has been reported, changes may be occurring in parts of the aquifer. If possible, Arkansas River water should only be diverted into the recharge pond when the river water salinity is relatively low. Changes in water quality should be monitored to determine trends of deterioration in water quality.

The efficiency of the recharge system could be improved by pumping recharge water to one or more additional recharge ponds further up-gradient to the south. This concept should be developed further and investigated in greater detail.

Deep Dakota Wells

As discussed in the "Sources of Water Supply" section of this report, some work was conducted in 1979 by Lloyd Hershey to analyze the quantity of water that Lamar could expect to pump from eight Dakota wells on the Hixson Farm located south of Lamar. The locations of these wells and proposed facilities to connect the wells to Lamar's existing distribution system are shown on Figure 4. On a very preliminary basis, Mr. Hershey has estimated that the wells could produce up to 1,600 acre-feet per year over a productive life in the range of roughly five to ten years. There is some evidence that because of excessive well drawdowns, the annual well yields may be somewhat less than 1,600 acre-feet per year.

On an initial basis, it appears that these wells could be used for two purposes. First, the wells could be used to help supply the demands of Lamar for an interim period while more permanent facilities are being constructed. Second, these wells could be used during critical dry periods or peak water use months to increase the overall firm yield of all the water supply sources.

The cost of developing the Hixson water would primarily consist of leasing or purchasing the farm or of purchasing the produced water. Since the yield and life of the wells is not very well defined, it may be more economical to only purchase the water produced from the wells, while not obtaining any property interest in the farm. The estimated costs for development of the well field are shown below:

HIXSON WELL FIELD DEVELOPMENT COSTS

|  | Capital Cost | Annual Operation & Maintenance |
|---|---|---|
| Improve Well Facilities | $ 30,000 |  |
| Pipeline to Existing Storage Tank |  |  |
| 12-inch pipeline | 160,000 |  |
| 15-inch pipeline | 165,000 |  |
| Pumping and Maintenance |  | $17,000 |
| Totals | $355,000 | $17,000 |

## Willow Creek Reservoir

The Willow Creek Reservoir has been proposed by the U. S. Army Corps of Engineers as a flood control facility as a part of the Lamar Local Protection Project. The Corps has studied the feasibility, costs, and benefits of the reservoir. The project study was suspended in 1977 when it was realized that the flood control benefits did not equal or exceed the costs. The Willow Creek Dam would be located on Willow Creek immediately above U. S. Highway 287-385 about 2.5 miles south of Lamar. The reservoir would contain 17,230 acre-feet of storage at the top of the flood control pool, with 13,730 acre-feet of required flood control storage, 1,500 acre-feet of recreation, fish and wildlife storage, and 2,000 acre-feet of sediment reserve. The dam would be a rolled earthfill structure 11,200 feet long and rising 82 feet above the streambed.

The Willow Creek Reservoir concept could be expanded to include municipal water storage as well as flood protection and recreation. A minumum pool would be maintained in the reservoir to provide water storage through drought periods to insure a firm water supply for Lamar. Diversions from the Arkansas River would be pumped to the reservoir for storage at times when the natural flow of Willow Creek is not sufficient. It is anticipated that the salinity of Willow Creek flows would be considerably lower than that of the Arkansas River. The collection of runoff in Willow Creek Reservoir would tend to dilute the concentrations of salinity resulting from the Arkansas River diversions. Releases from the reservoir would be made to a nearby treatment plant for delivery to Lamar.

Advantages of this water supply system include the multiple use of the reservoir for flood control, water supply, and recreation. Disadvantages include the high construction cost, the long period required to obtain government approval,financing, design, and the high operating cost associated with pumping water from the Arkansas River. Construction of Willow Creek Dam could be ten years or more in the future since its feasibility depends on Federal financing. Therefore, it was considered that the reservoir could not be constructed in time to provide a water supply for the proposed Iowa Beef Processors plant. Since that plant is no longer to be constructed at Lamar, the Willow Creek Reservoir alternate may be more feasible.

The Corps of Engineers estimated the construction cost of Willow Creek Reservoir to be $14,267,000 at 1977 prices, resulting in a flood control benefit-cost ratio of 0.442. Estimates prepared by Wheeler indicate that the 1979 cost for the reservoir including an additional storage capacity of 8,000 acre-feet for municipal and industrial storage would be about $17,000,000, as shown in Table 5.

Since Lamar no longer needs to contend with the time constraints imposed by the proposed IBP water requirements, the eventual construction of Willow Creek Reservoir should be reconsidered. The Corps of

## TABLE 5

## WILLOW CREEK RESERVOIR

## CONSTRUCTION COST ESTIMATE

| | 1977 Corps of Engineers Estimate | 1979 Wheeler Estimate |
|---|---|---|
| General | $ 34,000 | $ 39,000 |
| Embankment | 10,087,000 | 12,261,000* |
| Spillway | 95,000 | 106,000 |
| Outlet Works | 449,000 | 512,000 |
| Auxiliary Levee | 320,000 | 355,000 |
| Engineering and Design | 1,096,000 | 1,260,000 |
| Supervision and Administration | 870,000 | 1,001,000 |
| Land Acquisition | 1,316,000 | 1,513,000 |
| Total | $14,267,000 | $17,047,000 |

---

* Includes embankment for storage of an additional 8,000 acre-feet of storage.

Costs of pipelines, treatment plant, treated water storage and distribution are not included.

Engineers should be contacted and the concept of using Willow Creek Reservoir for storage of municipal water supply should be included in the benefit-cost analysis. The dam could potentially be constructed initially for flood control with provisions for subsequent use for water supply storage.

## Thurston Reservoir

Consideration was given to the use of Thurston Reservoir for municipal water supply storage. Thurston Reservoir is located nine miles north of Lamar, below the Fort Lyon Canal. The elevation of the reservoir is about 200 feet higher than Lamar. Irrigation water is presently stored in Thurston Reservoir by the Fort Lyon Canal Company and the Amity Canal Company. In order for Lamar to make use of Thurston Reservoir, it would first be necessary to obtain permission from the owners.

It is anticipated that water would be taken at the Lamar Canal diversion dam and diverted to a pump station. Water immediately required for use by Lamar would be pumped to a treatment plant near the city. Surplus water under Lamar's water rights would be piped north across the Arkansas River to Thurston Reservoir. Water would be held in storage for release by gravity through the pipeline at times when the municipal water requirements exceed the available supply.

Disadvantages of the Thurston Reservoir alternate include the high construction cost, high pumping cost, and potential water quality problems. Use of Thurston Reservoir would require continual pumping of Lamar Canal diversions against a pumping head of about 240 feet. The total length of pipeline required to deliver Thurston Reservoir water to a treatment plant at Lamar would be about 17 miles. It is anticipated that the enlargement of Thurston Reservoir to provide storage for 8,000 acre-feet of water in addition to the existing irrigation storage would require about 90,000 cubic yards of embankment. The reservoir would probably need to be sealed to reduce seepage losses. The irrigation water stored in Thurston Reservoir normally has a high dissolved solids concentration because the reservoir is filled from the Fort Lyon Canal in winter when the Arkansas River salinity level is high. The quality of the municipal water supply would be degraded as it mixes with the poor quality irrigation water. A summary of the preliminary construction and operation costs is provided in Table 6.

### Arkansas Valley Conduit

A proposed feature of the Fryingpan-Arkansas Project is the proposed construction of a pipeline to provide potable water to towns in the Arkansas River Valley. The pipeline, known as the Arkansas Valley Conduit or the Valley Pipeline, would extend from Pueblo to Lamar. In 1972, a report concerning the pipeline was submitted to the Southeastern Colorado Water Conservancy District, the Four Corners Regional Commission, and the U. S. Bureau of Reclamation by Black & Veatch, Consulting Engineers. The report included information on the proposed route of the pipeline, treatment methods, costs, and anticipated water demands.

The primary purpose of the Valley Pipeline is to provide to the various communities a potable water supply with a total dissolved solids content of less than 500 mg/l. Since the salinity of the Arkansas River continually increases from Pueblo to Lamar, Black & Veatch found that it would be more economical to transmit treated water through the Valley Pipeline system than raw water. The water would be treated near Pueblo by the reverse osmosis process whereby the water would be desalinated. In the time since the 1972 report was issued, plans to construct the Valley Pipeline have been dropped as a result of lack of interest on the part of several municipalities.

A preliminary study of constructing a limited portion of the pipeline was conducted. The pipeline would provide a supplemental water supply for La Junta, Las Animas, Lamar, and intervening communities. The pipeline would originate near the Fort Lyon Canal diversion dam west of La Junta where the water would be desalinated and pumped to the various communities. The advantages to Lamar of the Valley Pipeline are twofold. First, the economy of scale for a large water treatment plant to serve several cities could result in considerable savings.

# TABLE 6

## THURSTON RESERVOIR ALTERNATE

## PRELIMINARY CONSTRUCTION AND OPERATION COSTS

| | Construction Cost | Annual Operation Cost |
|---|---|---|
| Lamar Canal Pump Station | $ 800,000 | $ 88,000 |
| Pipeline to Thurston Reservoir | 3,700,000 | |
| Pipeline to Treatment Plant | 510,000 | |
| Thurston Reservoir Improvements | | |
| Embankment | 500,000 | |
| Outlet Works | 100,000 | |
| Reservoir Sealing | 2,700,000 | |
| Subtotals | $ 8,310,000 | $ 88,000 |
| Contingencies | 830,000 | 9,000 |
| Engineering | 830,000 | |
| Totals | $ 9,970,000 | $ 97,000 |

Costs of treatment plant, treated water storage, distribution system, and land acquisition are not included.

Second, the water quality of the Arkansas River at La Junta is much better (by an average of 1,000 mg/l TDS) than at Lamar. The better quality of raw water would result in lower construction and operating costs for the treatment plant.

Use of the Valley Pipeline has several disadvantages. Lamar's water rights in the Lamar and Fort Bent canals probably cannot be transferred to a point of diversion near La Junta. Construction of the pipeline would require a joint venture with La Junta and Las Animas. These cities may not wish to participate because of the high costs involved. An estimate of the cost of delivered water was made based on projected peak demands for the year 2020 in La Junta and Las Animas and a tripling of population with additional industrial water demands in Lamar. It was assumed that the treatment plant and pipeline near La Junta would have a capacity of 18 MGD. The cost of delivered water was estimated to vary from $1.30 per 1,000 gallons at La Junta to $1.75 at Lamar, exclusive of the costs of water rights and pipeline easements. If the treatment plant and pipeline was constructed to a smaller capacity whereby only Fry-Ark Project water would be delivered, Lamar's cost would rise to $2.15 per 1,000 gallons.

Construction of the Valley Pipeline is not considered to be feasible for Lamar unless substantially all of the communities east of Pueblo participate. If the pipeline is only constructed from La Junta to Lamar, the cost of treating and delivering the water to Lamar would be very high, even if La Junta and Las Animas share part of the cost. Therefore, construction of the Valley Pipeline was rejected as being too expensive.

### Storage of Water in John Martin Reservoir

The use of John Martin Reservoir to store water for Lamar was rejected for several reasons. The quality of water stored in John Martin during the winter is usually very poor. Salinity concentrations in winter are typically about 2,500 mg/l. Release of this water in winter for diversion by Lamar would result in unacceptable water quality for the municipal supply. During much of the year a live stream does not exist between Lamar and John Martin Reservoir. Therefore, it would be very difficult to make storage releases from John Martin that could be rediverted at Lamar. Similarly, it would be very difficult to transfer Lamar Canal water rights to John Martin Reservoir.

### Alluvial Wells

The use of Arkansas River alluvial wells to provide a supplemental water supply for Lamar was rejected. The dissolved solids content of alluvial wells in the Lamar area is very high, with values ranging near 4,000 mg/l. This high salinity level renders the alluvial wells unsuitable for use as a municipal supply except under emergency conditions.

### Water Storage on the Cruikshank Farm

The City of Lamar owns the Cruikshank Farm and associated water rights. The farm is located about five miles east of Lamar, south of Highway 50. A study was made of the feasibility of storing water on the farm in lined ponds for use as needed by Lamar. It was estimated that storage ponds with a total capacity of up to 4,000 acre-feet could be constructed on the property. Water would be diverted into the ponds from the Lamar and Fort Bent canals. Some pumping would be required to make use of Lamar Canal water, but Fort Bent Canal water could be diverted by gravity. The ponds would be constructed by excavating material from the pond sites for use in building the dams. Four ponds with individual capacities of 1,000 acre-feet would be constructed to allow flexibility of operation, periodic maintenance of each pond, and to minimize evaporation losses when storage contents are below capacity. The ponds would cover about 250 acres and would be 25 feet deep when full. It is anticipated that the ponds would be lined with soil cement, bentonite, or an asphalt membrane to reduce seepage losses. Each of the four ponds would have outlet works for release of water to a nearby treatment plant.

On a preliminary basis, the cost of constructing the ponds on the Cruikshank Farm was estimated to be $5.5 million. Based on limited available geological data, the construction cost could be considerably higher if it is found necessary to design the embankment for poor geological conditions.

In order to make use of diversions from the Lamar Canal, it would be necessary to make some provision for removal of the Lamar Power Plant cooling water. Cooling water for the Lamar Power Plant is produced at a rate of 12,000 gpm from alluvial wells near Lamar. The water, with a total dissolved solids content of about 4,000 mg/l, is too brackish to be used by Lamar except in emergencies. After use at the power plant, the water is either delivered to the Connecticut General Farm east of Lamar, discharged into the Lamar Canal, or released into the Arkansas River. During the irrigation season when Lamar's water rights in the Lamar Canal are producing relatively good quality water, it will be necessary to keep the cooling water from mixing with the municipal and industrial water in the canal. It is anticipated that an arrangement can be worked out whereby the cooling water not required by Connecticut General is released into the Arkansas River. In exchange, water would be pumped from alluvial wells into the Lamar Canal east of the storage and treatment facilities. As an alternative to pumping into the Lamar Canal, downstream irrigators on the Lamar Canal could be given compensation for pumping their existing wells at times when the loss of the cooling water causes shortages in the canal.

### Water Storage on the Queens Farm

Iowa Beef Processors holds an option to purchase the Queens Farm which was to be used as the site of the proposed beef packing plant. The farm ~~is~~ located about seven miles east of Lamar along Highway 50. A study was made of using the western portion of the Queens Farm for storage and treatment of water primarily for use by IBP. The Queens Farm site would be used as an alternate to the use of the Cruikshank Farm. The proposed facilities on the Queens Farm would be very similar to those described above for the Cruikshank Farm. Since IBP was considering construction of a large plant on the Queens Farm, use of the Queens Farm storage and treatment facilities was found to be desirable because of its close proximity to the proposed plant.

### Dual Distribution System

The purpose of a dual water distribution system would be to stretch the use of a limited supply of high quality water while making separate use of an abundant source of highly mineralized water. As water requirements in Lamar increase to the point where the Clay Creek system is no longer sufficient, the use of a dual water system should be considered.

A dual water distribution system would consist of a potable system and a separate nonpotable system. The potable system would provide water of excellent physical, chemical, and biological quality. The nonpotable supply should be consistently maintained at a quality level such that its occasional inadvertent use for drinking purposes will not cause harm to the consumer. This means virtual freedom from pathogens of all kinds and toxic chemicals. In addition, the nonpotable supply should not stain plumbing fixtures and there should not be corrosive or encrusting tendencies at normal temperatures.

A dual distribution system would consist of providing highly mineralized river water for use in toilets, swimming pools, lawn watering, and fire fighting in new housing developments and in irrigation of the City's parks, golf course, and cemetery. It is anticipated that the river water would be pumped from alluvial wells and disinfected by chlorination. Since the water would be safe for human consumption, inadvertent drinking or cross connections with the potable system would not pose a health hazard. The potable system providing good quality Clay Creek water would be used for drinking, cooking, dishwashing, bathing, and laundry. New potable water mains could consist of relatively small diameter pipe since these mains would not need to carry large volumes for lawn irrigation and fire fighting.

The costs of providing dual service would be considerably higher than single service. Two sets of water mains, service lines, and meters would be required. By limiting the dual distribution system primarily to newly developed areas of the City, the high cost of installing mains down existing streets could be eliminated as well as the cost of replumbing existing houses. Over the years, as streets in Lamar are repaved and existing structures are renovated, it might be possible to extend the dual system somewhat into established areas.

It has been estimated that use of the potable water supply would be about 40 gallons per capita per day. An additional 160 gallons per day might typically be used from the nonpotable supply. Thus, the savings in the use of Clay Creek water would be very great.

An economic analysis of dual distribution systems was presented at an American Water Works Association Annual Conference in 1976 by Paul Haney and Fred Beatty of Black & Veatch, Consulting Engineers. It was found that for a city similar in size to Lamar, the cost of installing a dual distribution system, including the cost of replumbing the existing part of the city, would be 20 percent less than constructing and operating a desalination plant. It is anticipated that even greater economies could be achieved if the expense of replumbing existing water users is not incurred.

## ENVIRONMENTAL AND ENERGY CONSIDERATIONS

Consideration should be given to the effects that proposed actions will have on the natural and human environment. Plans should also take into account current and long-term energy considerations related to the consumption of scarce, expensive, undesirable, or potentially unavailable resources. The major beneficial and adverse impacts of the alternate water supply delivery systems are set forth below.

If no steps are taken to increase Lamar's water supply, potentially severe impacts may occur in terms of the human environment. As the town continues to grow, municipal water demands will eventually exceed the capacity of the existing water supply facilities. Water shortages could eventually stifle economic growth, resulting in a lower standard of living for Lamar's residents. Increasingly severe watering restrictions could result in the death of many trees and bushes and in a general deterioration of lawns and gardens throughout the town. One of the benefits of all the alternate water supply delivery systems discussed in this report is the mitigation of the effects that would result from water shortages.

As the water requirements of Lamar increase, it may become necessary to acquire additional water rights out of the Arkansas River. However, water is considered to be a scarce natural resource in the region. Essentially all water rights acquisitions would result in the retirement of irrigated lands, tending to erode somewhat the agricultural base of the area's economy. The retirement of irrigated farmland could result in a slight increase in cover available for wildlife.

The continued chlorination of groundwater supplies would have essentially no environmental or energy implications other than the prevention of water-borne disease. However, use of surface water supplies would require the construction of extensive treatment facilities with potential environmental and energy effects. Flocculation, sedimentation, and filtration of Arkansas River water would require the shipment of aluminum sulfate and other chemicals, energy consumption at the treatment plant, and disposal of moderate amounts of alum sludge in a landfill.

Softening treatment would make much greater demands on energy supplies and natural resources. A softening plant treating 8,000 acre-feet per year would require about 100 rail cars of lime and soda ash each year from Wyoming or other sources of supply. The energy required to mine, process, and transport these chemicals would be considerable. Sludge drying and disposal would require land that could otherwise be used for other purposes. Advantages of softening would include the human benefits that would result from the use of a better quality municipal water supply. These benefits would include the preservation of water heaters and other appliances, elimination of zeolite softeners in individual residences (which may contribute to health problems resulting from high sodium concentrations in the water), and a reduction of the need to use bottled drinking water. Sewage return flows of softened water may actually improve the overall water quality of the river.

Desalination treatment of surface water would require softening as pretreatment and, therefore, the effects listed above are applicable. Reverse osmosis desalination is a very energy intensive process, requiring a large amount of pumping. Normally about 25 percent of the water entering the plant is rejected as brine waste. A considerable amount of land would be needed as a site for an evaporation pond. Additional water rights would be required to compensate for the high evaporation losses. The extremely high overall cost of desalination could have a substantial economic impact on the residents of Lamar, slowing business activity and growth. Advantages of desalination would include the various health and aesthetic benefits associated with a high quality water supply. Treated sewage return flows would improve the water quality of the river.

The continued development of the Clay Creek recharge program should have minimal environmental and energy effects. Moderate amounts of power will be required to pump water to future recharge sites and to recover water from the aquifer. Some temporary air pollution may occur during construction of recharge facilities and installation of new wells and pipelines. A major benefit of recharge is the fact that disinfection would be the only water treatment required. The introduction of relatively low salinity sewage flows into the Arkansas River would be a possible benefit.

The use of deep Dakota groundwater would result in the eventual exhaustion of this non-renewable source of water. Pumping of the deep groundwater would entail a much greater use of energy than required for the shallow wells in the Clay Creek Aquifer.

A revised draft environmental statement was prepared for the Lamar Local Protection Project in June, 1974 by the U. S. Army Corps of Engineers. Environmental impacts associated with construction of Willow Creek Dam included the following:

1. Elimination of periodic flood damages to urban developments, rural properties, public utilities, and transportation systems. A sense of security would be imparted to local residents.
2. Impoundment of a permanent pool would provide a source for land-and-water-based recreation pursuits. Monetary benefits would be attributable to general and wildlife affiliated recreation.
3. Construction of the proposed dam and lake project would require acquisition of about 1,075 acres of predominantly grazing land with a corresponding loss of tax revenue and agricultural production. Tax losses may be offset by increased property valuations of surrounding lands.
4. Project construction would destroy wildlife habitat. However, the new aquatic and semi-aquatic habitat formed by construction of the dam would provide diversified plant and animal communities, thereby helping to compensate any losses.
5. Work sites and haul roads would scar the landscape until the disturbed areas were revegetated under project activities. The Willow Creek Basin would be altered from a rolling expanse of grazing land to that of a lake behind an earthen, rock covered dam.

Additional impacts associated with the use of Willow Creek Reservoir for municipal water storage would include the necessity of a higher dam and larger minimum pool. Energy would be continually used in pumping Arkansas River diversions to the reservoir. The pipeline route would be scarred during the construction operation.

The enlargement of Thurston Reservoir would result in various environmental impacts similar to those for Willow Creek Reservoir. Since there is an existing pool at Thurston, the reservoir enlargement should not require a large amount of additional land or a large amount of embankment material. Thurston Reservoir would provide no flood control benefits. Pumping of water would require a considerable amount of energy because the reservoir is located at an elevation 200 feet higher than the river. The mixture of high salinity water from the Fort Lyon Canal with Lamar's water in the reservoir would degrade the overall water quality.

Construction of the Arkansas Valley Conduit would result in temporary environmental effects associated with scarring of the route, destruction of vegetation, and dust production. Operation of the pipeline would include the use of a softening and desalinating water treatment plant with the associated environmental and energy effects described above. Although the flow in the pipeline would primarily be by gravity, some pumping would be required. The valley pipeline would result in a tremendous improvement in the quality of water supplied to La Junta, Las Animas, and other communities in the area.

Arkansas River alluvial wells would provide water with an unacceptably high level of salinity for continuous human consumption. Use of this water in a dual distribution system could result in damage to plants with a low salt tolerance.

Storage of water on the Cruikshank or Queens farms would result in many of the environmental effects listed above for Willow Creek Reservoir. It is anticipated that recreational use of the ponds would be limited to reduce pollution of the water supply. The ponds would not provide flood control benefits. Since the ponds would be located near the Lamar and Fort Bent canals, energy requirements for pumping would be minor.

## PROPOSED PLAN OF AUGMENTATION

During the period of November, 1978 through August, 1979, efforts were made to develop a plan to provide an adequate water supply for the industrial requirements of the proposed plant to be constructed by Iowa Beef Processors, Inc. (IBP). The City of Lamar engaged the firm of Moses, Wittemyer, Harrison and Woodruff, P.C. and the water resources engineering firm of W. W. Wheeler and Associates, Inc. for assistance. In December, 1978, an application was submitted to the Division 2 Water Court for approval of a plan of augmentation. In accordance with subsequent changes in the plan, an amended plan was filed in April, 1979.

Because it was anticipated that construction of water supply facilities for IBP must be completed on a very tight time schedule, the plan of augmentation for IBP's water supply was separated from the plan of augmentation for Lamar. Efforts were made to expedite court approval for IBP. Enclosed in the Appendix are copies of the "Stipulation for Judgment and Decree" and the proposed "Findings of Fact, Conclusions of Law, Judgment and Decree" prepared by John Wittemyer. After negotiation, consent of all objectors was obtained. Since IBP no longer plans to construct an industrial plant near Lamar, it is not anticipated that additional action will be taken concerning the plan of augmentation.

The documents in the Appendix were included in this report as an example of the type of arrangement that may be made to provide the legal basis of a supplemental water supply for Lamar. Judicial approval of a water rights transfer or plan of augmentation is an integral part of a water supply development program.

# MAY VALLEY

RECEIVED
SEP 5 1996
Southeastern Colorado Water Conservancy District

# Survey of Water Users
# in the
# Southeastern Colorado Water Conservancy District

Please take a few minutes to fill out this important survey. It will assist the Southeastern Colorado Water Conservancy District in assessing the future demand for Fryingpan-Arkansas Project water and storage space. If you have questions or comments regarding this survey, you can call Steve Arveschoug (719-544-2040). **Please complete and return the survey to the District in the enclosed envelope before Monday, September 23, 1996.** Your cooperation is appreciated.

---

Name of Organization May Valley Water Assn
Contact Person ______ Phone 839457

User Group—Municipal X Agricultural ___ Industrial ___
Recreation ___ Other ___

What is your primary source of supply? (surface water rights, [✓ ground water] rights, or leased water, please describe)

Do you have a raw-water storage system? Yes ✓ No ___
(Please describe your existing water storage system, rights.)
above ground storage 30.000 gallon &
300.000 gallon tanks

Do you currently request Fryingpan-Arkansas Project Water? (If yes, please describe your existing use, amount and purpose, of Project Water)
No

Have you used Fry-Ark Project IF-and-When storage space for the storage of your own water rights? Yes ___ No X

## Municipal Population and Irr. Acreage Water/Storage Demand Projections

List your projected use of water and Project water (acre-feet).

| Year | Population | Irr. acreage | Water Use | Storage Use | Proj. Water Use |
|---|---|---|---|---|---|
| Current | 1500 | -0- | Domestic | Same | NA |
| 2000 | 1700 | -0- | " | " | NA |
| 2010 | 1800 | -0- | " | " | Domestic if available |
| 2020 | 2000 | -0- | " | " | " " |

Please describe your projected future demand for Fry-Ark Project Water and Storage (include copies of any reports or studies which provide the basis for your projections).

If pipeline becomes available we would definitely use more Ark water.

## Water Resource Planning Efforts

Do you currently have a water resource plan to meet future water/storage demands? Yes ✓ No ____ If yes, do your plans include the construction of raw-water storage facilities? Yes ✓ No ____

Please describe your current water resource planning efforts and any construction plans.

Try to drill 2 or more wells if possible.

Would you be willing to participate in a cooperative effort to assess the future demands for water and storage in the Arkansas River Basin and the future need for Fry-Ark Project Water and storage.

Yes ✓ No ____ Need more information ____

Comments ____

DRAFT

# SOUTHEASTERN COLORADO WATER CONSERVANCY DISTRICT

## Arkansas River Basin Water Storage and Future Needs Assessment

WATER SYSTEM SURVEY (Compiled by BWR)

### 1. General Information

**Entity** MAY VALLEY WATER ASSOCIATION

**Contact Name/District Manager** JAMES GRUENLOH

**Address** 221 MAIN
WILEY, CO 81092

**Phone No.** (719) 829 - 4571

**Fax No.** ( ) -

**Primary Use** Municipal Agricultural Industrial Recreational Other

**Master Plan or other Water Resource Planning Documents?** Y N
(If yes we must obtain it)
**Prepared by:**

**Geographic Location of Service Area** (obtain service area map)

### 2. Demographics/Water Use

*Historic Water Use*

| Year | Population | Water Use, af | ¾ -in Domestic Taps (optional) |
|---|---|---|---|
| 1987 | | | |
| 1988 | | | |
| 1989 | | | |
| 1990 | | | |
| 1991 | | | |
| 1992 | | | |
| 1993 | | | |
| 1994 | | | |
| 1995 | | | |
| 1996 | 1700 | 624 | 545 |

*Projected Water Use*

| Year | Population | Water Use, af | ¾ -in Domestic Taps (optional) |
|---|---|---|---|
| 2000 | 1700 | | |
| 2010 | 1800 | | |
| 2020 | 2000 | | |
| 2040 | | | |

**Major industrial or other uses other than domestic**

# SOUTHEASTERN COLORADO WATER CONSERVANCY DISTRICT

## Arkansas River Basin Water Storage and Future Needs Assessment

WATER SYSTEM SURVEY (Compiled by BWR)

| 3. Estimated Monthly Water Use | |
|---|---|
| | as a percent of total annual use,% |
| JAN | |
| FEB | |
| MAR | |
| APR | |
| MAY | |
| JUN | |
| JUL | |
| AUG | |
| SEP | |
| OCT | |
| NOV | |
| DEC | |
| **TOTAL** | **100%** |

Notes:

100 - 110 MG/YR TOTAL USE

~ 307 - 338 AF/YR " "

DRAFT

# SOUTHEASTERN COLORADO WATER CONSERVANCY DISTRICT

## Arkansas River Basin Water Storage and Future Needs Assessment

WATER SYSTEM SURVEY (Compiled by BWR)

## 4. Sources of Water

*Surface Water*

**Sources**

**Point of Diversion** (for larger municipalities attach map, if available)

Location

Capacity

*Ground Water*

**Sources**

Tributary

Nontributary

Number of Wells
10 DAKOTA / CHEYENNE WELLS - ACTIVE
1 " / " WELL - INACTIVE

**Combined Annual Flow Rate** (from decrees or based on conveyance capacity)

(May only be available as an annual total)

| | gpm | cfs | af |
|---|---|---|---|
| JAN | | | |
| FEB | | | |
| MAR | | | |
| APR | | | |
| MAY | | | |
| JUN | | | |
| JUL | | | |
| AUG | | | |
| SEP | | | |
| OCT | | | |
| NOV | | | |
| DEC | | | |
| **TOTAL ANNUAL** | 425 GPM ALL WELLS | | |

425gpm ≈ 686 AF/yr

DRAFT

# SOUTHEASTERN COLORADO WATER CONSERVANCY DISTRICT

## Arkansas River Basin Water Storage and Future Needs Assessment

WATER SYSTEM SURVEY (Compiled by BWR)

### 5. Firm Yield

**District Managers may not have this information, attorneys and/ or consulting engineers may need to be contacted**

| **Monthly Average Firm Yield for 1966-1995** | **af** |
|---|---|
| JAN | |
| FEB | |
| MAR | |
| APR | |
| MAY | |
| JUN | |
| JUL | |
| AUG | |
| SEP | |
| OCT | |
| NOV | |
| DEC | |
| TOTAL ANNUAL | |

Firm yield can estimated from:
- Response of water rights during critical dry year
- Potential volume limitation per decree or well permit
- Ability to augment out of priority depletions

Consulting Engineer or Attorney

### 6. Future Water Planning

Estimated future yield of existing water rights ____________af/yr

Conditional Water Rights

Direct flow/wells CURRENT STORAGE ADEQUATE

"NEED TO ASSESS SYSTEM FOR FUTURE NEEDS

Storage

DRAFT

# SOUTHEASTERN COLORADO WATER CONSERVANCY DISTRICT

## Arkansas River Basin Water Storage and Future Needs Assessment

WATER SYSTEM SURVEY (Compiled by BWR)

### 7. Raw Water Storage

Total Vol. in af TANKS → 0.88 MG OF STORAGE

Type:

Fry-Ark

If and When

Shared

Owned

### 8. Raw Water Conveyance

Type:

Pipeline

Canal

Estimated Raw Water Conveyance Losses

### 9. Treatment Plant Capacity

Type

Capacity

<u>Also:</u>

1. Attach copies of relevant tables and text from master plans, or water resource planning documents.
2. Compare data found in reports to data obtained from contacting entity via telephone or previous survey.

Notes:

**GEI Consultants, Inc.**

5660 Greenwood Plaza Blvd., Suite 202
Englewood, CO 80111-2418

Tel. (303) 779-5565
Fax (303) 779-5653

# FAX

DATE 10/30/97

PROPOSAL/ PROJECT NO. 97411

Task Code 1020

NO. OF PAGES 5 (including this page)

TO: MAY VALLEY WATER ASSN.

FAX NO. (719) 829-4571

FROM: BRAD RASTALL

MESSAGE: PLEASE COMPLETE THE ATTACHED SURVEY. IF POSSIBLE, WE ALSO NEED:

1) FIRM YIELD OF WATER RIGHTS, IN ACRE-FEET
2) ESTIMATED POPULATION SERVED 1987-1997
3) PROJECTED POPULATION 2000, 2010, 2020, 2040
4) PER CAPITA WATER DEMAND, gallons per person perday

PLEASE LET US KNOW IF THE TRANSMISSION IS UNSATISFACTORY
** THANK YOU **

---

## SERVICES

**Geotechnical Engineering**
- Site Evaluation
- Foundation Design
- Construction

**Forensic Engineering**
- Failure Investigation
- Litigation Support
- Construction Claim Analysis
- Expert Testimony

**Environmental Engineering**
- Process Engineering
- Site Evaluation
- Remediation
- Litigation Support

**Geohydrology & Hydrology**
- Water Supply Development and Protection
- Contaminated Ground Water Remediation
- Construction Dewatering
- Flood Routing Studies

**Dam Engineering**
- Site Studies
- Dam Design
- Inspection

**Air Quality**
- Operating Permits
- Emission Inventories
- Control Technology Engineering
- Measurements and Modeling

# Survey of Water Users
# in the
# Southeastern Colorado Water Conservancy District

Please take a few minutes to fill out this important survey. It will assist the Southeastern Colorado Water Conservancy District in assessing the future demand for Fryingpan-Arkansas Project water and storage space. If you have questions or comments regarding this survey, you can call Steve Arveschoug (719-544-2040). **Please complete and return the survey to the District in the enclosed envelope before Monday, September 23, 1996.** Your cooperation is appreciated.

---

Name of Organization MAY. VALLEY
Contact Person______________________ Phone__________

User Group—Municipal____ Agricultural____ Industrial_____
Recreation____ Other_____

What is your primary source of supply? (surface water rights, ground water rights, or leased water, please describe)

Do you have a raw-water storage system? Yes_____ No ________
(Please describe your existing water storage system, rights.)

Do you currently request Fryingpan-Arkansas Project Water? (If yes, please describe your existing use, amount and purpose, of Project Water)

Have you used Fry-Ark Project IF-and-When storage space for the storage of your own water rights? Yes______ No_____

## Project Storage Space Use Trends

List your current and historic use of Project storage space for your own (non-Project) water. (acre-feet)

| | Amt. of Stored Water (af) | Facility(s) |
|---|---|---|
| Current Yr | | |
| 1995 | | |
| 1994 | | |
| 1993 | | |
| 1992 | | |
| 1991 | | |
| 1990 | | |
| 1985 | | |
| 1980 | | |

## Water Use Trends

List your historic use of water for municipal or agricultural use, and your historic use of Project water (acre-feet).

| | Population | Irr. Acreage<br>ac | Water Use<br>gal or af | Proj. Water Use |
|---|---|---|---|---|
| Current Yr. | | | | |
| 1995 | | | | |
| 1994 | | | | |
| 1993 | | | | |
| 1992 | | | | |
| 1991 | | | | |
| 1990 | | | | |
| 1985 | | | | |
| 1980 | | | | |

IF POSSIBLE

## Municipal Population and Irr. Acreage Water/Storage Demand Projections

List your projected use of water and Project water (acre-feet).

| Year | Population | Irr. acreage | Water Use | Storage Use | Proj. Water Use |
|---|---|---|---|---|---|
| Current | | | | | |
| 2000 | | | | | |
| 2010 | | | | | |
| 2020 | | | | | |

Please describe your projected future demand for Fry-Ark Project Water and Storage (include copies of any reports or studies which provide the basis for your projections).

## Water Resource Planning Efforts

Do you currently have a water resource plan to meet future water/storage demands? Yes_______ No_______ If yes, do your plans include the construction of raw-water storage facilities? Yes______ No_______

Please describe your current water resource planning efforts and any construction plans.

Would you be willing to participate in a cooperative effort to assess the future demands for water and storage in the Arkansas River Basin and the future need for Fry-Ark Project Water and storage.

Yes______ No_________ Need more information__________

Comments______________________________________________

**Arkansas Valley Pipeline**

Are you aware of the Fry-Ark Project's originally proposed Arkansas Valley Pipeline? Yes_____ No______ If yes, would you have an interest in taking another look at the cost/benefits of such a treated-water delivery system?

Comments ______________________________________________

______________________________________________

______________________________________________

**Any additional comments?**

______________________________________________

______________________________________________

______________________________________________

______________________________________________

______________________________________________

Thank you for your help!

# SECWCD/ARKANSAS BASIN FUTURE WATER AND STORAGE NEEDS ASSESSMENT

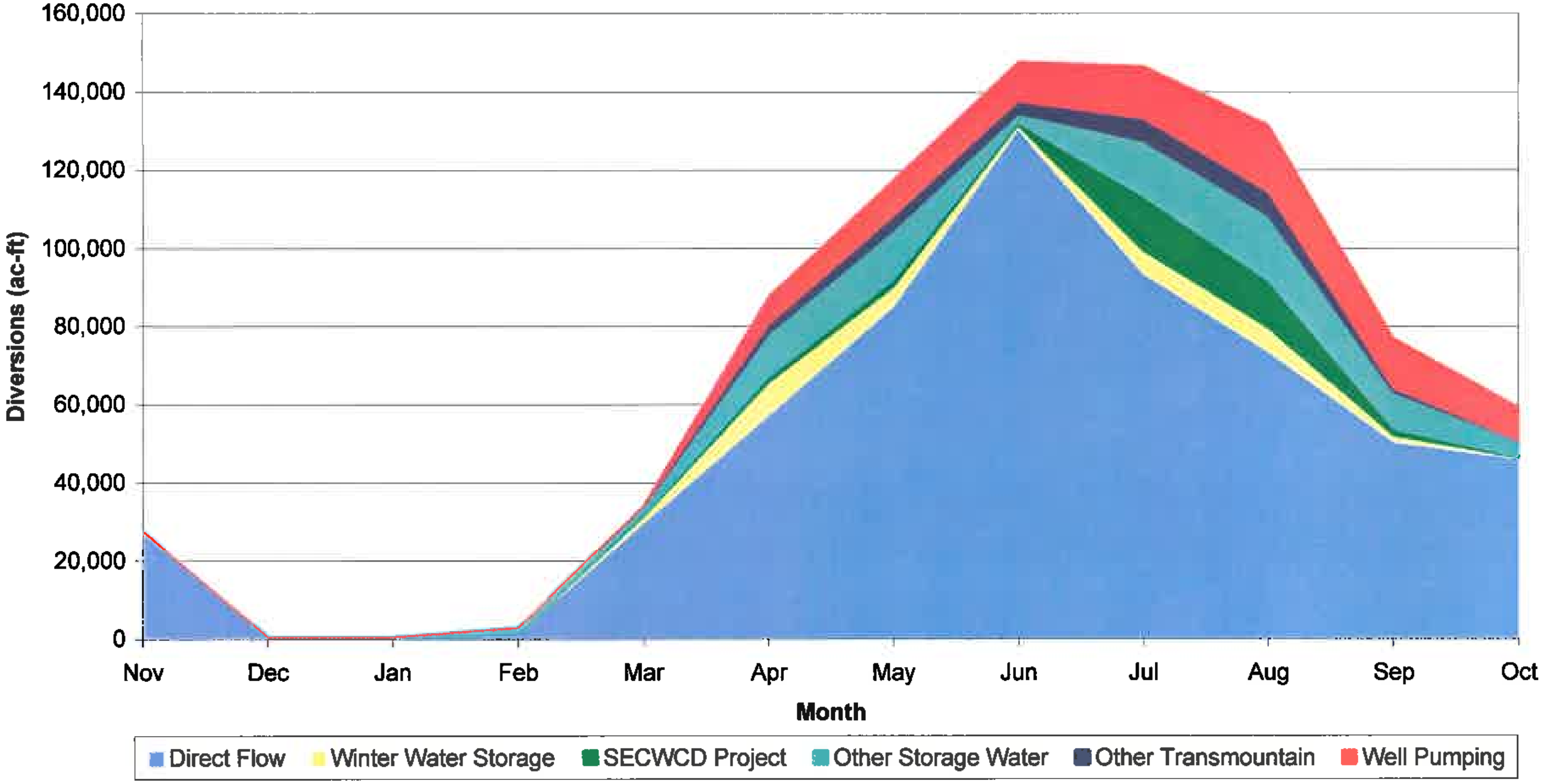
## APPENDIX B

Agricultural water use data for the SECWD compiled during the Future Water and Storage Needs Assessment is summarized as follows:

- **Total Use in District**
- **Use by Ditch System**
- **Monthly Depletions by Irrigation Wells**

# TOTAL USE IN DISTRICT

**Average Monthly Irrigation Diversions from the Arkansas River**
**Pueblo to John Martin Dam 1986-95**



Note: Includes the Bessemer, Excelsior, Colorado, Highline, Oxford, Otero, Catlin, Fort Lyon, Rocky Ford, Holbrook, Las Animas Consolidated and Keesee Canals. Winter water includes only the water stored in Pueblo Reservoir for the direct flow ditches and in John Martin Reservoir for the Las Animas Consolidated and Fort Lyon Canals. Data was compiled from the State Engineer's records.

Divsum1/All Ditches Chart

**FIGURE 5-17**
**AGRICULTURAL WATER USE**

All Ditches and Canals
Direct Flow Diversions
units = acre-feet

| Year | Nov | Dec | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1986 | 22,966 | 0 | 512 | 3,277 | 32,985 | 45,560 | 60,873 | 149,538 | 154,280 | 93,702 | 66,004 | 57,308 | 687,005 |
| 1987 | 20,753 | 552 | 3,562 | 6,989 | 25,651 | 102,856 | 122,975 | 168,503 | 113,505 | 78,143 | 68,305 | 57,386 | 769,180 |
| 1988 | 38,187 | 1,055 | 0 | 0 | 29,833 | 65,464 | 61,073 | 131,067 | 71,126 | 53,615 | 39,606 | 37,529 | 528,553 |
| 1989 | 26,374 | 773 | 0 | 388 | 36,848 | 46,901 | 65,240 | 99,551 | 63,390 | 54,727 | 30,329 | 32,526 | 457,046 |
| 1990 | 26,538 | 710 | 0 | 0 | 20,406 | 39,923 | 62,025 | 122,390 | 87,520 | 64,268 | 32,201 | 40,935 | 496,916 |
| 1991 | 32,495 | 264 | 0 | 1,161 | 30,403 | 32,948 | 45,243 | 104,340 | 56,612 | 78,118 | 39,351 | 34,783 | 455,719 |
| 1992 | 18,789 | 43 | 0 | 207 | 32,012 | 50,906 | 60,300 | 99,443 | 60,401 | 63,692 | 45,524 | 35,847 | 467,165 |
| 1993 | 28,351 | 0 | 0 | 0 | 27,774 | 58,697 | 109,729 | 164,146 | 110,580 | 54,388 | 41,875 | 36,235 | 631,774 |
| 1994 | 28,058 | 0 | 17 | 1,623 | 29,946 | 60,552 | 144,601 | 148,870 | 53,134 | 42,577 | 33,431 | 48,247 | 591,056 |
| 1995 | 29,374 | 540 | 0 | 402 | 29,789 | 67,930 | 117,739 | 114,761 | 162,747 | 150,060 | 104,972 | 77,805 | 856,119 |
| Average | 27,189 | 394 | 409 | 1,405 | 29,565 | 57,173 | 84,980 | 130,261 | 93,329 | 73,329 | 50,160 | 45,860 | 594,053 |
| Maximum | 38,187 | 1,055 | 3,562 | 6,989 | 36,848 | 102,856 | 144,601 | 168,503 | 162,747 | 150,060 | 104,972 | 77,805 | 856,119 |
| Minimum | 18,789 | 0 | 0 | 0 | 20,406 | 32,948 | 45,243 | 99,443 | 53,134 | 42,577 | 30,329 | 32,526 | 455,719 |

All Ditches and Canals
SECWCD Project Water Diversions
units = acre-feet

| Year | Nov | Dec | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1986 | 0 | 0 | 0 | 0 | 0 | 372 | 0 | 0 | 200 | 5,319 | 0 | 0 | 5,891 |
| 1987 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3,215 | 7,834 | 1,271 | 0 | 12,320 |
| 1988 | 0 | 0 | 0 | 0 | 0 | 0 | 1,565 | 215 | 25,243 | 29,778 | 1,381 | 0 | 58,182 |
| 1989 | 0 | 0 | 0 | 0 | 142 | 4,549 | 165 | 666 | 37,456 | 30,268 | 1,076 | 1,472 | 75,794 |
| 1990 | 0 | 0 | 0 | 0 | 0 | 1,344 | 895 | 2,128 | 10,096 | 5,310 | 5,767 | 0 | 25,540 |
| 1991 | 0 | 0 | 0 | 0 | 0 | 1,768 | 7,027 | 2,093 | 24,891 | 4,034 | 884 | 0 | 40,697 |
| 1992 | 0 | 0 | 0 | 0 | 0 | 1,267 | 4,264 | 455 | 6,941 | 2,238 | 4,154 | 0 | 19,319 |
| 1993 | 0 | 0 | 0 | 0 | 0 | 0 | 3,981 | 132 | 6,114 | 29,897 | 673 | 89 | 40,886 |
| 1994 | 0 | 0 | 0 | 0 | 609 | 2,962 | 1,078 | 715 | 26,492 | 5,332 | 1,265 | 32 | 38,485 |
| 1995 | 0 | 0 | 0 | 0 | 52 | 2,548 | 99 | 0 | 0 | 2,515 | 348 | 0 | 5,562 |
| Average | 0 | 0 | 0 | 0 | 80 | 1,481 | 1,907 | 640 | 14,065 | 12,253 | 1,682 | 159 | 32,268 |
| Maximum | 0 | 0 | 0 | 0 | 609 | 4,549 | 7,027 | 2,128 | 37,456 | 30,268 | 5,767 | 1,472 | 75,794 |
| Minimum | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2,238 | 0 | 0 | 5,562 |

All Ditches and Canals
Winter Water Storage Diversions
units = acre-feet

| Year | Nov | Dec | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1986 | 473 | 0 | 0 | 129 | 6,601 | 14,249 | 7,458 | 0 | 0 | 0 | 0 | 0 | 28,910 |
| 1987 | 0 | 0 | 0 | 0 | 0 | 2,969 | 0 | 0 | 0 | 0 | 0 | 0 | 2,969 |
| 1988 | 0 | 0 | 0 | 0 | 1,264 | 5,162 | 10,942 | 589 | 7,586 | 4,885 | 753 | 171 | 31,352 |
| 1989 | 0 | 0 | 0 | 0 | 843 | 14,380 | 4,453 | 1,374 | 8,156 | 3,809 | 3,237 | 0 | 36,252 |
| 1990 | 0 | 0 | 0 | 0 | 0 | 4,295 | 3,942 | 2,000 | 6,109 | 5,800 | 6,522 | 31 | 28,699 |
| 1991 | 0 | 0 | 0 | 0 | 2,674 | 10,161 | 10,221 | 3,954 | 9,228 | 2,448 | 180 | 1,680 | 40,546 |
| 1992 | 0 | 0 | 0 | 0 | 900 | 12,859 | 6,846 | 889 | 10,167 | 9,023 | 212 | 2,331 | 43,227 |
| 1993 | 0 | 0 | 0 | 0 | 0 | 8,103 | 5,968 | 1,215 | 7,559 | 18,188 | 4,230 | 0 | 45,263 |
| 1994 | 0 | 0 | 0 | 0 | 1,658 | 6,948 | 585 | 2,492 | 11,438 | 17,683 | 2,534 | 0 | 43,338 |
| 1995 | 0 | 0 | 0 | 0 | 4,228 | 5,027 | 91 | 0 | 194 | 0 | 0 | 0 | 9,540 |
| Average | 47 | 0 | 0 | 13 | 1,817 | 8,415 | 5,051 | 1,251 | 6,044 | 6,184 | 1,767 | 421 | 31,010 |
| Maximum | 473 | 0 | 0 | 129 | 6,601 | 14,380 | 10,942 | 3,954 | 11,438 | 18,188 | 6,522 | 2,331 | 45,263 |
| Minimum | 0 | 0 | 0 | 0 | 0 | 2,969 | 0 | 0 | 0 | 0 | 0 | 0 | 2,969 |

All Ditches and Canals
Storage Water
units = acre-feet

| Year | Nov | Dec | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1986 | 0 | 0 | 601 | 14,400 | 9,369 | 29,706 | 25,237 | 86 | 5,777 | 14,587 | 8,406 | 7,399 | 115,568 |
| 1987 | 0 | 0 | 0 | 0 | 0 | 4,179 | 5,590 | 5,498 | 43,346 | 37,742 | 12,378 | 6,143 | 114,876 |
| 1988 | 0 | 0 | 0 | 0 | 0 | 9,138 | 20,922 | 0 | 13,082 | 15,024 | 16,500 | 2,839 | 77,505 |
| 1989 | 691 | 1,129 | 72 | 0 | 10,292 | 26,767 | 12,029 | 0 | 9,074 | 8,496 | 4,794 | 151 | 73,495 |
| 1990 | 0 | 0 | 0 | 0 | 0 | 0 | 6,276 | 2,231 | 7,519 | 18,647 | 6,441 | 240 | 41,354 |
| 1991 | 0 | 0 | 0 | 0 | 0 | 15,166 | 14,880 | 2,342 | 1,850 | 5,036 | 11,328 | 3,031 | 53,633 |
| 1992 | 0 | 0 | 0 | 0 | 0 | 13,903 | 22,009 | 1,641 | 6,721 | 5,885 | 915 | 0 | 51,074 |
| 1993 | 0 | 0 | 0 | 0 | 0 | 0 | 11,332 | 377 | 11,230 | 10,005 | 10,684 | 13,861 | 57,489 |
| 1994 | 0 | 0 | 0 | 0 | 3,960 | 9,773 | 7,729 | 1,920 | 35,853 | 22,770 | 14,466 | 1,333 | 97,804 |
| 1995 | 0 | 0 | 0 | 0 | 0 | 1,679 | 1,361 | 8,404 | 5,102 | 27,371 | 8,109 | 4,990 | 57,016 |
| | | | | | | | | | | | | | |
| Average | 69 | 113 | 67 | 1,440 | 2,362 | 11,031 | 12,737 | 2,250 | 13,955 | 16,556 | 9,402 | 3,999 | 73,981 |
| Maximum | 691 | 1,129 | 601 | 14,400 | 10,292 | 29,706 | 25,237 | 8,404 | 43,346 | 37,742 | 16,500 | 13,861 | 115,568 |
| Minimum | 0 | 0 | 0 | 0 | 0 | 0 | 1,361 | 0 | 1,850 | 5,036 | 915 | 0 | 41,354 |

All Ditches and Canals
Other Transmountain Diversions
units = acre-feet

| Year | Nov | Dec | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1986 | 0 | 0 | 0 | 0 | 0 | 8,648 | 10,832 | 9,806 | 12,405 | 7,318 | 1,097 | 996 | 51,102 |
| 1987 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 20 | 3,530 | 6,525 | 0 | 0 | 10,075 |
| 1988 | 0 | 0 | 0 | 0 | 884 | 1,054 | 2,845 | 536 | 2,898 | 6,394 | 0 | 0 | 14,611 |
| 1989 | 0 | 0 | 0 | 0 | 0 | 2,624 | 0 | 0 | 8,404 | 4,852 | 0 | 0 | 15,880 |
| 1990 | 0 | 0 | 0 | 0 | 0 | 0 | 564 | 2,113 | 3,562 | 6,612 | 0 | 0 | 12,851 |
| 1991 | 0 | 0 | 0 | 0 | 0 | 33 | 4,531 | 3,788 | 3,803 | 3,962 | 777 | 0 | 16,894 |
| 1992 | 0 | 0 | 0 | 0 | 0 | 218 | 1,418 | 2,033 | 2,871 | 6,629 | 595 | 0 | 13,764 |
| 1993 | 0 | 0 | 0 | 0 | 0 | 7,146 | 11,249 | 861 | 9,662 | 7,020 | 2,802 | 0 | 38,740 |
| 1994 | 0 | 0 | 0 | 0 | 0 | 5,228 | 1,902 | 12,853 | 10,337 | 4,684 | 1,980 | 0 | 36,984 |
| 1995 | 454 | 0 | 0 | 0 | 0 | 0 | 2,431 | 262 | 1,011 | 7,440 | 1,880 | 52 | 13,530 |
| | | | | | | | | | | | | | |
| Average | 45 | 0 | 0 | 0 | 88 | 2,495 | 3,577 | 3,227 | 5,848 | 6,144 | 913 | 105 | 22,443 |
| Maximum | 454 | 0 | 0 | 0 | 884 | 8,648 | 11,249 | 12,853 | 12,405 | 7,440 | 2,802 | 996 | 51,102 |
| Minimum | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1,011 | 3,962 | 0 | 0 | 10,075 |

All Ditches and Canals
Total Diversions
units = acre-feet

| Year | Nov | Dec | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1986 | 23,439 | 0 | 1,113 | 17,806 | 48,955 | 98,535 | 104,400 | 159,430 | 172,662 | 120,926 | 75,507 | 65,703 | 888,476 |
| 1987 | 20,753 | 552 | 3,562 | 6,989 | 25,651 | 110,004 | 128,565 | 174,021 | 163,596 | 130,244 | 81,954 | 63,529 | 909,420 |
| 1988 | 38,187 | 1,055 | 0 | 0 | 31,981 | 80,818 | 97,347 | 132,407 | 119,935 | 109,696 | 58,240 | 40,539 | 710,203 |
| 1989 | 27,065 | 1,902 | 72 | 388 | 48,125 | 95,221 | 81,887 | 101,591 | 126,480 | 102,152 | 39,436 | 34,149 | 658,467 |
| 1990 | 26,538 | 710 | 0 | 0 | 20,406 | 45,562 | 73,702 | 130,862 | 114,806 | 100,637 | 50,931 | 41,206 | 605,360 |
| 1991 | 32,495 | 264 | 0 | 1,161 | 33,077 | 60,076 | 81,902 | 116,517 | 96,384 | 93,598 | 52,520 | 39,494 | 607,489 |
| 1992 | 18,789 | 43 | 0 | 207 | 32,912 | 79,153 | 94,837 | 104,461 | 87,101 | 87,467 | 51,400 | 38,178 | 594,549 |
| 1993 | 28,351 | 0 | 0 | 0 | 27,774 | 73,946 | 142,259 | 166,731 | 145,145 | 119,498 | 60,264 | 50,185 | 814,152 |
| 1994 | 28,058 | 0 | 17 | 1,623 | 36,173 | 85,463 | 155,895 | 166,850 | 137,254 | 93,046 | 53,676 | 49,612 | 807,667 |
| 1995 | 29,828 | 540 | 0 | 402 | 34,069 | 77,184 | 121,721 | 123,427 | 169,054 | 187,386 | 115,309 | 82,847 | 941,767 |
| | | | | | | | | | | | | | |
| Average | 27,350 | 507 | 476 | 2,858 | 33,912 | 80,596 | 108,251 | 137,630 | 133,242 | 114,465 | 63,924 | 50,544 | 753,755 |
| Maximum | 38,187 | 1,902 | 3,562 | 17,806 | 48,955 | 110,004 | 155,895 | 174,021 | 172,662 | 187,386 | 115,309 | 82,847 | 941,767 |
| Minimum | 18,789 | 0 | 0 | 0 | 20,406 | 45,562 | 73,702 | 101,591 | 87,101 | 87,467 | 39,436 | 34,149 | 594,549 |

# USE BY DITCH SYSTEM

Bessemer Ditch
Direct Flow Diversions
units = acre-feet

| Year | Nov | Dec | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1986 | 2,656 | 0 | 0 | 0 | 2,370 | 4,112 | 5,357 | 13,641 | 14,914 | 6,832 | 7,938 | 4,455 | 62,275 |
| 1987 | 1,968 | 0 | 0 | 0 | 2,299 | 8,858 | 12,700 | 15,342 | 10,898 | 4,957 | 4,372 | 4,421 | 65,815 |
| 1988 | 1,921 | 0 | 0 | 0 | 2,044 | 4,296 | 4,609 | 14,012 | 5,926 | 6,835 | 4,307 | 4,381 | 48,331 |
| 1989 | 2,068 | 0 | 0 | 0 | 1,683 | 4,149 | 5,580 | 11,476 | 5,705 | 4,317 | 4,186 | 4,342 | 43,506 |
| 1990 | 1,989 | 0 | 0 | 0 | 2,321 | 4,204 | 5,250 | 10,554 | 6,537 | 4,838 | 4,250 | 4,408 | 44,351 |
| 1991 | 1,130 | 0 | 0 | 0 | 2,398 | 4,228 | 4,260 | 9,848 | 4,366 | 4,357 | 4,203 | 4,365 | 39,155 |
| 1992 | 1,975 | 0 | 0 | 0 | 2,528 | 4,143 | 6,325 | 11,393 | 5,112 | 5,307 | 4,324 | 4,410 | 45,517 |
| 1993 | 788 | 0 | 0 | 0 | 2,567 | 4,242 | 8,199 | 14,019 | 11,038 | 4,556 | 4,312 | 4,483 | 54,204 |
| 1994 | 1,960 | 0 | 0 | 0 | 2,369 | 4,537 | 9,156 | 13,245 | 4,294 | 4,342 | 4,107 | 4,269 | 48,279 |
| 1995 | 1,948 | 0 | 0 | 0 | 2,356 | 4,461 | 7,801 | 11,201 | 16,505 | 15,709 | 11,915 | 5,623 | 77,519 |
| Average | 1,840 | 0 | 0 | 0 | 2,294 | 4,723 | 6,924 | 12,473 | 8,530 | 6,205 | 5,391 | 4,516 | 52,895 |
| Maximum | 2,656 | 0 | 0 | 0 | 2,567 | 8,858 | 12,700 | 15,342 | 16,505 | 15,709 | 11,915 | 5,623 | 77,519 |
| Minimum | 788 | 0 | 0 | 0 | 1,683 | 4,112 | 4,260 | 9,848 | 4,294 | 4,317 | 4,107 | 4,269 | 39,155 |

Bessemer Ditch
SECWCD Project Water Diversions
units = acre-feet

| Year | Nov | Dec | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1986 | 0 | 0 | 0 | 0 | 0 | 372 | 0 | 0 | 200 | 4,089 | 0 | 0 | 4,661 |
| 1987 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1,379 | 0 | 368 | 0 | 1,747 |
| 1988 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3,070 | 3,114 | 329 | 0 | 6,513 |
| 1989 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 4,316 | 6,433 | 187 | 0 | 10,936 |
| 1990 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1,994 | 1,135 | 0 | 3,129 |
| 1991 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1,916 | 1,709 | 809 | 0 | 4,434 |
| 1992 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 439 | 0 | 0 | 439 |
| 1993 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1,869 | 0 | 0 | 0 | 1,869 |
| 1994 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2,234 | 0 | 0 | 0 | 2,234 |
| 1995 | 0 | 0 | 0 | 0 | 0 | 763 | 0 | 0 | 0 | 0 | 0 | 0 | 763 |
| Average | 0 | 0 | 0 | 0 | 0 | 114 | 0 | 0 | 1,498 | 1,778 | 283 | 0 | 3,673 |
| Maximum | 0 | 0 | 0 | 0 | 0 | 763 | 0 | 0 | 4,316 | 6,433 | 1,135 | 0 | 10,936 |
| Minimum | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 439 |

Bessemer Ditch
Winter Water Storage Diversions
units = acre-feet

| Year | Nov | Dec | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1986 | 0 | 0 | 0 | 0 | 0 | 2,403 | 2,792 | 0 | 0 | 0 | 0 | 0 | 5,195 |
| 1987 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1988 | 0 | 0 | 0 | 0 | 0 | 2,999 | 1,824 | 0 | 2,071 | 2,060 | 0 | 0 | 8,954 |
| 1989 | 0 | 0 | 0 | 0 | 0 | 2,724 | 2,966 | 1,305 | 1,454 | 0 | 0 | 0 | 8,449 |
| 1990 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1,207 | 3,044 | 3,186 | 0 | 0 | 7,437 |
| 1991 | 0 | 0 | 0 | 0 | 0 | 1,109 | 3,733 | 1,537 | 1,782 | 0 | 0 | 0 | 8,161 |
| 1992 | 0 | 0 | 0 | 0 | 0 | 190 | 2,916 | 93 | 3,987 | 1,693 | 0 | 0 | 8,879 |
| 1993 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 567 | 746 | 6,706 | 652 | 0 | 8,671 |
| 1994 | 0 | 0 | 0 | 0 | 0 | 297 | 221 | 0 | 5,005 | 2,879 | 0 | 0 | 8,402 |
| 1995 | 0 | 0 | 0 | 0 | 407 | 4 | 0 | 0 | 0 | 0 | 0 | 0 | 411 |
| Average | 0 | 0 | 0 | 0 | 41 | 973 | 1,445 | 471 | 1,809 | 1,652 | 65 | 0 | 6,456 |
| Maximum | 0 | 0 | 0 | 0 | 407 | 2,999 | 3,733 | 1,537 | 5,005 | 6,706 | 652 | 0 | 8,954 |
| Minimum | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

Includes Pueblo Res (Winter) & Unlisted Reservoir Storage

Bessemer Ditch
Storage Water
units = acre-feet

| Year | Nov | Dec | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1986 | 0 | 0 | 0 | 0 | 0 | 540 | 1,045 | 52 | 13 | 1,107 | 433 | 0 | 3,190 |
| 1987 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2,321 | 5,399 | 0 | 0 | 7,720 |
| 1988 | 0 | 0 | 0 | 0 | 0 | 0 | 4,521 | 0 | 0 | 0 | 0 | 0 | 4,521 |
| 1989 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1990 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1991 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1992 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1993 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1994 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1995 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 48 | 535 | 583 |
| Average | 0 | 0 | 0 | 0 | 0 | 54 | 557 | 5 | 233 | 651 | 48 | 54 | 1,601 |
| Maximum | 0 | 0 | 0 | 0 | 0 | 540 | 4,521 | 52 | 2,321 | 5,399 | 433 | 535 | 7,720 |
| Minimum | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

Includes storage at Lake Minnequa & Clear Creek Reservoir

Bessemer Ditch
Other Transmountain Diversions
units = acre-feet

| Year | Nov | Dec | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1986 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1987 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1988 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 531 | 920 | 1,382 | 0 | 0 | 2,833 |
| 1989 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1990 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1991 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1992 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1,376 | 0 | 0 | 1,376 |
| 1993 | 0 | 0 | 0 | 0 | 0 | 1,070 | 2,088 | 0 | 1,226 | 0 | 0 | 0 | 4,384 |
| 1994 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 835 | 2,163 | 2,999 | 0 | 0 | 5,997 |
| 1995 | 0 | 0 | 0 | 0 | 0 | 0 | 1,274 | 0 | 0 | 0 | 154 | 52 | 1,480 |
| Average | 0 | 0 | 0 | 0 | 0 | 107 | 336 | 137 | 431 | 576 | 15 | 5 | 1,607 |
| Maximum | 0 | 0 | 0 | 0 | 0 | 1,070 | 2,088 | 835 | 2,163 | 2,999 | 154 | 52 | 5,997 |
| Minimum | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

Includes If&When Pueblo Res water & Twin Lakes

Bessemer Ditch
Total Diversions
units = acre-feet

| Year | Nov | Dec | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1986 | 2,656 | 0 | 0 | 0 | 2,370 | 7,427 | 9,194 | 13,693 | 15,127 | 12,028 | 8,371 | 4,455 | 75,321 |
| 1987 | 1,968 | 0 | 0 | 0 | 2,299 | 8,858 | 12,700 | 15,342 | 14,598 | 10,356 | 4,740 | 4,421 | 75,282 |
| 1988 | 1,921 | 0 | 0 | 0 | 2,044 | 7,295 | 10,954 | 14,543 | 11,987 | 13,391 | 4,636 | 4,381 | 71,152 |
| 1989 | 2,068 | 0 | 0 | 0 | 1,683 | 6,873 | 8,546 | 12,781 | 11,475 | 10,750 | 4,373 | 4,342 | 62,891 |
| 1990 | 1,989 | 0 | 0 | 0 | 2,321 | 4,204 | 5,250 | 11,761 | 9,581 | 10,018 | 5,385 | 4,408 | 54,917 |
| 1991 | 1,130 | 0 | 0 | 0 | 2,398 | 5,337 | 7,993 | 11,385 | 8,064 | 6,066 | 5,012 | 4,365 | 51,750 |
| 1992 | 1,975 | 0 | 0 | 0 | 2,528 | 4,333 | 9,241 | 11,486 | 9,099 | 8,815 | 4,324 | 4,410 | 56,211 |
| 1993 | 788 | 0 | 0 | 0 | 2,567 | 5,312 | 10,287 | 14,586 | 14,879 | 11,262 | 4,964 | 4,483 | 69,128 |
| 1994 | 1,960 | 0 | 0 | 0 | 2,369 | 4,834 | 9,377 | 14,080 | 13,696 | 10,220 | 4,107 | 4,269 | 64,912 |
| 1995 | 1,948 | 0 | 0 | 0 | 2,763 | 5,228 | 9,075 | 11,201 | 16,505 | 15,709 | 12,117 | 6,210 | 80,756 |
| Average | 1,840 | 0 | 0 | 0 | 2,334 | 5,970 | 9,262 | 13,086 | 12,501 | 10,862 | 5,803 | 4,574 | 66,232 |
| Maximum | 2,656 | 0 | 0 | 0 | 2,763 | 8,858 | 12,700 | 15,342 | 16,505 | 15,709 | 12,117 | 6,210 | 80,756 |
| Minimum | 788 | 0 | 0 | 0 | 1,683 | 4,204 | 5,250 | 11,201 | 8,064 | 6,066 | 4,107 | 4,269 | 51,750 |

Catlin Canal
Direct Flow Diversions
units = acre-feet

| Year | Nov | Dec | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1986 | 2,897 | 0 | 0 | 0 | 7,910 | 10,343 | 12,262 | 13,574 | 16,005 | 14,802 | 9,335 | 8,490 | 95,618 |
| 1987 | 2,832 | 0 | 0 | 0 | 7,288 | 12,612 | 12,268 | 16,378 | 16,216 | 13,721 | 10,218 | 9,280 | 100,813 |
| 1988 | 5,136 | 0 | 0 | 0 | 5,502 | 10,504 | 8,295 | 16,524 | 12,428 | 10,480 | 9,516 | 9,502 | 87,887 |
| 1989 | 4,646 | 0 | 0 | 0 | 8,515 | 12,567 | 12,123 | 15,331 | 13,914 | 12,498 | 4,796 | 5,417 | 89,807 |
| 1990 | 3,854 | 0 | 0 | 0 | 3,669 | 10,177 | 10,563 | 15,668 | 14,461 | 14,013 | 2,780 | 8,301 | 83,486 |
| 1991 | 3,504 | 0 | 0 | 0 | 6,539 | 4,003 | 9,533 | 16,766 | 14,965 | 16,107 | 9,447 | 7,050 | 87,914 |
| 1992 | 0 | 0 | 0 | 0 | 6,518 | 11,404 | 14,811 | 12,754 | 15,149 | 13,697 | 12,147 | 7,430 | 93,910 |
| 1993 | 4,157 | 0 | 0 | 0 | 4,124 | 12,505 | 15,715 | 17,757 | 16,362 | 15,698 | 12,483 | 9,600 | 108,401 |
| 1994 | 4,169 | 0 | 0 | 0 | 7,819 | 10,981 | 13,558 | 19,523 | 17,529 | 9,342 | 11,807 | 10,531 | 105,259 |
| 1995 | 4,437 | 0 | 0 | 0 | 7,972 | 13,326 | 13,470 | 13,443 | 19,452 | 19,351 | 15,859 | 12,617 | 119,927 |
| Average | 3,563 | 0 | 0 | 0 | 6,586 | 10,842 | 12,260 | 15,772 | 15,648 | 13,971 | 9,839 | 8,822 | 97,302 |
| Maximum | 5,136 | 0 | 0 | 0 | 8,515 | 13,326 | 15,715 | 19,523 | 19,452 | 19,351 | 15,859 | 12,617 | 119,927 |
| Minimum | 0 | 0 | 0 | 0 | 3,669 | 4,003 | 8,295 | 12,754 | 12,428 | 9,342 | 2,780 | 5,417 | 83,486 |

Catlin Canal
SECWCD Project Water Diversions
units = acre-feet

| Year | Nov | Dec | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1986 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1987 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 298 | 3,299 | 42 | 0 | 3,639 |
| 1988 | 0 | 0 | 0 | 0 | 0 | 0 | 1,257 | 0 | 4,010 | 2,743 | 0 | 0 | 8,010 |
| 1989 | 0 | 0 | 0 | 0 | 0 | 1,090 | 0 | 0 | 2,946 | 284 | 0 | 1,165 | 5,485 |
| 1990 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1,380 | 4,065 | 0 | 5,445 |
| 1991 | 0 | 0 | 0 | 0 | 0 | 735 | 1,917 | 0 | 0 | 0 | 0 | 0 | 2,652 |
| 1992 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 432 | 0 | 0 | 432 |
| 1993 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 669 | 1,578 | 0 | 0 | 2,247 |
| 1994 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1,460 | 938 | 0 | 0 | 2,398 |
| 1995 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Average | 0 | 0 | 0 | 0 | 0 | 183 | 317 | 0 | 938 | 1,065 | 411 | 117 | 3,031 |
| Maximum | 0 | 0 | 0 | 0 | 0 | 1,090 | 1,917 | 0 | 4,010 | 3,299 | 4,065 | 1,165 | 8,010 |
| Minimum | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

Catlin Canal
Winter Water Storage Diversions
units = acre-feet

| Year | Nov | Dec | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1986 | 473 | 0 | 0 | 129 | 3,892 | 4,295 | 4,053 | 0 | 0 | 0 | 0 | 0 | 12,842 |
| 1987 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1988 | 0 | 0 | 0 | 0 | 0 | 0 | 2,608 | 0 | 0 | 2,825 | 620 | 0 | 6,053 |
| 1989 | 0 | 0 | 0 | 0 | 0 | 2,021 | 0 | 0 | 0 | 3,592 | 3,237 | 0 | 8,850 |
| 1990 | 0 | 0 | 0 | 0 | 0 | 3,791 | 304 | 0 | 0 | 0 | 4,462 | 0 | 8,557 |
| 1991 | 0 | 0 | 0 | 0 | 423 | 4,438 | 0 | 0 | 599 | 198 | 0 | 1,680 | 7,338 |
| 1992 | 0 | 0 | 0 | 0 | 0 | 6,113 | 551 | 0 | 0 | 1,109 | 0 | 2,331 | 10,104 |
| 1993 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1,075 | 65 | 0 | 1,140 |
| 1994 | 0 | 0 | 0 | 0 | 1,296 | 5,722 | 347 | 0 | 0 | 5,025 | 0 | 0 | 12,390 |
| 1995 | 0 | 0 | 0 | 0 | 1,629 | 4,329 | 38 | 0 | 0 | 0 | 0 | 0 | 5,996 |
| Average | 47 | 0 | 0 | 13 | 724 | 3,071 | 790 | 0 | 60 | 1,382 | 838 | 401 | 7,327 |
| Maximum | 473 | 0 | 0 | 129 | 3,892 | 6,113 | 4,053 | 0 | 599 | 5,025 | 4,462 | 2,331 | 12,842 |
| Minimum | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

Catlin Canal
Storage Water
units = acre-feet

| Year | Nov | Dec | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1986 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1987 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1988 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1989 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1990 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1991 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1992 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1993 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1994 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1995 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1,975 | 0 | 0 | 1,975 |
| Average | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 198 | 0 | 0 | 198 |
| Maximum | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1,975 | 0 | 0 | 1,975 |
| Minimum | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

Catlin Canal
Other Transmountain Diversions
units = acre-feet

| Year | Nov | Dec | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1986 | 0 | 0 | 0 | 0 | 0 | 0 | 71 | 88 | 27 | 5 | 0 | 0 | 191 |
| 1987 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 20 | 34 | 11 | 0 | 0 | 65 |
| 1988 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1989 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1990 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1991 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1992 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1993 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 223 | 0 | 0 | 223 |
| 1994 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2,012 | 0 | 0 | 0 | 2,012 |
| 1995 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Average | 0 | 0 | 0 | 0 | 0 | 0 | 7 | 11 | 207 | 24 | 0 | 0 | 249 |
| Maximum | 0 | 0 | 0 | 0 | 0 | 0 | 71 | 88 | 2,012 | 223 | 0 | 0 | 2,012 |
| Minimum | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

Includes Larkspur Ditch & If&When Pueblo Res water

Catlin Canal
Total Diversions
units = acre-feet

| Year | Nov | Dec | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1986 | 3,370 | 0 | 0 | 129 | 11,802 | 14,638 | 16,386 | 13,662 | 16,032 | 14,807 | 9,335 | 8,490 | 108,651 |
| 1987 | 2,832 | 0 | 0 | 0 | 7,288 | 12,612 | 12,268 | 16,398 | 16,548 | 17,031 | 10,260 | 9,280 | 104,517 |
| 1988 | 5,136 | 0 | 0 | 0 | 5,502 | 10,504 | 12,160 | 16,524 | 16,438 | 16,048 | 10,136 | 9,502 | 101,950 |
| 1989 | 4,646 | 0 | 0 | 0 | 8,515 | 15,678 | 12,123 | 15,331 | 16,860 | 16,374 | 8,033 | 6,582 | 104,142 |
| 1990 | 3,854 | 0 | 0 | 0 | 3,669 | 13,968 | 10,867 | 15,668 | 14,461 | 15,393 | 11,307 | 8,301 | 97,488 |
| 1991 | 3,504 | 0 | 0 | 0 | 6,962 | 9,176 | 11,450 | 16,766 | 15,564 | 16,305 | 9,447 | 8,730 | 97,904 |
| 1992 | 0 | 0 | 0 | 0 | 6,518 | 17,517 | 15,362 | 12,754 | 15,149 | 15,238 | 12,147 | 9,761 | 104,446 |
| 1993 | 4,157 | 0 | 0 | 0 | 4,124 | 12,505 | 15,715 | 17,757 | 17,031 | 18,574 | 12,548 | 9,600 | 112,011 |
| 1994 | 4,169 | 0 | 0 | 0 | 9,115 | 16,703 | 13,905 | 19,523 | 21,001 | 15,305 | 11,807 | 10,531 | 122,059 |
| 1995 | 4,437 | 0 | 0 | 0 | 9,601 | 17,655 | 13,508 | 13,443 | 19,452 | 21,326 | 15,859 | 12,617 | 127,898 |
| Average | 3,611 | 0 | 0 | 13 | 7,310 | 14,096 | 13,374 | 15,783 | 16,854 | 16,640 | 11,088 | 9,339 | 108,107 |
| Maximum | 5,136 | 0 | 0 | 129 | 11,802 | 17,655 | 16,386 | 19,523 | 21,001 | 21,326 | 15,859 | 12,617 | 127,898 |
| Minimum | 0 | 0 | 0 | 0 | 3,669 | 9,176 | 10,867 | 12,754 | 14,461 | 14,807 | 8,033 | 6,582 | 97,488 |

Colorado Canal
Direct Flow Diversions
units = acre-feet

| Year | Nov | Dec | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1986 | 614 | 0 | 0 | 0 | 0 | 0 | 25 | 22,759 | 8,668 | 3,470 | 5,437 | 304 | 41,277 |
| 1987 | 4,623 | 0 | 0 | 0 | 0 | 4,094 | 14,641 | 20,214 | 4,155 | 1,336 | 746 | 0 | 49,809 |
| 1988 | 0 | 0 | 0 | 0 | 6 | 2,459 | 2,271 | 9,594 | 122 | 580 | 0 | 0 | 15,032 |
| 1989 | 0 | 0 | 0 | 0 | 0 | 0 | 1,112 | 404 | 1,592 | 0 | 0 | 0 | 3,108 |
| 1990 | 0 | 0 | 0 | 0 | 0 | 0 | 2,011 | 7,206 | 1,363 | 712 | 0 | 0 | 11,292 |
| 1991 | 2,775 | 0 | 0 | 0 | 0 | 0 | 0 | 4,931 | 0 | 574 | 0 | 0 | 8,280 |
| 1992 | 5,640 | 0 | 0 | 0 | 0 | 0 | 0 | 2,002 | 0 | 2,815 | 0 | 0 | 10,457 |
| 1993 | 0 | 0 | 0 | 0 | 1,382 | 0 | 10,239 | 26,241 | 1,720 | 0 | 0 | 0 | 39,582 |
| 1994 | 0 | 0 | 0 | 0 | 0 | 0 | 32,078 | 16,582 | 0 | 0 | 281 | 0 | 48,941 |
| 1995 | 0 | 0 | 0 | 0 | 0 | 368 | 21,963 | 31,948 | 18,684 | 8,592 | 1,257 | 0 | 82,812 |
| Average | 1,365 | 0 | 0 | 0 | 139 | 692 | 8,434 | 14,188 | 3,630 | 1,808 | 772 | 30 | 31,059 |
| Maximum | 5,640 | 0 | 0 | 0 | 1,382 | 4,094 | 32,078 | 31,948 | 18,684 | 8,592 | 5,437 | 304 | 82,812 |
| Minimum | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 404 | 0 | 0 | 0 | 0 | 3,108 |

Colorado Canal
SECWCD Project Water Diversions
units = acre-feet

| Year | Nov | Dec | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1986 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 161 | 0 | 0 | 161 |
| 1987 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 181 | 1,148 | 0 | 0 | 1,329 |
| 1988 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 736 | 1,731 | 0 | 0 | 2,467 |
| 1989 | 0 | 0 | 0 | 0 | 0 | 702 | 0 | 0 | 1,880 | 575 | 0 | 0 | 3,157 |
| 1990 | 0 | 0 | 0 | 0 | 0 | 0 | 6 | 938 | 622 | 569 | 0 | 0 | 2,135 |
| 1991 | 0 | 0 | 0 | 0 | 0 | 2 | 499 | 697 | 666 | 540 | 75 | 0 | 2,479 |
| 1992 | 0 | 0 | 0 | 0 | 0 | 13 | 75 | 0 | 353 | 159 | 0 | 0 | 600 |
| 1993 | 0 | 0 | 0 | 0 | 0 | 0 | 21 | 0 | 108 | 294 | 173 | 0 | 596 |
| 1994 | 0 | 0 | 0 | 0 | 0 | 0 | 17 | 266 | 504 | 896 | 741 | 0 | 2,424 |
| 1995 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Average | 0 | 0 | 0 | 0 | 0 | 72 | 62 | 190 | 505 | 607 | 99 | 0 | 1,535 |
| Maximum | 0 | 0 | 0 | 0 | 0 | 702 | 499 | 938 | 1,880 | 1,731 | 741 | 0 | 3,157 |
| Minimum | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

Colorado Canal
Winter Water Storage Diversions
units = acre-feet

| Year | Nov | Dec | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1986 | | | | | | | | | | | | | 0 |
| 1987 | | | | | | | | | | | | | 0 |
| 1988 | | | | | | | | | | | | | 0 |
| 1989 | 0 | 0 | 0 | 0 | 0 | 1,239 | 0 | 0 | 322 | 0 | 0 | 0 | 1,561 |
| 1990 | 0 | 0 | 0 | 0 | 0 | 0 | 203 | 365 | 307 | 65 | 0 | 0 | 940 |
| 1991 | | | | | | | | | | | | | 0 |
| 1992 | | | | | | | | | | | | | 0 |
| 1993 | 0 | 0 | 0 | 0 | 0 | 1,888 | 407 | 0 | 405 | 311 | 103 | 0 | 3,114 |
| 1994 | 0 | 0 | 0 | 0 | 0 | 266 | 17 | 0 | 0 | 74 | 77 | 0 | 434 |
| 1995 | 0 | 0 | 0 | 0 | 0 | 0 | 53 | 0 | 194 | 0 | 0 | 0 | 247 |
| Average | 0 | 0 | 0 | 0 | 0 | 679 | 136 | 73 | 246 | 90 | 36 | 0 | 630 |
| Maximum | 0 | 0 | 0 | 0 | 0 | 1,888 | 407 | 365 | 405 | 311 | 103 | 0 | 3,114 |
| Minimum | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

Colorado Canal
Storage Water
units = acre-feet

| Year | Nov | Dec | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1986 | 0 | 0 | 0 | 0 | 0 | 0 | 1,484 | 0 | 3,184 | 4,393 | 0 | 0 | 9,061 |
| 1987 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 8,693 | 3,250 | 2,970 | 0 | 14,913 |
| 1988 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1989 | 0 | 0 | 0 | 0 | 0 | 1,464 | 0 | 0 | 417 | 0 | 0 | 0 | 1,881 |
| 1990 | 0 | 0 | 0 | 0 | 0 | 0 | 1,147 | 957 | 1,068 | 0 | 0 | 0 | 3,172 |
| 1991 | 0 | 0 | 0 | 0 | 0 | 36 | 3,932 | 235 | 0 | 0 | 0 | 0 | 4,203 |
| 1992 | 0 | 0 | 0 | 0 | 0 | 311 | 2,770 | 833 | 1,881 | 803 | 0 | 0 | 6,598 |
| 1993 | 0 | 0 | 0 | 0 | 0 | 0 | 98 | 0 | 1,119 | 153 | 36 | 0 | 1,406 |
| 1994 | 0 | 0 | 0 | 0 | 0 | 0 | 1,693 | 756 | 9,788 | 2,999 | 0 | 0 | 15,236 |
| 1995 | 0 | 0 | 0 | 0 | 0 | 0 | 296 | 5,323 | 0 | 3,653 | 1,462 | 2,504 | 13,238 |
| Average | 0 | 0 | 0 | 0 | 0 | 181 | 1,142 | 810 | 2,615 | 1,525 | 447 | 250 | 6,971 |
| Maximum | 0 | 0 | 0 | 0 | 0 | 1,464 | 3,932 | 5,323 | 9,788 | 4,393 | 2,970 | 2,504 | 15,236 |
| Minimum | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

Colorado Canal
Other Transmountain Diversions
units = acre-feet

| Year | Nov | Dec | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1986 | 0 | 0 | 0 | 0 | 0 | 8,648 | 9,079 | 8,617 | 11,337 | 6,391 | 1,097 | 996 | 46,165 |
| 1987 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3,496 | 6,514 | 0 | 0 | 10,010 |
| 1988 | 0 | 0 | 0 | 0 | 884 | 1,054 | 2,845 | 5 | 1,978 | 5,012 | 0 | 0 | 11,778 |
| 1989 | 0 | 0 | 0 | 0 | 0 | 2,624 | 0 | 0 | 8,404 | 4,852 | 0 | 0 | 15,880 |
| 1990 | 0 | 0 | 0 | 0 | 0 | 0 | 564 | 2,113 | 3,562 | 6,612 | 0 | 0 | 12,851 |
| 1991 | 0 | 0 | 0 | 0 | 0 | 33 | 4,531 | 3,788 | 3,803 | 3,962 | 777 | 0 | 16,894 |
| 1992 | 0 | 0 | 0 | 0 | 0 | 218 | 1,418 | 2,033 | 2,871 | 5,253 | 595 | 0 | 12,388 |
| 1993 | 0 | 0 | 0 | 0 | 0 | 6,076 | 9,161 | 861 | 8,436 | 6,797 | 2,802 | 0 | 34,133 |
| 1994 | 0 | 0 | 0 | 0 | 0 | 5,228 | 1,902 | 10,514 | 933 | 1,685 | 1,980 | 0 | 22,242 |
| 1995 | 454 | 0 | 0 | 0 | 0 | 0 | 1,157 | 262 | 1,011 | 7,440 | 1,726 | 0 | 12,050 |
| Average | 45 | 0 | 0 | 0 | 88 | 2,388 | 3,066 | 2,819 | 4,583 | 5,452 | 898 | 100 | 19,439 |
| Maximum | 454 | 0 | 0 | 0 | 884 | 8,648 | 9,161 | 10,514 | 11,337 | 7,440 | 2,802 | 996 | 46,165 |
| Minimum | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 933 | 1,685 | 0 | 0 | 10,010 |

Colorado Canal
Total Diversions
units = acre-feet

| Year | Nov | Dec | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1986 | 614 | 0 | 0 | 0 | 0 | 8,648 | 10,588 | 31,376 | 23,189 | 14,415 | 6,534 | 1,300 | 96,664 |
| 1987 | 4,623 | 0 | 0 | 0 | 0 | 4,094 | 14,641 | 20,214 | 16,525 | 12,248 | 3,716 | 0 | 76,061 |
| 1988 | 0 | 0 | 0 | 0 | 890 | 3,513 | 5,116 | 9,599 | 2,836 | 7,323 | 0 | 0 | 29,277 |
| 1989 | 0 | 0 | 0 | 0 | 0 | 6,029 | 1,112 | 404 | 12,615 | 5,427 | 0 | 0 | 25,587 |
| 1990 | 0 | 0 | 0 | 0 | 0 | 0 | 3,931 | 11,579 | 6,922 | 7,958 | 0 | 0 | 30,390 |
| 1991 | 2,775 | 0 | 0 | 0 | 0 | 71 | 8,962 | 9,651 | 4,469 | 5,076 | 852 | 0 | 31,856 |
| 1992 | 5,640 | 0 | 0 | 0 | 0 | 542 | 4,263 | 4,868 | 5,105 | 9,030 | 595 | 0 | 30,043 |
| 1993 | 0 | 0 | 0 | 0 | 1,382 | 7,964 | 19,926 | 27,102 | 11,788 | 7,555 | 3,114 | 0 | 78,831 |
| 1994 | 0 | 0 | 0 | 0 | 0 | 5,494 | 35,707 | 28,118 | 11,225 | 5,654 | 3,079 | 0 | 89,277 |
| 1995 | 454 | 0 | 0 | 0 | 0 | 368 | 23,469 | 37,533 | 19,889 | 19,685 | 4,445 | 2,504 | 108,347 |
| Average | 1,411 | 0 | 0 | 0 | 227 | 3,672 | 12,772 | 18,044 | 11,456 | 9,437 | 2,234 | 380 | 59,633 |
| Maximum | 5,640 | 0 | 0 | 0 | 1,382 | 8,648 | 35,707 | 37,533 | 23,189 | 19,685 | 6,534 | 2,504 | 108,347 |
| Minimum | 0 | 0 | 0 | 0 | 0 | 0 | 1,112 | 404 | 2,836 | 5,076 | 0 | 0 | 25,587 |

Excelsior Ditch
Direct Flow Diversions
units = acre-feet

| Year | Nov | Dec | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1986 | 0 | 0 | 0 | 0 | 0 | 250 | 48 | 357 | 333 | 226 | 0 | 0 | 1,214 |
| 1987 | 0 | 0 | 0 | 0 | 0 | 0 | 472 | 83 | 0 | 0 | 0 | 0 | 555 |
| 1988 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 226 | 0 | 0 | 0 | 0 | 226 |
| 1989 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1990 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1991 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1992 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1993 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1994 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1995 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Average | 0 | 0 | 0 | 0 | 0 | 25 | 52 | 67 | 33 | 23 | 0 | 0 | 200 |
| Maximum | 0 | 0 | 0 | 0 | 0 | 250 | 472 | 357 | 333 | 226 | 0 | 0 | 1,214 |
| Minimum | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

Excelsior Ditch
SECWCD Project Water Diversions
units = acre-feet

| Year | Nov | Dec | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1986 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1987 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1988 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1989 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1990 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1991 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1992 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1993 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1994 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1995 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Average | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Maximum | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Minimum | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

Excelsior Ditch
Winter Water Storage Diversions
units = acre-feet

| Year | Nov | Dec | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1986 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1987 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1988 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1989 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1990 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1991 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1992 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1993 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1994 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1995 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Average | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Maximum | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Minimum | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

Excelsior Ditch
Storage Water
units = acre-feet

| Year | Nov | Dec | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1986 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1987 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1988 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1989 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1990 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1991 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1992 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1993 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1994 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1995 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Average | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Maximum | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Minimum | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

Excelsior Ditch
Other Transmountain Diversions
units = acre-feet

| Year | Nov | Dec | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1986 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1987 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1988 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1989 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1990 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1991 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1992 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1993 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1994 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1995 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Average | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Maximum | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Minimum | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

Excelsior Ditch
Total Diversions
units = acre-feet

| Year | Nov | Dec | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1986 | 0 | 0 | 0 | 0 | 0 | 250 | 48 | 357 | 333 | 226 | 0 | 0 | 1,214 |
| 1987 | 0 | 0 | 0 | 0 | 0 | 0 | 472 | 83 | 0 | 0 | 0 | 0 | 555 |
| 1988 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 226 | 0 | 0 | 0 | 0 | 226 |
| 1989 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1990 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1991 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1992 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1993 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1994 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1995 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Average | 0 | 0 | 0 | 0 | 0 | 25 | 52 | 67 | 33 | 23 | 0 | 0 | 200 |
| Maximum | 0 | 0 | 0 | 0 | 0 | 250 | 472 | 357 | 333 | 226 | 0 | 0 | 1,214 |
| Minimum | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

Highline Canal
Other Transmountain Diversions
units = acre-feet

| Year | Nov | Dec | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1986 | 0 | 0 | 0 | 0 | 0 | 0 | 1,682 | 1,101 | 1,041 | 922 | 0 | 0 | 4,746 |
| 1987 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1988 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1989 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1990 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1991 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1992 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1993 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1994 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1,504 | 5,229 | 0 | 0 | 0 | 6,733 |
| 1995 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Average | 0 | 0 | 0 | 0 | 0 | 0 | 168 | 261 | 627 | 92 | 0 | 0 | 1,148 |
| Maximum | 0 | 0 | 0 | 0 | 0 | 0 | 1,682 | 1,504 | 5,229 | 922 | 0 | 0 | 6,733 |
| Minimum | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

Includes Lake Minnequa, If&When Pueblo Res water, & Other Transbasin

Highline Canal
Total Diversions
units = acre-feet

| Year | Nov | Dec | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1986 | 3,392 | 0 | 0 | 861 | 8,131 | 11,455 | 10,419 | 25,539 | 26,564 | 16,078 | 9,412 | 7,582 | 119,433 |
| 1987 | 3,410 | 0 | 0 | 3,657 | 5,818 | 18,052 | 14,207 | 31,128 | 20,044 | 13,151 | 8,251 | 7,506 | 125,224 |
| 1988 | 4,219 | 0 | 0 | 0 | 4,251 | 8,437 | 10,717 | 17,374 | 13,973 | 12,818 | 6,115 | 6,886 | 84,790 |
| 1989 | 2,619 | 0 | 0 | 0 | 5,499 | 14,459 | 8,924 | 12,366 | 11,706 | 11,070 | 5,897 | 5,657 | 78,197 |
| 1990 | 3,350 | 0 | 0 | 0 | 3,587 | 7,193 | 8,659 | 14,564 | 14,316 | 10,081 | 7,583 | 7,560 | 76,893 |
| 1991 | 3,034 | 0 | 0 | 0 | 5,578 | 9,107 | 9,952 | 17,647 | 13,651 | 13,480 | 6,719 | 5,828 | 84,996 |
| 1992 | 3,236 | 0 | 0 | 0 | 4,113 | 10,160 | 10,500 | 10,913 | 10,738 | 12,022 | 6,617 | 6,624 | 74,923 |
| 1993 | 3,286 | 0 | 0 | 0 | 2,466 | 11,136 | 17,986 | 21,045 | 18,121 | 12,616 | 7,847 | 6,496 | 100,999 |
| 1994 | 3,233 | 0 | 0 | 0 | 3,915 | 10,235 | 18,053 | 21,227 | 15,823 | 10,360 | 6,316 | 7,885 | 97,047 |
| 1995 | 3,410 | 0 | 0 | 0 | 5,107 | 10,949 | 16,663 | 15,555 | 25,607 | 21,770 | 10,531 | 7,351 | 116,943 |
| Average | 3,319 | 0 | 0 | 452 | 4,847 | 11,118 | 12,608 | 18,736 | 17,054 | 13,345 | 7,529 | 6,938 | 95,945 |
| Maximum | 4,219 | 0 | 0 | 3,657 | 8,131 | 18,052 | 18,053 | 31,128 | 26,564 | 21,770 | 10,531 | 7,885 | 125,224 |
| Minimum | 2,619 | 0 | 0 | 0 | 2,466 | 7,193 | 8,659 | 10,913 | 10,738 | 10,081 | 5,897 | 5,657 | 74,923 |

Las Animas Consolidated Canal
Direct Flow Diversions
units = acre-feet

| Year | Nov | Dec | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1986 | 1,227 | 0 | 0 | 0 | 1,887 | 3,163 | 4,172 | 6,330 | 7,196 | 5,273 | 2,318 | 2,943 | 34,509 |
| 1987 | 1,182 | 0 | 0 | 0 | 1,155 | 2,738 | 4,776 | 5,794 | 5,873 | 4,785 | 4,587 | 4,082 | 34,972 |
| 1988 | 1,565 | 0 | 0 | 0 | 1,439 | 2,986 | 3,533 | 5,617 | 6,239 | 4,450 | 2,970 | 3,154 | 31,951 |
| 1989 | 1,430 | 0 | 0 | 0 | 1,637 | 3,205 | 3,298 | 4,265 | 4,717 | 3,489 | 2,652 | 2,780 | 27,472 |
| 1990 | 1,348 | 0 | 0 | 0 | 1,482 | 2,653 | 3,356 | 4,210 | 4,675 | 3,959 | 2,755 | 2,398 | 26,836 |
| 1991 | 1,010 | 2 | 0 | 0 | 1,645 | 2,837 | 3,030 | 4,290 | 3,766 | 4,824 | 3,078 | 3,104 | 27,587 |
| 1992 | 233 | 0 | 0 | 0 | 1,455 | 3,115 | 4,075 | 4,739 | 3,880 | 3,772 | 3,086 | 2,958 | 27,314 |
| 1993 | 1,506 | 0 | 0 | 0 | 885 | 2,777 | 3,783 | 5,654 | 5,574 | 3,514 | 3,099 | 3,127 | 29,918 |
| 1994 | 1,669 | 0 | 17 | 0 | 1,787 | 3,362 | 4,142 | 6,004 | 3,447 | 3,273 | 3,299 | 2,554 | 29,554 |
| 1995 | 1,439 | 0 | 0 | 0 | 1,819 | 3,129 | 2,134 | 1,949 | 4,998 | 7,688 | 5,549 | 3,065 | 31,769 |
| Average | 1,261 | 0 | 2 | 0 | 1,519 | 2,996 | 3,630 | 4,885 | 5,036 | 4,503 | 3,339 | 3,017 | 30,188 |
| Maximum | 1,669 | 2 | 17 | 0 | 1,887 | 3,362 | 4,776 | 6,330 | 7,196 | 7,688 | 5,549 | 4,082 | 34,972 |
| Minimum | 233 | 0 | 0 | 0 | 885 | 2,653 | 2,134 | 1,949 | 3,447 | 3,273 | 2,318 | 2,398 | 26,836 |

* Includes the Natural Streamflow diversion for the Las Animas Consolidated Canal + Highland Canal Diversion * 0.9 * (200/3800)

Las Animas Consolidated Canal
SECWCD Project Water Diversions
units = acre-feet

| Year | Nov | Dec | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1986 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1987 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1988 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1989 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1990 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1991 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1992 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1993 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1994 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1995 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Average | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Maximum | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Minimum | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

Las Animas Consolidated Canal
Winter Water Storage Diversions
units = acre-feet

| Year | Nov | Dec | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1986 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1987 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1988 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1989 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1990 | 0 | 0 | 0 | 0 | 0 | 0 | 186 | 428 | 496 | 665 | 0 | 0 | 1,775 |
| 1991 | 0 | 0 | 0 | 0 | 0 | 0 | 218 | 714 | 1,027 | 0 | 0 | 0 | 1,959 |
| 1992 | 0 | 0 | 0 | 0 | 0 | 345 | 734 | 0 | 578 | 527 | 0 | 0 | 2,184 |
| 1993 | 0 | 0 | 0 | 0 | 0 | 0 | 407 | 0 | 1,259 | 721 | 0 | 0 | 2,387 |
| 1994 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 179 | 1,832 | 51 | 0 | 0 | 2,062 |
| 1995 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | | | | | | | | | | | | | |
| Average | 0 | 0 | 0 | 0 | 0 | 35 | 155 | 132 | 519 | 196 | 0 | 0 | 1,037 |
| Maximum | 0 | 0 | 0 | 0 | 0 | 345 | 734 | 714 | 1,832 | 721 | 0 | 0 | 2,387 |
| Minimum | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

Las Animas Consolidated Canal
Storage Water
units = acre-feet

| Year | Nov | Dec | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1986 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1987 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1988 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1989 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1990 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1991 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1992 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1993 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1994 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1995 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | | | | | | | | | | | | | |
| Average | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Maximum | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Minimum | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

Las Animas Consolidated Canal
Other Transmountain Diversions
units = acre-feet

| Year | Nov | Dec | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1986 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1987 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1988 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1989 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1990 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1991 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1992 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1993 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1994 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1995 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Average | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Maximum | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Minimum | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

Las Animas Consolidated Canal
Total Diversions
units = acre-feet

| Year | Nov | Dec | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1986 | 1,227 | 0 | 0 | 0 | 1,887 | 3,163 | 4,172 | 6,330 | 7,196 | 5,273 | 2,318 | 2,943 | 34,509 |
| 1987 | 1,182 | 0 | 0 | 0 | 1,155 | 2,738 | 4,776 | 5,794 | 5,873 | 4,785 | 4,587 | 4,082 | 34,972 |
| 1988 | 1,565 | 0 | 0 | 0 | 1,439 | 2,986 | 3,533 | 5,617 | 6,239 | 4,450 | 2,970 | 3,154 | 31,951 |
| 1989 | 1,430 | 0 | 0 | 0 | 1,637 | 3,205 | 3,298 | 4,265 | 4,717 | 3,489 | 2,652 | 2,780 | 27,472 |
| 1990 | 1,348 | 0 | 0 | 0 | 1,482 | 2,653 | 3,542 | 4,638 | 5,171 | 4,624 | 2,755 | 2,398 | 28,611 |
| 1991 | 1,010 | 2 | 0 | 0 | 1,645 | 2,837 | 3,248 | 5,004 | 4,793 | 4,824 | 3,078 | 3,104 | 29,546 |
| 1992 | 233 | 0 | 0 | 0 | 1,455 | 3,460 | 4,809 | 4,739 | 4,458 | 4,299 | 3,086 | 2,958 | 29,498 |
| 1993 | 1,506 | 0 | 0 | 0 | 885 | 2,777 | 4,190 | 5,654 | 6,833 | 4,235 | 3,099 | 3,127 | 32,305 |
| 1994 | 1,669 | 0 | 17 | 0 | 1,787 | 3,362 | 4,142 | 6,183 | 5,279 | 3,324 | 3,299 | 2,554 | 31,616 |
| 1995 | 1,439 | 0 | 0 | 0 | 1,819 | 3,129 | 2,134 | 1,949 | 4,998 | 7,688 | 5,549 | 3,065 | 31,769 |
| Average | 1,261 | 0 | 2 | 0 | 1,519 | 3,031 | 3,784 | 5,017 | 5,556 | 4,699 | 3,339 | 3,017 | 31,225 |
| Maximum | 1,669 | 2 | 17 | 0 | 1,887 | 3,460 | 4,809 | 6,330 | 7,196 | 7,688 | 5,549 | 4,082 | 34,972 |
| Minimum | 233 | 0 | 0 | 0 | 885 | 2,653 | 2,134 | 1,949 | 4,458 | 3,324 | 2,318 | 2,398 | 27,472 |

### Otero Canal
Direct Flow Diversions
units = acre-feet

| Year | Nov | Dec | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1986 | 0 | 0 | 512 | 774 | 1,578 | 0 | 0 | 3,373 | 1,811 | 776 | 1,021 | 0 | 9,845 |
| 1987 | 650 | 552 | 0 | 0 | 3,314 | 3,244 | 1,715 | 2,285 | 661 | 181 | 1 | 0 | 12,603 |
| 1988 | 0 | 0 | 0 | 0 | 79 | 442 | 344 | 2,189 | 563 | 472 | 0 | 0 | 4,089 |
| 1989 | 851 | 773 | 0 | 388 | 1,275 | 0 | 373 | 800 | 410 | 2 | 0 | 0 | 4,872 |
| 1990 | 2,843 | 710 | 0 | 0 | 1,204 | 0 | 1,039 | 2,007 | 1,534 | 0 | 11 | 0 | 9,348 |
| 1991 | 402 | 262 | 0 | 745 | 2,882 | 0 | 1 | 1,484 | 3 | 687 | 0 | 0 | 6,466 |
| 1992 | 1,640 | 43 | 0 | 126 | 2,669 | 0 | 0 | 738 | 0 | 923 | 1 | 0 | 6,140 |
| 1993 | 1,760 | 0 | 0 | 0 | 1,004 | 0 | 2,670 | 4,009 | 1,229 | 3 | 20 | 6 | 10,701 |
| 1994 | 0 | 0 | 0 | 1,112 | 2,987 | 9 | 2,067 | 1,199 | 10 | 6 | 3 | 0 | 7,393 |
| 1995 | 529 | 540 | 0 | 402 | 2,526 | 116 | 550 | 2,013 | 1,712 | 839 | 582 | 9 | 9,818 |
| Average | 868 | 288 | 51 | 355 | 1,952 | 381 | 876 | 2,010 | 793 | 389 | 164 | 2 | 8,128 |
| Maximum | 2,843 | 773 | 512 | 1,112 | 3,314 | 3,244 | 2,670 | 4,009 | 1,811 | 923 | 1,021 | 9 | 12,603 |
| Minimum | 0 | 0 | 0 | 0 | 79 | 0 | 0 | 738 | 0 | 0 | 0 | 0 | 4,089 |

### Otero Canal
SECWCD Project Water Diversions
units = acre-feet

| Year | Nov | Dec | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1986 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1987 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 146 | 709 | 106 | 0 | 961 |
| 1988 | 0 | 0 | 0 | 0 | 0 | 0 | 308 | 215 | 462 | 631 | 308 | 0 | 1,924 |
| 1989 | 0 | 0 | 0 | 0 | 0 | 0 | 165 | 124 | 1,054 | 551 | 0 | 0 | 1,894 |
| 1990 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 134 | 0 | 567 | 0 | 701 |
| 1991 | 0 | 0 | 0 | 0 | 0 | 0 | 425 | 204 | 286 | 173 | 0 | 0 | 1,088 |
| 1992 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 266 | 59 | 0 | 325 |
| 1993 | 0 | 0 | 0 | 0 | 0 | 0 | 97 | 132 | 269 | 300 | 293 | 89 | 1,180 |
| 1994 | 0 | 0 | 0 | 0 | 69 | 111 | 69 | 101 | 180 | 306 | 287 | 0 | 1,123 |
| 1995 | 0 | 0 | 0 | 0 | 22 | 0 | 0 | 0 | 0 | 246 | 123 | 0 | 391 |
| Average | 0 | 0 | 0 | 0 | 9 | 11 | 106 | 78 | 253 | 318 | 174 | 9 | 959 |
| Maximum | 0 | 0 | 0 | 0 | 69 | 111 | 425 | 215 | 1,054 | 709 | 567 | 89 | 1,924 |
| Minimum | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

Otero Canal
Winter Water Storage Diversions
units = acre-feet

| Year | Nov | Dec | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1986 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1987 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1988 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1989 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1990 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1991 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1992 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1993 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1994 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1995 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Average | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Maximum | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Minimum | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

Otero Canal
Storage Water
units = acre-feet

| Year | Nov | Dec | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1986 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1987 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1988 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1989 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1990 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1991 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1992 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1993 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1994 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1995 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Average | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Maximum | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Minimum | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

Otero Canal
Other Transmountain Diversions
units = acre-feet

| Year | Nov | Dec | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1986 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1987 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1988 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1989 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1990 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1991 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1992 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1993 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1994 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1995 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Average | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Maximum | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Minimum | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

Otero Canal
Total Diversions
units = acre-feet

| Year | Nov | Dec | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1986 | 0 | 0 | 512 | 774 | 1,578 | 0 | 0 | 3,373 | 1,811 | 776 | 1,021 | 0 | 9,845 |
| 1987 | 650 | 552 | 0 | 0 | 3,314 | 3,244 | 1,715 | 2,285 | 807 | 890 | 107 | 0 | 13,564 |
| 1988 | 0 | 0 | 0 | 0 | 79 | 442 | 652 | 2,404 | 1,025 | 1,103 | 308 | 0 | 6,013 |
| 1989 | 851 | 773 | 0 | 388 | 1,275 | 0 | 538 | 924 | 1,464 | 553 | 0 | 0 | 6,766 |
| 1990 | 2,843 | 710 | 0 | 0 | 1,204 | 0 | 1,039 | 2,007 | 1,668 | 0 | 578 | 0 | 10,049 |
| 1991 | 402 | 262 | 0 | 745 | 2,882 | 0 | 426 | 1,688 | 289 | 860 | 0 | 0 | 7,554 |
| 1992 | 1,640 | 43 | 0 | 126 | 2,669 | 0 | 0 | 738 | 0 | 1,189 | 60 | 0 | 6,465 |
| 1993 | 1,760 | 0 | 0 | 0 | 1,004 | 0 | 2,767 | 4,141 | 1,498 | 303 | 313 | 95 | 11,881 |
| 1994 | 0 | 0 | 0 | 1,112 | 3,056 | 120 | 2,136 | 1,300 | 190 | 312 | 290 | 0 | 8,516 |
| 1995 | 529 | 540 | 0 | 402 | 2,548 | 116 | 550 | 2,013 | 1,712 | 1,085 | 705 | 9 | 10,209 |
| Average | 868 | 288 | 51 | 355 | 1,961 | 392 | 982 | 2,087 | 1,046 | 707 | 338 | 10 | 9,086 |
| Maximum | 2,843 | 773 | 512 | 1,112 | 3,314 | 3,244 | 2,767 | 4,141 | 1,811 | 1,189 | 1,021 | 95 | 13,564 |
| Minimum | 0 | 0 | 0 | 0 | 79 | 0 | 0 | 738 | 0 | 0 | 0 | 0 | 6,013 |

Fort Lyon Canal
Direct Flow Diversions
units = acre-feet

| Year | Nov | Dec | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1986 | 9,792 | 0 | 0 | 0 | 5,305 | 13,152 | 16,707 | 29,116 | 50,767 | 31,755 | 21,814 | 21,213 | 199,620 |
| 1987 | 3,367 | 0 | 3,562 | 1,728 | 0 | 39,707 | 45,509 | 46,566 | 37,691 | 26,322 | 32,677 | 25,755 | 262,884 |
| 1988 | 21,562 | 0 | 0 | 0 | 14,362 | 30,285 | 22,873 | 44,803 | 25,074 | 14,058 | 11,241 | 10,442 | 194,700 |
| 1989 | 12,340 | 0 | 0 | 0 | 13,556 | 10,387 | 23,614 | 37,939 | 12,467 | 12,228 | 9,395 | 10,387 | 142,313 |
| 1990 | 10,472 | 0 | 0 | 0 | 5,251 | 11,885 | 21,780 | 42,578 | 30,784 | 20,108 | 9,776 | 14,309 | 166,943 |
| 1991 | 20,223 | 0 | 0 | 0 | 8,802 | 9,426 | 12,386 | 36,117 | 14,697 | 27,802 | 10,044 | 10,067 | 149,564 |
| 1992 | 5,916 | 0 | 0 | 0 | 12,738 | 17,387 | 19,922 | 41,384 | 18,387 | 17,382 | 14,181 | 10,388 | 157,685 |
| 1993 | 15,240 | 0 | 0 | 0 | 10,662 | 21,445 | 29,456 | 42,218 | 40,227 | 13,262 | 8,820 | 6,335 | 187,665 |
| 1994 | 15,911 | 0 | 0 | 0 | 6,734 | 24,821 | 28,998 | 47,530 | 12,322 | 11,623 | 662 | 14,924 | 163,526 |
| 1995 | 15,956 | 0 | 0 | 0 | 7,596 | 27,104 | 32,903 | 23,303 | 48,478 | 50,082 | 44,404 | 38,962 | 288,788 |
| | | | | | | | | | | | | | |
| Average | 13,078 | 0 | 356 | 173 | 8,501 | 20,560 | 25,415 | 39,155 | 29,089 | 22,462 | 16,301 | 16,278 | 191,369 |
| Maximum | 21,562 | 0 | 3,562 | 1,728 | 14,362 | 39,707 | 45,509 | 47,530 | 50,767 | 50,082 | 44,404 | 38,962 | 288,788 |
| Minimum | 3,367 | 0 | 0 | 0 | 0 | 9,426 | 12,386 | 23,303 | 12,322 | 11,623 | 662 | 6,335 | 142,313 |

Kicking Bird Canal diversions taken from Amity Canal Annual Reports for 1986-95.

Direct Flow calculated as Ft Lyon Direct Flow Diversions - (Kicking Bird Canal Diversion / 0.75).

Kicking Bird Canal diversions for 1986: Diversions split for November through February as all of Fort Lyon Diversions in Feb remainder in November.

Kicking Bird Canal diversions for 1987: Maximum of 16,701 ac-ft of diversions in March due to maximum direct flow available to Fort Lyon, balance of 266 ac-ft applied to Feb diversions.

Fort Lyon Canal
SECWCD Project Water Diversions
units = acre-feet

| Year | Nov | Dec | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1986 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1987 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1988 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 14,195 | 8,083 | 0 | 0 | 22,278 |
| 1989 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 542 | 23,417 | 12,929 | 0 | 0 | 36,888 |
| 1990 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 4,840 | 347 | 0 | 0 | 5,187 |
| 1991 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1,098 | 22,023 | 1,612 | 0 | 0 | 24,733 |
| 1992 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 6,166 | 0 | 4,095 | 0 | 10,261 |
| 1993 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3,199 | 27,632 | 0 | 0 | 30,831 |
| 1994 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 16,888 | 0 | 0 | 0 | 16,888 |
| 1995 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | | | | | | | | | | | | | |
| Average | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 164 | 9,073 | 5,060 | 410 | 0 | 14,707 |
| Maximum | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1,098 | 23,417 | 27,632 | 4,095 | 0 | 36,888 |
| Minimum | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

Not included is 996 af diverted by Storage Canal in 1988
Not included is 5893 af diverted by Storage Canal in 1989
Not included is 3409 af diverted by Storage Canal in 1990
Not included is 694 af diverted by Storage Canal in 1991
Not included is 256 af diverted by Storage Canal in 1992

Fort Lyon Canal
Winter Water Storage Diversions
units = acre-feet

| Year | Nov | Dec | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1986 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1987 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1988 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1989 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1990 | 0 | 0 | 0 | 0 | 0 | 0 | 2,124 | 0 | 1,215 | 0 | 0 | 0 | 3,339 |
| 1991 | 0 | 0 | 0 | 0 | 0 | 0 | 2,220 | 0 | 685 | 0 | 0 | 0 | 2,905 |
| 1992 | 0 | 0 | 0 | 0 | 0 | 1,720 | 0 | 172 | 603 | 0 | 212 | 0 | 2,707 |
| 1993 | 0 | 0 | 0 | 0 | 0 | 2,241 | 2,034 | 0 | 917 | 67 | 330 | 0 | 5,589 |
| 1994 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2,313 | 117 | 760 | 74 | 0 | 3,264 |
| 1995 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Average | 0 | 0 | 0 | 0 | 0 | 396 | 638 | 249 | 354 | 83 | 62 | 0 | 1,780 |
| Maximum | 0 | 0 | 0 | 0 | 0 | 2,241 | 2,220 | 2,313 | 1,215 | 760 | 330 | 0 | 5,589 |
| Minimum | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

Includes JMR exchange water & Lake Meredith winter water

Fort Lyon Canal
Storage Water
units = acre-feet

| Year | Nov | Dec | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1986 | 0 | 0 | 601 | 14,400 | 9,369 | 29,166 | 20,805 | 34 | 2,580 | 9,087 | 7,973 | 5,212 | 99,227 |
| 1987 | 0 | 0 | 0 | 0 | 0 | 4,179 | 5,590 | 5,498 | 29,037 | 24,578 | 7,542 | 5,431 | 81,855 |
| 1988 | 0 | 0 | 0 | 0 | 0 | 9,138 | 16,401 | 0 | 13,082 | 15,024 | 16,500 | 2,839 | 72,984 |
| 1989 | 0 | 0 | 0 | 0 | 2,633 | 21,691 | 9,547 | 0 | 5,693 | 7,606 | 4,794 | 151 | 52,115 |
| 1990 | 0 | 0 | 0 | 0 | 0 | 0 | 2,739 | 1,274 | 5,413 | 15,689 | 5,984 | 240 | 31,339 |
| 1991 | 0 | 0 | 0 | 0 | 0 | 15,058 | 8,207 | 0 | 0 | 4,976 | 11,328 | 3,031 | 42,600 |
| 1992 | 0 | 0 | 0 | 0 | 0 | 11,969 | 18,319 | 0 | 1,945 | 3,841 | 557 | 0 | 36,631 |
| 1993 | 0 | 0 | 0 | 0 | 0 | 0 | 8,027 | 0 | 8,035 | 5,403 | 10,648 | 13,861 | 45,974 |
| 1994 | 0 | 0 | 0 | 0 | 3,960 | 7,724 | 6,036 | 339 | 20,732 | 19,556 | 14,466 | 1,333 | 74,146 |
| 1995 | 0 | 0 | 0 | 0 | 0 | 1,141 | 0 | 3,081 | 5,102 | 20,510 | 6,599 | 0 | 36,433 |
| Average | 0 | 0 | 60 | 1,440 | 1,596 | 10,007 | 9,567 | 1,023 | 9,162 | 12,627 | 8,639 | 3,210 | 57,330 |
| Maximum | 0 | 0 | 601 | 14,400 | 9,369 | 29,166 | 20,805 | 5,498 | 29,037 | 24,578 | 16,500 | 13,861 | 99,227 |
| Minimum | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3,841 | 557 | 0 | 31,339 |

Fort Lyon Canal
Other Transmountain Diversions
units = acre-feet

| Year | Nov | Dec | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1986 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1987 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1988 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1989 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1990 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1991 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1992 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1993 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1994 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1995 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Average | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Maximum | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Minimum | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

Fort Lyon Canal
Total Diversions
units = acre-feet

| Year | Nov | Dec | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1986 | 9,792 | 0 | 601 | 14,400 | 14,674 | 42,318 | 37,512 | 29,150 | 53,347 | 40,842 | 29,787 | 26,425 | 298,847 |
| 1987 | 3,367 | 0 | 3,562 | 1,728 | 0 | 43,886 | 51,099 | 52,064 | 66,728 | 50,900 | 40,219 | 31,186 | 344,739 |
| 1988 | 21,562 | 0 | 0 | 0 | 14,362 | 39,423 | 39,274 | 44,803 | 52,351 | 37,165 | 27,741 | 13,281 | 289,962 |
| 1989 | 12,340 | 0 | 0 | 0 | 16,189 | 32,078 | 33,161 | 38,481 | 41,577 | 32,763 | 14,189 | 10,538 | 231,316 |
| 1990 | 10,472 | 0 | 0 | 0 | 5,251 | 11,885 | 26,643 | 43,852 | 42,252 | 36,144 | 15,760 | 14,549 | 206,808 |
| 1991 | 20,223 | 0 | 0 | 0 | 8,802 | 24,484 | 22,813 | 37,215 | 37,405 | 34,390 | 21,372 | 13,098 | 219,802 |
| 1992 | 5,916 | 0 | 0 | 0 | 12,738 | 31,076 | 38,241 | 41,556 | 27,101 | 21,223 | 19,045 | 10,388 | 207,284 |
| 1993 | 15,240 | 0 | 0 | 0 | 10,662 | 23,686 | 39,517 | 42,218 | 52,378 | 46,364 | 19,798 | 20,196 | 270,059 |
| 1994 | 15,911 | 0 | 0 | 0 | 10,694 | 32,545 | 35,034 | 50,182 | 50,059 | 31,939 | 15,202 | 16,257 | 257,824 |
| 1995 | 15,956 | 0 | 0 | 0 | 7,596 | 28,245 | 32,903 | 26,384 | 53,580 | 70,592 | 51,003 | 38,962 | 325,221 |
| Average | 13,078 | 0 | 416 | 1,613 | 10,097 | 30,963 | 35,620 | 40,590 | 47,678 | 40,232 | 25,412 | 19,488 | 265,186 |
| Maximum | 21,562 | 0 | 3,562 | 14,400 | 16,189 | 43,886 | 51,099 | 52,064 | 66,728 | 70,592 | 51,003 | 38,962 | 344,739 |
| Minimum | 3,367 | 0 | 0 | 0 | 0 | 11,885 | 22,813 | 26,384 | 27,101 | 21,223 | 14,189 | 10,388 | 206,808 |

Fort Lyon Canal
Direct Flow Diversions
units = acre-feet

| Year | Nov | Dec | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1986 | 25,906 | 0 | 0 | 5,150 | 11,670 | 13,152 | 16,707 | 61,217 | 54,515 | 31,755 | 21,814 | 21,213 | 263,099 |
| 1987 | 3,367 | 0 | 6,225 | 46,064 | 22,268 | 39,707 | 45,509 | 52,607 | 40,362 | 26,322 | 32,677 | 25,755 | 340,863 |
| 1988 | 21,562 | 0 | 0 | 0 | 14,362 | 30,285 | 22,873 | 44,803 | 25,074 | 14,058 | 11,241 | 10,442 | 194,700 |
| 1989 | 12,340 | 0 | 0 | 0 | 13,556 | 10,387 | 23,614 | 37,939 | 12,467 | 12,228 | 9,395 | 10,387 | 142,313 |
| 1990 | 10,472 | 0 | 0 | 0 | 5,251 | 11,885 | 21,780 | 42,578 | 30,784 | 20,108 | 9,776 | 14,309 | 166,943 |
| 1991 | 20,223 | 0 | 0 | 0 | 8,802 | 9,426 | 12,386 | 36,117 | 14,697 | 27,802 | 10,044 | 10,067 | 149,564 |
| 1992 | 5,916 | 0 | 0 | 0 | 12,738 | 17,387 | 19,922 | 41,384 | 18,387 | 17,382 | 14,181 | 10,388 | 157,685 |
| 1993 | 15,240 | 0 | 0 | 0 | 10,662 | 21,445 | 29,456 | 42,218 | 40,227 | 13,262 | 11,037 | 15,942 | 199,489 |
| 1994 | 15,911 | 0 | 0 | 0 | 6,734 | 31,534 | 31,734 | 52,829 | 12,322 | 11,623 | 19,133 | 18,003 | 199,823 |
| 1995 | 15,956 | 0 | 0 | 0 | 7,596 | 27,104 | 45,204 | 38,679 | 78,481 | 52,106 | 44,404 | 39,293 | 348,823 |
| Average | 14,689 | 0 | 623 | 5,121 | 11,364 | 21,231 | 26,919 | 45,037 | 32,732 | 22,665 | 18,370 | 17,580 | 216,330 |
| Maximu | 25,906 | 0 | 6,225 | 46,064 | 22,268 | 39,707 | 45,509 | 61,217 | 78,481 | 52,106 | 44,404 | 39,293 | 348,823 |
| Minimum | 3,367 | 0 | 0 | 0 | 5,251 | 9,426 | 12,386 | 36,117 | 12,322 | 11,623 | 9,395 | 10,067 | 142,313 |

Kicking Bird Canal
Diversions from the Fort Lyon Canal to Kicking Bird Canal
units = acre-feet

| Year | Nov | Dec | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1986 | 12,086 | 0 | 0 | 3,863 | 4,774 | 0 | 0 | 24,076 | 2,811 | 0 | 0 | 0 | 47,609 |
| 1987 | 0 | 0 | 1,997 | 33,252 | 16,701 | 0 | 0 | 4,531 | 2,003 | 0 | 0 | 0 | 58,484 |
| 1988 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1989 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1990 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1991 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1992 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1993 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1,663 | 7,205 | 8,868 |
| 1994 | 0 | 0 | 0 | 0 | 0 | 5,035 | 2,052 | 3,974 | 0 | 0 | 13,853 | 2,309 | 27,223 |
| 1995 | 0 | 0 | 0 | 0 | 0 | 0 | 9,226 | 11,532 | 22,502 | 1,518 | 0 | 248 | 45,026 |
| Average | 1,209 | 0 | 200 | 3,711 | 2,148 | 504 | 1,128 | 4,411 | 2,732 | 152 | 1,552 | 976 | 18,721 |
| Maximu | 12,086 | 0 | 1,997 | 33,252 | 16,701 | 5,035 | 9,226 | 24,076 | 22,502 | 1,518 | 13,853 | 7,205 | 58,484 |
| Minimum | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

Taken from the Amity Canal Annual Reports

Holbrook Ditch
Direct Flow Diversions
units = acre-feet

| Year | Nov | Dec | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1986 | 423 | 0 | 0 | 0 | 0 | 0 | 2,925 | 25,061 | 13,700 | 4,337 | 1,202 | 4,787 | 52,435 |
| 1987 | 0 | 0 | 0 | 0 | 724 | 7,884 | 7,183 | 18,333 | 4,302 | 3,710 | 269 | 0 | 42,405 |
| 1988 | 0 | 0 | 0 | 0 | 992 | 1,885 | 2,020 | 6,779 | 2,009 | 230 | 0 | 0 | 13,915 |
| 1989 | 0 | 0 | 0 | 0 | 434 | 393 | 1,381 | 5,430 | 6,499 | 4,732 | 0 | 0 | 18,869 |
| 1990 | 0 | 0 | 0 | 0 | 1,328 | 0 | 3,601 | 14,219 | 7,176 | 2,732 | 0 | 0 | 29,056 |
| 1991 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2,038 | 437 | 2,036 | 61 | 12 | 4,584 |
| 1992 | 0 | 0 | 0 | 0 | 0 | 6 | 425 | 8,094 | 586 | 3,700 | 233 | 0 | 13,044 |
| 1993 | 0 | 0 | 0 | 0 | 1,972 | 0 | 13,641 | 21,088 | 6,079 | 290 | 0 | 0 | 43,070 |
| 1994 | 0 | 0 | 0 | 0 | 0 | 1,067 | 26,776 | 12,225 | 111 | 44 | 233 | 525 | 40,981 |
| 1995 | 0 | 0 | 0 | 0 | 0 | 1,552 | 13,070 | 6,622 | 13,917 | 14,247 | 4,884 | 2,593 | 56,885 |
| Average | 42 | 0 | 0 | 0 | 545 | 1,279 | 7,102 | 11,989 | 5,482 | 3,606 | 688 | 792 | 31,524 |
| Maximum | 423 | 0 | 0 | 0 | 1,972 | 7,884 | 26,776 | 25,061 | 13,917 | 14,247 | 4,884 | 4,787 | 56,885 |
| Minimum | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2,038 | 111 | 44 | 0 | 0 | 4,584 |

Holbrook Ditch
SECWCD Project Water Diversions
units = acre-feet

| Year | Nov | Dec | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1986 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1987 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1988 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1,144 | 6,047 | 0 | 0 | 7,191 |
| 1989 | 0 | 0 | 0 | 0 | 0 | 2,757 | 0 | 0 | 1,336 | 4,853 | 0 | 0 | 8,946 |
| 1990 | 0 | 0 | 0 | 0 | 0 | 0 | 548 | 0 | 922 | 472 | 0 | 0 | 1,942 |
| 1991 | 0 | 0 | 0 | 0 | 0 | 0 | 1,251 | 0 | 0 | 0 | 0 | 0 | 1,251 |
| 1992 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 942 | 0 | 0 | 942 |
| 1993 | 0 | 0 | 0 | 0 | 0 | 0 | 678 | 0 | 0 | 0 | 207 | 0 | 885 |
| 1994 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 4,318 | 3,152 | 0 | 0 | 7,470 |
| 1995 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Average | 0 | 0 | 0 | 0 | 0 | 276 | 248 | 0 | 772 | 1,547 | 21 | 0 | 2,863 |
| Maximum | 0 | 0 | 0 | 0 | 0 | 2,757 | 1,251 | 0 | 4,318 | 6,047 | 207 | 0 | 8,946 |
| Minimum | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

Holbrook Ditch
Winter Water Storage Diversions
units = acre-feet

| Year | Nov | Dec | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1986 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1987 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1988 | 0 | 0 | 0 | 0 | 0 | 0 | 2,104 | 0 | 0 | 0 | 0 | 0 | 2,104 |
| 1989 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3,688 | 0 | 0 | 0 | 3,688 |
| 1990 | 0 | 0 | 0 | 0 | 0 | 504 | 1,125 | 0 | 0 | 0 | 0 | 0 | 1,629 |
| 1991 | 0 | 0 | 0 | 0 | 0 | 965 | 3,892 | 0 | 0 | 0 | 0 | 0 | 4,857 |
| 1992 | 0 | 0 | 0 | 0 | 0 | 2,521 | 2,645 | 0 | 1,643 | 1,891 | 0 | 0 | 8,700 |
| 1993 | 0 | 0 | 0 | 0 | 0 | 0 | 2,709 | 0 | 0 | 2,063 | 2,242 | 0 | 7,014 |
| 1994 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2,839 | 2,383 | 0 | 5,222 |
| 1995 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Average | 0 | 0 | 0 | 0 | 0 | 399 | 1,248 | 0 | 533 | 679 | 463 | 0 | 3,321 |
| Maximum | 0 | 0 | 0 | 0 | 0 | 2,521 | 3,892 | 0 | 3,688 | 2,839 | 2,383 | 0 | 8,700 |
| Minimum | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

Holbrook Ditch
Storage Water
units = acre-feet

| Year | Nov | Dec | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1986 | 0 | 0 | 0 | 0 | 0 | 0 | 1,903 | 0 | 0 | 0 | 0 | 2,187 | 4,090 |
| 1987 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3,295 | 4,515 | 1,866 | 712 | 10,388 |
| 1988 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1989 | 590 | 1,129 | 72 | 0 | 6,384 | 3,612 | 2,482 | 0 | 2,964 | 890 | 0 | 0 | 18,123 |
| 1990 | 0 | 0 | 0 | 0 | 0 | 0 | 2,390 | 0 | 897 | 2,822 | 457 | 0 | 6,566 |
| 1991 | 0 | 0 | 0 | 0 | 0 | 72 | 2,741 | 1,989 | 1,591 | 60 | 0 | 0 | 6,453 |
| 1992 | 0 | 0 | 0 | 0 | 0 | 1,623 | 920 | 808 | 2,697 | 1,241 | 358 | 0 | 7,647 |
| 1993 | 0 | 0 | 0 | 0 | 0 | 0 | 3,207 | 377 | 2,076 | 4,449 | 0 | 0 | 10,109 |
| 1994 | 0 | 0 | 0 | 0 | 0 | 2,049 | 0 | 825 | 5,333 | 215 | 0 | 0 | 8,422 |
| 1995 | 0 | 0 | 0 | 0 | 0 | 538 | 1,065 | 0 | 0 | 1,233 | 0 | 1,951 | 4,787 |
| Average | 59 | 113 | 7 | 0 | 638 | 789 | 1,471 | 400 | 1,885 | 1,543 | 268 | 485 | 7,659 |
| Maximum | 590 | 1,129 | 72 | 0 | 6,384 | 3,612 | 3,207 | 1,989 | 5,333 | 4,515 | 1,866 | 2,187 | 18,123 |
| Minimum | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

Holbrook Ditch
Other Transmountain Diversions
units = acre-feet

| Year | Nov | Dec | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1986 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1987 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1988 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1989 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1990 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1991 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1992 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1993 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1994 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1995 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Average | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Maximum | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Minimum | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

Holbrook Ditch
Total Diversions
units = acre-feet

| Year | Nov | Dec | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1986 | 423 | 0 | 0 | 0 | 0 | 0 | 4,828 | 25,061 | 13,700 | 4,337 | 1,202 | 6,974 | 56,525 |
| 1987 | 0 | 0 | 0 | 0 | 724 | 7,884 | 7,183 | 18,333 | 7,597 | 8,225 | 2,135 | 712 | 52,793 |
| 1988 | 0 | 0 | 0 | 0 | 992 | 1,885 | 4,124 | 6,779 | 3,153 | 6,277 | 0 | 0 | 23,210 |
| 1989 | 590 | 1,129 | 72 | 0 | 6,818 | 6,762 | 3,863 | 5,430 | 14,487 | 10,475 | 0 | 0 | 49,626 |
| 1990 | 0 | 0 | 0 | 0 | 1,328 | 504 | 7,664 | 14,219 | 8,995 | 6,026 | 457 | 0 | 39,193 |
| 1991 | 0 | 0 | 0 | 0 | 0 | 1,037 | 7,884 | 4,027 | 2,028 | 2,096 | 61 | 12 | 17,145 |
| 1992 | 0 | 0 | 0 | 0 | 0 | 4,150 | 3,990 | 8,902 | 4,926 | 7,774 | 591 | 0 | 30,333 |
| 1993 | 0 | 0 | 0 | 0 | 1,972 | 0 | 20,235 | 21,465 | 8,155 | 6,802 | 2,449 | 0 | 61,078 |
| 1994 | 0 | 0 | 0 | 0 | 0 | 3,116 | 26,776 | 13,050 | 9,762 | 6,250 | 2,616 | 525 | 62,095 |
| 1995 | 0 | 0 | 0 | 0 | 0 | 2,090 | 14,135 | 6,622 | 13,917 | 15,480 | 4,884 | 4,544 | 61,672 |
| Average | 101 | 113 | 7 | 0 | 1,183 | 2,743 | 10,068 | 12,389 | 8,672 | 7,374 | 1,440 | 1,277 | 45,367 |
| Maximum | 590 | 1,129 | 72 | 0 | 6,818 | 7,884 | 26,776 | 25,061 | 14,487 | 15,480 | 4,884 | 6,974 | 62,095 |
| Minimum | 0 | 0 | 0 | 0 | 0 | 0 | 3,863 | 4,027 | 2,028 | 2,096 | 0 | 0 | 17,145 |

Highline Canal
Direct Flow Diversions
units = acre-feet

| Year | Nov | Dec | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1986 | 3,392 | 0 | 0 | 861 | 5,475 | 5,809 | 8,211 | 24,438 | 25,523 | 14,087 | 9,412 | 7,582 | 104,790 |
| 1987 | 3,410 | 0 | 0 | 3,657 | 5,818 | 15,083 | 14,207 | 31,128 | 18,833 | 10,921 | 7,496 | 7,506 | 118,059 |
| 1988 | 4,219 | 0 | 0 | 0 | 2,987 | 6,274 | 7,104 | 16,785 | 7,113 | 6,779 | 5,535 | 6,886 | 63,682 |
| 1989 | 2,518 | 0 | 0 | 0 | 3,336 | 7,546 | 8,019 | 12,366 | 8,200 | 6,970 | 5,306 | 5,657 | 59,918 |
| 1990 | 3,350 | 0 | 0 | 0 | 3,587 | 5,987 | 8,469 | 13,374 | 10,582 | 8,099 | 6,107 | 7,560 | 67,115 |
| 1991 | 3,034 | 0 | 0 | 0 | 3,552 | 6,099 | 7,306 | 15,850 | 9,895 | 11,333 | 6,719 | 5,828 | 69,616 |
| 1992 | 3,236 | 0 | 0 | 0 | 3,213 | 7,274 | 7,068 | 9,834 | 7,428 | 9,131 | 6,617 | 6,624 | 60,425 |
| 1993 | 3,286 | 0 | 0 | 0 | 2,466 | 7,162 | 14,978 | 20,490 | 13,889 | 7,156 | 7,173 | 6,496 | 83,096 |
| 1994 | 3,233 | 0 | 0 | 0 | 3,070 | 7,384 | 17,061 | 19,375 | 7,082 | 5,979 | 6,316 | 7,885 | 77,385 |
| 1995 | 3,410 | 0 | 0 | 0 | 2,915 | 8,470 | 16,564 | 15,555 | 25,607 | 19,501 | 10,306 | 7,351 | 109,679 |
| Average | 3,309 | 0 | 0 | 452 | 3,642 | 7,709 | 10,899 | 17,920 | 13,415 | 9,996 | 7,099 | 6,938 | 81,377 |
| Maximum | 4,219 | 0 | 0 | 3,657 | 5,818 | 15,083 | 17,061 | 31,128 | 25,607 | 19,501 | 10,306 | 7,885 | 118,059 |
| Minimum | 2,518 | 0 | 0 | 0 | 2,466 | 5,809 | 7,068 | 9,834 | 7,082 | 5,979 | 5,306 | 5,657 | 59,918 |

Highline Canal
SECWCD Project Water Diversions
units = acre-feet

| Year | Nov | Dec | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1986 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1,069 | 0 | 0 | 1,069 |
| 1987 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1,211 | 2,230 | 755 | 0 | 4,196 |
| 1988 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1,426 | 6,039 | 580 | 0 | 8,045 |
| 1989 | 0 | 0 | 0 | 0 | 142 | 0 | 0 | 0 | 2,507 | 4,100 | 591 | 0 | 7,340 |
| 1990 | 0 | 0 | 0 | 0 | 0 | 1,206 | 190 | 1,190 | 2,687 | 0 | 0 | 0 | 5,273 |
| 1991 | 0 | 0 | 0 | 0 | 0 | 521 | 2,646 | 94 | 0 | 0 | 0 | 0 | 3,261 |
| 1992 | 0 | 0 | 0 | 0 | 0 | 1,253 | 3,432 | 455 | 0 | 0 | 0 | 0 | 5,140 |
| 1993 | 0 | 0 | 0 | 0 | 0 | 0 | 2,597 | 0 | 0 | 0 | 0 | 0 | 2,597 |
| 1994 | 0 | 0 | 0 | 0 | 540 | 2,851 | 992 | 348 | 0 | 0 | 0 | 0 | 4,731 |
| 1995 | 0 | 0 | 0 | 0 | 0 | 1,785 | 99 | 0 | 0 | 2,269 | 225 | 0 | 4,378 |
| Average | 0 | 0 | 0 | 0 | 68 | 762 | 996 | 209 | 783 | 1,571 | 215 | 0 | 4,603 |
| Maximum | 0 | 0 | 0 | 0 | 540 | 2,851 | 3,432 | 1,190 | 2,687 | 6,039 | 755 | 0 | 8,045 |
| Minimum | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1,069 |

Highline Canal
Winter Water Storage Diversions
units = acre-feet

| Year | Nov | Dec | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1986 | 0 | 0 | 0 | 0 | 2,656 | 5,646 | 526 | 0 | 0 | 0 | 0 | 0 | 8,828 |
| 1987 | 0 | 0 | 0 | 0 | 0 | 2,969 | 0 | 0 | 0 | 0 | 0 | 0 | 2,969 |
| 1988 | 0 | 0 | 0 | 0 | 1,264 | 2,163 | 3,613 | 589 | 5,434 | 0 | 0 | 0 | 13,063 |
| 1989 | 0 | 0 | 0 | 0 | 746 | 6,913 | 905 | 0 | 999 | 0 | 0 | 0 | 9,563 |
| 1990 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1,047 | 1,846 | 1,476 | 0 | 4,369 |
| 1991 | 0 | 0 | 0 | 0 | 2,026 | 2,487 | 0 | 1,703 | 3,756 | 2,147 | 0 | 0 | 12,119 |
| 1992 | 0 | 0 | 0 | 0 | 900 | 1,633 | 0 | 624 | 3,310 | 2,891 | 0 | 0 | 9,358 |
| 1993 | 0 | 0 | 0 | 0 | 0 | 3,974 | 411 | 555 | 4,232 | 5,460 | 674 | 0 | 15,306 |
| 1994 | 0 | 0 | 0 | 0 | 305 | 0 | 0 | 0 | 3,512 | 4,381 | 0 | 0 | 8,198 |
| 1995 | 0 | 0 | 0 | 0 | 2,192 | 694 | 0 | 0 | 0 | 0 | 0 | 0 | 2,886 |
| Average | 0 | 0 | 0 | 0 | 1,009 | 2,648 | 546 | 347 | 2,229 | 1,673 | 215 | 0 | 8,666 |
| Maximum | 0 | 0 | 0 | 0 | 2,656 | 6,913 | 3,613 | 1,703 | 5,434 | 5,460 | 1,476 | 0 | 15,306 |
| Minimum | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2,886 |

Highline Canal
Storage Water
units = acre-feet

| Year | Nov | Dec | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1986 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1987 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1988 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1989 | 101 | 0 | 0 | 0 | 1,275 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1,376 |
| 1990 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 136 | 0 | 0 | 136 |
| 1991 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1992 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1993 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1994 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1995 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Average | 10 | 0 | 0 | 0 | 128 | 0 | 0 | 0 | 0 | 14 | 0 | 0 | 151 |
| Maximum | 101 | 0 | 0 | 0 | 1,275 | 0 | 0 | 0 | 0 | 136 | 0 | 0 | 1,376 |
| Minimum | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

Includes Turquoise Reservoir, Twin Lakes, & Pueblo Reservoir

Oxford Canal
Direct Flow Diversions
units = acre-feet

| Year | Nov | Dec | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1986 | 634 | 0 | 0 | 152 | 2,713 | 828 | 3,468 | 5,371 | 8,052 | 5,659 | 3,117 | 3,081 | 33,075 |
| 1987 | 1,395 | 0 | 0 | 0 | 1,653 | 3,305 | 4,850 | 6,067 | 6,971 | 4,978 | 3,781 | 2,490 | 35,490 |
| 1988 | 880 | 0 | 0 | 0 | 1,102 | 2,662 | 3,677 | 6,751 | 4,305 | 2,531 | 1,296 | 1,024 | 24,228 |
| 1989 | 1,335 | 0 | 0 | 0 | 3,459 | 1,429 | 3,893 | 5,656 | 2,178 | 3,043 | 863 | 943 | 22,799 |
| 1990 | 1,609 | 0 | 0 | 0 | 640 | 1,956 | 2,259 | 6,881 | 4,066 | 3,752 | 1,142 | 2,131 | 24,436 |
| 1991 | 338 | 0 | 0 | 0 | 1,559 | 810 | 2,719 | 7,063 | 2,566 | 4,584 | 971 | 895 | 21,505 |
| 1992 | 149 | 0 | 0 | 0 | 1,089 | 4,165 | 2,955 | 4,499 | 4,857 | 2,321 | 1,773 | 1,035 | 22,843 |
| 1993 | 1,109 | 0 | 0 | 0 | 1,073 | 5,062 | 4,712 | 5,515 | 7,103 | 2,117 | 850 | 1,333 | 28,874 |
| 1994 | 456 | 0 | 0 | 0 | 1,636 | 3,459 | 4,728 | 5,993 | 1,260 | 1,089 | 1,787 | 2,076 | 22,484 |
| 1995 | 729 | 0 | 0 | 0 | 1,099 | 3,862 | 4,061 | 3,300 | 5,650 | 6,021 | 4,142 | 2,465 | 31,329 |
| Average | 863 | 0 | 0 | 15 | 1,602 | 2,754 | 3,732 | 5,710 | 4,701 | 3,610 | 1,972 | 1,747 | 26,706 |
| Maximum | 1,609 | 0 | 0 | 152 | 3,459 | 5,062 | 4,850 | 7,063 | 8,052 | 6,021 | 4,142 | 3,081 | 35,490 |
| Minimum | 149 | 0 | 0 | 0 | 640 | 810 | 2,259 | 3,300 | 1,260 | 1,089 | 850 | 895 | 21,505 |

Oxford Canal
SECWCD Project Water Diversions
units = acre-feet

| Year | Nov | Dec | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1986 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1987 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 448 | 0 | 0 | 448 |
| 1988 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 200 | 1,390 | 164 | 0 | 1,754 |
| 1989 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 543 | 298 | 307 | 1,148 |
| 1990 | 0 | 0 | 0 | 0 | 0 | 138 | 151 | 0 | 891 | 548 | 0 | 0 | 1,728 |
| 1991 | 0 | 0 | 0 | 0 | 0 | 510 | 289 | 0 | 0 | 0 | 0 | 0 | 799 |
| 1992 | 0 | 0 | 0 | 0 | 0 | 1 | 757 | 0 | 422 | 0 | 0 | 0 | 1,180 |
| 1993 | 0 | 0 | 0 | 0 | 0 | 0 | 588 | 0 | 0 | 93 | 0 | 0 | 681 |
| 1994 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 908 | 40 | 237 | 32 | 1,217 |
| 1995 | 0 | 0 | 0 | 0 | 30 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 30 |
| Average | 0 | 0 | 0 | 0 | 3 | 65 | 179 | 0 | 242 | 306 | 70 | 34 | 899 |
| Maximum | 0 | 0 | 0 | 0 | 30 | 510 | 757 | 0 | 908 | 1,390 | 298 | 307 | 1,754 |
| Minimum | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

Oxford Canal
Winter Water Storage Diversions
units = acre-feet

| Year | Nov | Dec | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1986 | 0 | 0 | 0 | 0 | 53 | 1,905 | 87 | 0 | 0 | 0 | 0 | 0 | 2,045 |
| 1987 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1988 | 0 | 0 | 0 | 0 | 0 | 0 | 793 | 0 | 81 | 0 | 133 | 171 | 1,178 |
| 1989 | 0 | 0 | 0 | 0 | 97 | 1,483 | 582 | 69 | 1,693 | 217 | 0 | 0 | 4,141 |
| 1990 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 38 | 584 | 31 | 653 |
| 1991 | 0 | 0 | 0 | 0 | 225 | 1,162 | 158 | 0 | 1,379 | 103 | 180 | 0 | 3,207 |
| 1992 | 0 | 0 | 0 | 0 | 0 | 337 | 0 | 0 | 46 | 912 | 0 | 0 | 1,295 |
| 1993 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 93 | 0 | 1,785 | 164 | 0 | 2,042 |
| 1994 | 0 | 0 | 0 | 0 | 57 | 663 | 0 | 0 | 972 | 1,674 | 0 | 0 | 3,366 |
| 1995 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Average | 0 | 0 | 0 | 0 | 43 | 555 | 162 | 16 | 417 | 473 | 106 | 20 | 1,793 |
| Maximum | 0 | 0 | 0 | 0 | 225 | 1,905 | 793 | 93 | 1,693 | 1,785 | 584 | 171 | 4,141 |
| Minimum | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

Oxford Canal
Storage Water
units = acre-feet

| Year | Nov | Dec | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1986 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1987 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1988 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1989 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1990 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1991 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1992 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1993 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1994 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1995 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Average | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Maximum | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Minimum | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

Oxford Canal
Other Transmountain Diversions
units = acre-feet

| Year | Nov | Dec | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1986 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1987 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1988 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1989 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1990 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1991 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1992 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1993 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1994 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1995 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Average | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Maximum | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Minimum | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

Oxford Canal
Total Diversions
units = acre-feet

| Year | Nov | Dec | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1986 | 634 | 0 | 0 | 152 | 2,766 | 2,733 | 3,555 | 5,371 | 8,052 | 5,659 | 3,117 | 3,081 | 35,120 |
| 1987 | 1,395 | 0 | 0 | 0 | 1,653 | 3,305 | 4,850 | 6,067 | 6,971 | 5,426 | 3,781 | 2,490 | 35,938 |
| 1988 | 880 | 0 | 0 | 0 | 1,102 | 2,662 | 4,470 | 6,751 | 4,586 | 3,921 | 1,593 | 1,195 | 27,160 |
| 1989 | 1,335 | 0 | 0 | 0 | 3,556 | 2,912 | 4,475 | 5,725 | 3,871 | 3,803 | 1,161 | 1,250 | 28,088 |
| 1990 | 1,609 | 0 | 0 | 0 | 640 | 2,094 | 2,410 | 6,881 | 4,957 | 4,338 | 1,726 | 2,162 | 26,817 |
| 1991 | 338 | 0 | 0 | 0 | 1,784 | 2,482 | 3,166 | 7,063 | 3,945 | 4,687 | 1,151 | 895 | 25,511 |
| 1992 | 149 | 0 | 0 | 0 | 1,089 | 4,503 | 3,712 | 4,499 | 5,325 | 3,233 | 1,773 | 1,035 | 25,318 |
| 1993 | 1,109 | 0 | 0 | 0 | 1,073 | 5,062 | 5,300 | 5,608 | 7,103 | 3,995 | 1,014 | 1,333 | 31,597 |
| 1994 | 456 | 0 | 0 | 0 | 1,693 | 4,122 | 4,728 | 5,993 | 3,140 | 2,803 | 2,024 | 2,108 | 27,067 |
| 1995 | 729 | 0 | 0 | 0 | 1,129 | 3,862 | 4,061 | 3,300 | 5,650 | 6,021 | 4,142 | 2,465 | 31,359 |
| Average | 863 | 0 | 0 | 15 | 1,649 | 3,374 | 4,073 | 5,726 | 5,360 | 4,389 | 2,148 | 1,801 | 29,398 |
| Maximum | 1,609 | 0 | 0 | 152 | 3,556 | 5,062 | 5,300 | 7,063 | 8,052 | 6,021 | 4,142 | 3,081 | 35,938 |
| Minimum | 149 | 0 | 0 | 0 | 640 | 2,094 | 2,410 | 3,300 | 3,140 | 2,803 | 1,014 | 895 | 25,318 |

Rocky Ford Canal
Direct Flow Diversions
units = acre-feet

| Year | Nov | Dec | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1986 | 1,331 | 0 | 0 | 1,490 | 5,515 | 6,704 | 6,403 | 4,838 | 5,879 | 5,536 | 4,020 | 4,034 | 45,750 |
| 1987 | 1,326 | 0 | 0 | 1,604 | 3,400 | 5,200 | 3,890 | 5,534 | 6,618 | 5,950 | 3,387 | 3,268 | 40,177 |
| 1988 | 2,504 | 1,055 | 0 | 0 | 1,320 | 2,925 | 5,405 | 6,698 | 6,195 | 5,940 | 3,684 | 1,977 | 37,703 |
| 1989 | 1,037 | 0 | 0 | 0 | 2,953 | 6,428 | 5,218 | 5,289 | 6,637 | 6,605 | 2,831 | 2,258 | 39,256 |
| 1990 | 1,007 | 0 | 0 | 0 | 924 | 2,771 | 2,816 | 4,852 | 5,350 | 4,994 | 4,368 | 1,580 | 28,662 |
| 1991 | 79 | 0 | 0 | 416 | 2,770 | 4,702 | 5,137 | 5,023 | 4,969 | 4,943 | 3,987 | 2,579 | 34,605 |
| 1992 | 0 | 0 | 0 | 81 | 1,746 | 2,609 | 3,874 | 3,109 | 4,169 | 3,751 | 2,257 | 2,195 | 23,791 |
| 1993 | 160 | 0 | 0 | 0 | 1,639 | 4,909 | 5,439 | 6,215 | 6,435 | 6,711 | 4,235 | 4,248 | 39,991 |
| 1994 | 660 | 0 | 0 | 511 | 3,086 | 4,424 | 5,041 | 6,268 | 6,151 | 6,010 | 4,085 | 4,583 | 40,819 |
| 1995 | 523 | 0 | 0 | 0 | 3,304 | 4,739 | 4,444 | 4,790 | 6,699 | 6,868 | 4,888 | 4,219 | 40,474 |
| Average | 863 | 106 | 0 | 410 | 2,666 | 4,541 | 4,767 | 5,262 | 5,910 | 5,731 | 3,774 | 3,094 | 37,123 |
| Maximum | 2,504 | 1,055 | 0 | 1,604 | 5,515 | 6,704 | 6,403 | 6,698 | 6,699 | 6,868 | 4,888 | 4,583 | 45,750 |
| Minimum | 0 | 0 | 0 | 0 | 924 | 2,609 | 2,816 | 3,109 | 4,169 | 3,751 | 2,257 | 1,580 | 23,791 |

Rocky Ford Canal
SECWCD Project Water Diversions
units = acre-feet

| Year | Nov | Dec | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1986 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1987 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1988 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1989 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1990 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1991 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1992 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1993 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1994 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1995 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Average | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Maximum | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Minimum | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

Rocky Ford Canal
Winter Water Storage Diversions
units = acre-feet

| Year | Nov | Dec | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1986 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1987 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1988 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1989 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1990 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1991 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1992 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1993 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1994 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1995 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Average | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Maximum | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Minimum | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

Rocky Ford Canal
Storage Water
units = acre-feet

| Year | Nov | Dec | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1986 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1987 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1988 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1989 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1990 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 141 | 0 | 0 | 0 | 141 |
| 1991 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 118 | 259 | 0 | 0 | 0 | 377 |
| 1992 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 198 | 0 | 0 | 0 | 198 |
| 1993 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1994 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1995 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Average | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 12 | 60 | 0 | 0 | 0 | 72 |
| Maximum | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 118 | 259 | 0 | 0 | 0 | 377 |
| Minimum | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

*Includes storage from Pueblo Reservoir and Clear Creek Reservoir

Rocky Ford Canal
Other Transmountain Diversions
units = acre-feet

| Year | Nov | Dec | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1986 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1987 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1988 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1989 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1990 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1991 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1992 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1993 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1994 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1995 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Average | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Maximum | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Minimum | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

Rocky Ford Canal
Total Diversions
units = acre-feet

| Year | Nov | Dec | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1986 | 1,331 | 0 | 0 | 1,490 | 5,515 | 6,704 | 6,403 | 4,838 | 5,879 | 5,536 | 4,020 | 4,034 | 45,750 |
| 1987 | 1,326 | 0 | 0 | 1,604 | 3,400 | 5,200 | 3,890 | 5,534 | 6,618 | 5,950 | 3,387 | 3,268 | 40,177 |
| 1988 | 2,504 | 1,055 | 0 | 0 | 1,320 | 2,925 | 5,405 | 6,698 | 6,195 | 5,940 | 3,684 | 1,977 | 37,703 |
| 1989 | 1,037 | 0 | 0 | 0 | 2,953 | 6,428 | 5,218 | 5,289 | 6,637 | 6,605 | 2,831 | 2,258 | 39,256 |
| 1990 | 1,007 | 0 | 0 | 0 | 924 | 2,771 | 2,816 | 4,852 | 5,491 | 4,994 | 4,368 | 1,580 | 28,803 |
| 1991 | 79 | 0 | 0 | 416 | 2,770 | 4,702 | 5,137 | 5,141 | 5,228 | 4,943 | 3,987 | 2,579 | 34,982 |
| 1992 | 0 | 0 | 0 | 81 | 1,746 | 2,609 | 3,874 | 3,109 | 4,367 | 3,751 | 2,257 | 2,195 | 23,989 |
| 1993 | 160 | 0 | 0 | 0 | 1,639 | 4,909 | 5,439 | 6,215 | 6,435 | 6,711 | 4,235 | 4,248 | 39,991 |
| 1994 | 660 | 0 | 0 | 511 | 3,086 | 4,424 | 5,041 | 6,268 | 6,151 | 6,010 | 4,085 | 4,583 | 40,819 |
| 1995 | 523 | 0 | 0 | 0 | 3,304 | 4,739 | 4,444 | 4,790 | 6,699 | 6,868 | 4,888 | 4,219 | 40,474 |
| Average | 863 | 106 | 0 | 410 | 2,666 | 4,541 | 4,767 | 5,273 | 5,970 | 5,731 | 3,774 | 3,094 | 37,194 |
| Maximum | 2,504 | 1,055 | 0 | 1,604 | 5,515 | 6,704 | 6,403 | 6,698 | 6,699 | 6,868 | 4,888 | 4,583 | 45,750 |
| Minimum | 0 | 0 | 0 | 0 | 924 | 2,609 | 2,816 | 3,109 | 4,367 | 3,751 | 2,257 | 1,580 | 23,989 |

Keesee Ditch
Direct Flow Diversions
units = acre-feet

| Year | Nov | Dec | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1986 | 0 | 0 | 0 | 0 | 232 | 1,199 | 1,295 | 681 | 1,432 | 949 | 390 | 419 | 6,597 |
| 1987 | 0 | 0 | 0 | 0 | 0 | 131 | 764 | 779 | 1,287 | 1,282 | 771 | 584 | 5,598 |
| 1988 | 400 | 0 | 0 | 0 | 0 | 746 | 942 | 1,089 | 1,152 | 1,260 | 1,057 | 163 | 6,809 |
| 1989 | 149 | 0 | 0 | 0 | 0 | 797 | 629 | 595 | 1,071 | 843 | 300 | 742 | 5,126 |
| 1990 | 66 | 0 | 0 | 0 | 0 | 290 | 881 | 841 | 992 | 1,061 | 1,012 | 248 | 5,391 |
| 1991 | 0 | 0 | 0 | 0 | 256 | 843 | 871 | 930 | 948 | 871 | 841 | 883 | 6,443 |
| 1992 | 0 | 0 | 0 | 0 | 56 | 803 | 845 | 897 | 833 | 893 | 905 | 807 | 6,039 |
| 1993 | 345 | 0 | 0 | 0 | 0 | 595 | 897 | 940 | 924 | 1,081 | 883 | 607 | 6,272 |
| 1994 | 0 | 0 | 0 | 0 | 458 | 508 | 996 | 926 | 928 | 869 | 851 | 899 | 6,435 |
| 1995 | 403 | 0 | 0 | 0 | 202 | 803 | 780 | 637 | 1,045 | 1,162 | 1,186 | 901 | 7,119 |
| Average | 136 | 0 | 0 | 0 | 120 | 672 | 890 | 832 | 1,061 | 1,027 | 820 | 625 | 6,183 |
| Maximum | 403 | 0 | 0 | 0 | 458 | 1,199 | 1,295 | 1,089 | 1,432 | 1,282 | 1,186 | 901 | 7,119 |
| Minimum | 0 | 0 | 0 | 0 | 0 | 131 | 629 | 595 | 833 | 843 | 300 | 163 | 5,126 |

Keesee Ditch
SECWCD Project Water Diversions
units = acre-feet

| Year | Nov | Dec | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1986 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1987 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1988 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1989 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1990 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1991 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1992 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1993 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1994 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1995 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Average | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Maximum | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Minimum | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

Keesee Ditch
Winter Water Storage Diversions
units = acre-feet

| Year | Nov | Dec | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1986 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1987 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1988 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1989 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1990 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1991 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1992 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1993 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1994 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1995 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Average | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Maximum | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Minimum | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

Keesee Ditch
Storage Water
units = acre-feet

| Year | Nov | Dec | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1986 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1987 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1988 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1989 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1990 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1991 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1992 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1993 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1994 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1995 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Average | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Maximum | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Minimum | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

Keesee Ditch
Other Transmountain Diversions
units = acre-feet

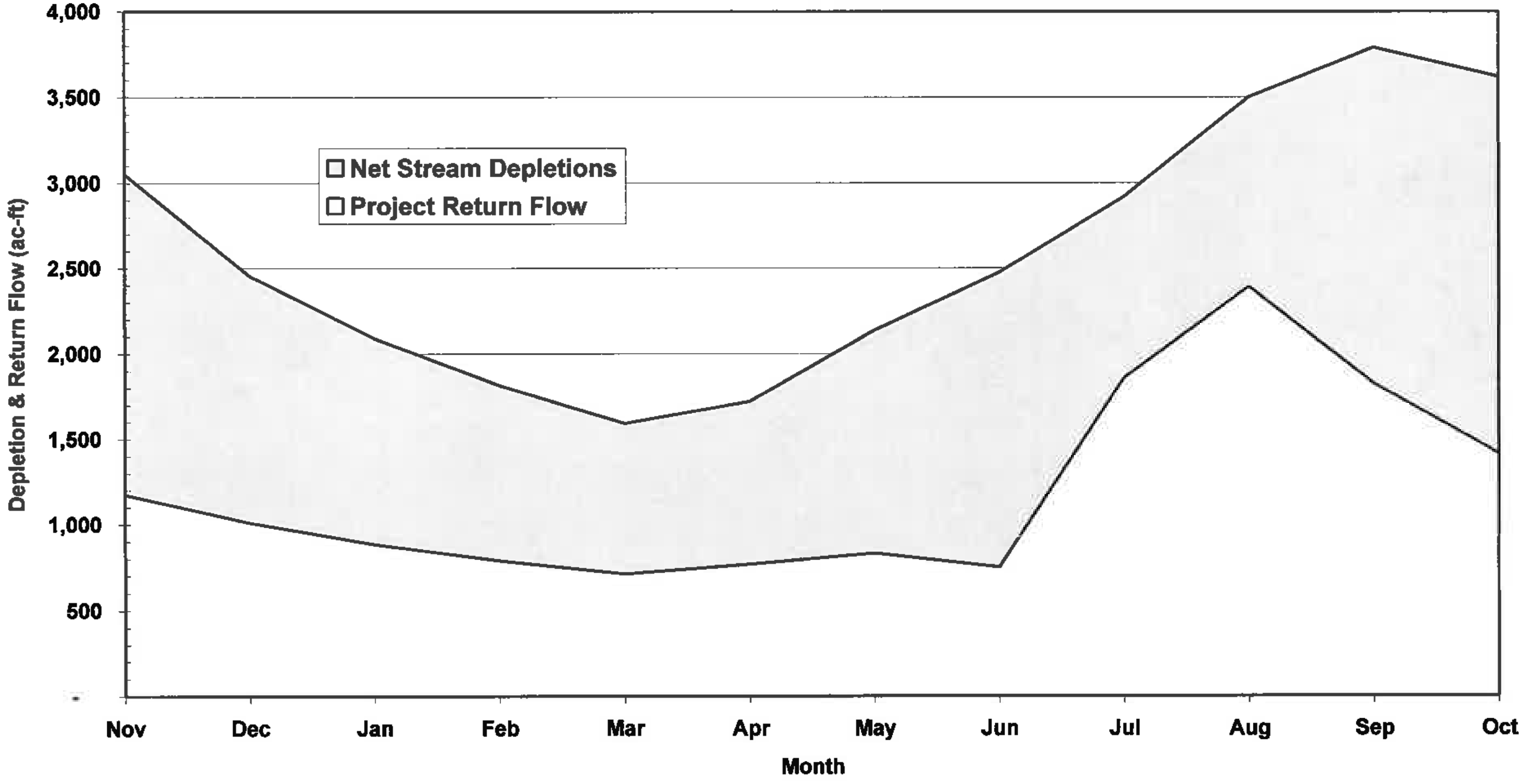
| Year | Nov | Dec | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1986 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1987 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1988 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1989 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1990 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1991 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1992 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1993 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1994 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1995 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Average | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Maximum | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Minimum | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

Keesee Ditch
Total Diversions
units = acre-feet

| Year | Nov | Dec | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1986 | 0 | 0 | 0 | 0 | 232 | 1,199 | 1,295 | 681 | 1,432 | 949 | 390 | 419 | 6,597 |
| 1987 | 0 | 0 | 0 | 0 | 0 | 131 | 764 | 779 | 1,287 | 1,282 | 771 | 584 | 5,598 |
| 1988 | 400 | 0 | 0 | 0 | 0 | 746 | 942 | 1,089 | 1,152 | 1,260 | 1,057 | 163 | 6,809 |
| 1989 | 149 | 0 | 0 | 0 | 0 | 797 | 629 | 595 | 1,071 | 843 | 300 | 742 | 5,126 |
| 1990 | 66 | 0 | 0 | 0 | 0 | 290 | 881 | 841 | 992 | 1,061 | 1,012 | 248 | 5,391 |
| 1991 | 0 | 0 | 0 | 0 | 256 | 843 | 871 | 930 | 948 | 871 | 841 | 883 | 6,443 |
| 1992 | 0 | 0 | 0 | 0 | 56 | 803 | 845 | 897 | 833 | 893 | 905 | 807 | 6,039 |
| 1993 | 345 | 0 | 0 | 0 | 0 | 595 | 897 | 940 | 924 | 1,081 | 883 | 607 | 6,272 |
| 1994 | 0 | 0 | 0 | 0 | 458 | 508 | 996 | 926 | 928 | 869 | 851 | 899 | 6,435 |
| 1995 | 403 | 0 | 0 | 0 | 202 | 803 | 780 | 637 | 1,045 | 1,162 | 1,186 | 901 | 7,119 |
| Average | 136 | 0 | 0 | 0 | 120 | 672 | 890 | 832 | 1,061 | 1,027 | 820 | 625 | 6,183 |
| Maximum | 403 | 0 | 0 | 0 | 458 | 1,199 | 1,295 | 1,089 | 1,432 | 1,282 | 1,186 | 901 | 7,119 |
| Minimum | 0 | 0 | 0 | 0 | 0 | 131 | 629 | 595 | 833 | 843 | 300 | 163 | 5,126 |

# MONTHLY DEPLETIONS BY IRRIGATION WELLS

## Average Monthly Depletions Caused by Irrigation Wells and Project Water Return Flow Within the SECWCD and Downstream of Pueblo Reservoir (1986-95)

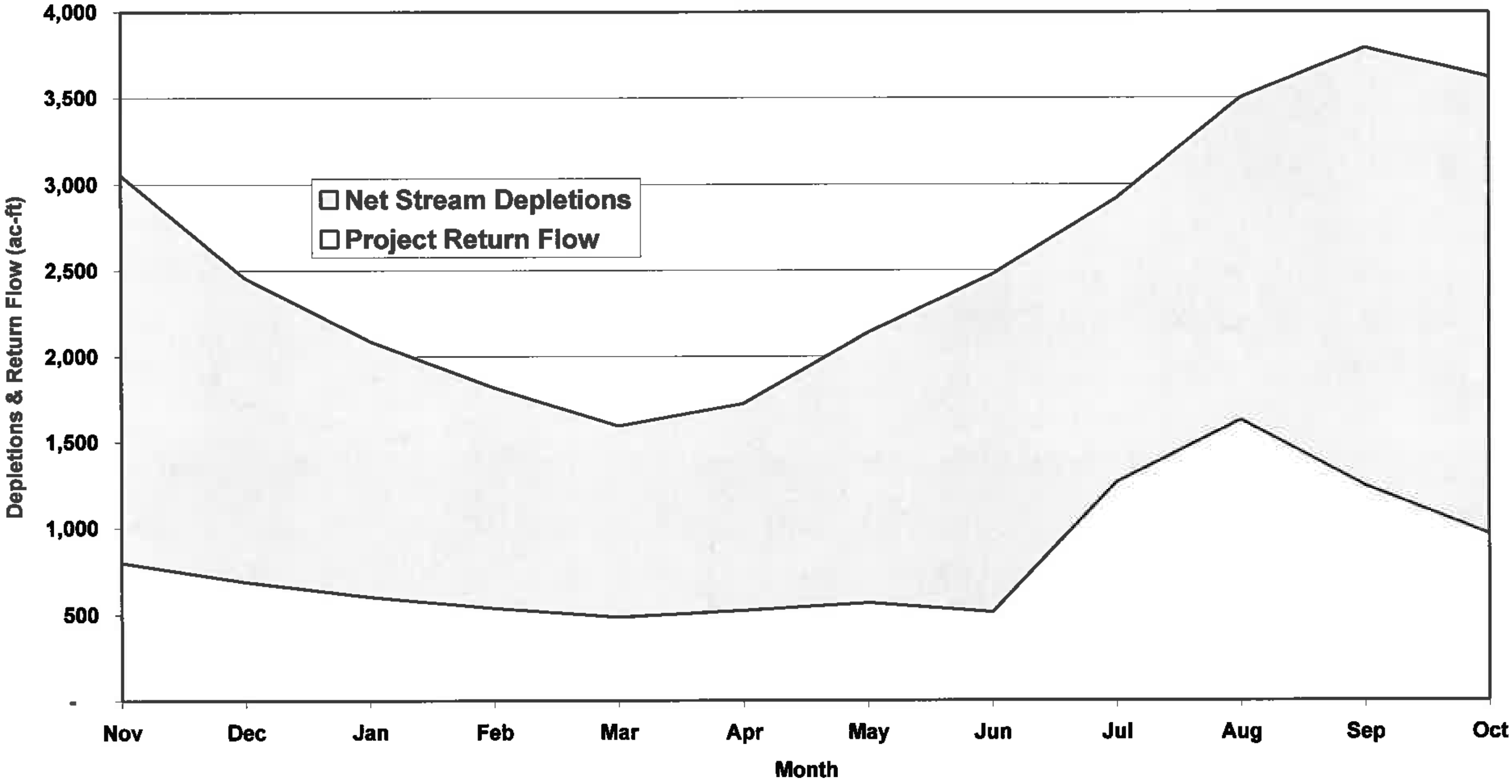


Note: Annual depletions caused by wells averaged 31,154 acre-feet. Project water return flows averaged 14,400 acre-feet annually based on an allocation to irrigation of 40,000 acre-feet, distributed to the ditches based on reported acreage and historical pattern of use, and return flows equivalent to 40 percent of the delivery.

**POTENTIAL SHORTFALL TO**
**OFFSET WELL DEPLETIONS**
**(FULL FRY-ARK ALLOCATION)**

Divsum1/Historical Stream Effect Chart

**Average Monthly Depletions Caused by Irrigation Wells and Project Water Return Flows Within the SECWCD and Downstream of Pueblo Reservoir (1986-95)**



Note: Annual depletions caused by wells averaged 31,154 acre-feet. Project water return flows averaged 9,790 acre-feet annually based on an allocation to irrigation of 49 percent of the historical allocation, distributed to the ditches based on reported acreage and historical pattern of use, transit loss of 10 percent and return flows equivalent to 40 percent of the delivery.

## POTENTIAL SHORTFALL TO OFFSET WELL DEPLETIONS

### (HISTORIC FRY-ARK ALLOCATION)

Divsum1/1986-95 Stream Effect Chart

| User Group | User Group # | 1997 Avg Dep Factor |
|---|---|---|
| Bessemer | 1 | 0.41 |
| Booth Orchard | 2 | 0.61 |
| Excelsior | 3 | 0.67 |
| Collier | 4 | 0.30 |
| Colorado | 5 | 0.44 |
| Highline | 6 | 0.32 |
| Oxford | 7 | 0.32 |
| Otero | 8 | 0.33 |
| Catlin | 9 | 0.43 |
| Fort Lyon Upstream | 10 | 0.33 |
| Rocky Ford | 11 | 0.35 |
| Holbrook | 12 | 0.35 |
| LACC | 13 | 0.33 |
| Baldwin-Stubbs | 14 | 0.50 |
| Keesee | 16 | 0.30 |
| Fort Lyon Downstream | 20 | 0.45 |

|  |  | Total Estimated Pumping |  |
|---|---|---|---|
| Fort Lyon Upstream | 10 | 12,320.51 | 0.53 |
| Fort Lyon Downstream | 20 | 11,087.28 | 0.47 |

| User Group | User # | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | Jan | Feb | Mar | Annual |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Bessemer** | 1 | | | | | | | | | | | | | |
| Monthly Pumping | | 590.57 | 999.33 | 1287.03 | 2274.53 | 1774.48 | 1135.81 | 417.06 | | | | | 241.85 | 8720.66 |
| Well Head Depletions | | 243.31 | 434.72 | 549.64 | 909.23 | 707.25 | 464.43 | 173.39 | | | | | 94.00 | 3575.97 |
| Depletion Factor | | 0.41 | 0.44 | 0.43 | 0.40 | 0.40 | 0.41 | 0.42 | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! | 0.39 | 0.41 |
| **Booth Orchard** | 2 | | | | | | | | | | | | | |
| Monthly Pumping | | 57.55 | 80.09 | 88.94 | 182.56 | 64.59 | 101.46 | 13.19 | | | | | 10.11 | 598.49 |
| Well Head Depletions | | 27.65 | 39.54 | 70.39 | 116.37 | 39.00 | 60.52 | 6.62 | | | | | 4.62 | 364.71 |
| Depletion Factor | | 0.48 | 0.49 | 0.79 | 0.64 | 0.60 | 0.60 | 0.50 | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! | 0.46 | 0.61 |
| **Excelsior** | 3 | | | | | | | | | | | | | |
| Monthly Pumping | | 179.43 | 454.71 | 580.96 | 885.90 | 430.63 | 649.40 | 219.50 | | | | | 24.56 | 3425.09 |
| Well Head Depletions | | 120.28 | 312.01 | 392.60 | 578.55 | 287.78 | 418.49 | 154.35 | | | | | 15.89 | 2279.95 |
| Depletion Factor | | 0.67 | 0.69 | 0.68 | 0.65 | 0.67 | 0.64 | 0.70 | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! | 0.65 | 0.67 |
| **Collier** | 4 | | | | | | | | | | | | | |
| Monthly Pumping | | 47.70 | 0.22 | 12.19 | 78.27 | 61.32 | 52.02 | 23.76 | | | | | 0.00 | 275.48 |
| Well Head Depletions | | 14.31 | 0.07 | 3.66 | 23.48 | 18.40 | 15.61 | 7.13 | | | | | 0.00 | 82.66 |
| Depletion Factor | | 0.30 | 0.32 | 0.30 | 0.30 | 0.30 | 0.30 | 0.30 | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! | 0.30 |
| **Colorado** | 5 | | | | | | | | | | | | | |
| Monthly Pumping | | 90.84 | 429.96 | 364.88 | 903.09 | 666.92 | 223.29 | 346.81 | | | | | 104.72 | 3130.51 |
| Well Head Depletions | | 39.77 | 181.00 | 156.65 | 419.73 | 278.24 | 89.24 | 171.01 | | | | | 54.43 | 1390.07 |
| Depletion Factor | | 0.44 | 0.42 | 0.43 | 0.46 | 0.42 | 0.40 | 0.49 | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! | 0.52 | 0.44 |
| **Highline** | 6 | | | | | | | | | | | | | |
| Monthly Pumping | | 536.50 | 602.69 | 394.89 | 819.51 | 784.94 | 445.68 | 423.32 | | | | | 17.95 | 4025.48 |
| Well Head Depletions | | 167.24 | 186.74 | 127.52 | 272.27 | 252.23 | 145.34 | 135.51 | | | | | 7.56 | 1294.41 |
| Depletion Factor | | 0.31 | 0.31 | 0.32 | 0.33 | 0.32 | 0.33 | 0.32 | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! | 0.42 | 0.32 |
| **Oxford** | 7 | | | | | | | | | | | | | |
| Monthly Pumping | | 243.78 | 128.34 | 147.75 | 514.72 | 521.85 | 100.29 | 129.84 | | | | | 3.62 | 1790.19 |
| Well Head Depletions | | 78.11 | 44.96 | 47.46 | 161.58 | 160.75 | 31.00 | 45.32 | | | | | 1.32 | 570.50 |
| Depletion Factor | | 0.32 | 0.35 | 0.32 | 0.31 | 0.31 | 0.31 | 0.35 | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! | 0.36 | 0.32 |
| **Otero** | 8 | | | | | | | | | | | | | |
| Monthly Pumping | | 125.91 | 218.12 | 68.95 | 203.54 | 175.87 | 83.25 | 42.47 | | | | | 17.30 | 935.41 |
| Well Head Depletions | | 38.94 | 72.25 | 24.32 | 65.53 | 56.60 | 28.48 | 17.08 | | | | | 5.19 | 308.39 |
| Depletion Factor | | 0.31 | 0.33 | 0.35 | 0.32 | 0.32 | 0.34 | 0.40 | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! | 0.30 | 0.33 |

| User Group | User # | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | Jan | Feb | Mar | Annual |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Catlin** | **9** | | | | | | | | | | | | | |
| Monthly Pumping | | 508.36 | 665.66 | 523.49 | 1477.23 | 1031.00 | 498.36 | 377.95 | | | | | 33.90 | 5115.95 |
| Well Head Depletions | | 220.32 | 327.22 | 243.92 | 620.85 | 357.73 | 248.62 | 172.22 | | | | | 21.91 | 2212.79 |
| Depletion Factor | | 0.43 | 0.49 | 0.47 | 0.42 | 0.35 | 0.50 | 0.46 | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! | 0.65 | 0.43 |
| **Fort Lyon Upstream** | **10** | | | | | | | | | | | | | |
| Monthly Pumping | | 766.54 | 1610.79 | 1601.68 | 2469.34 | 1672.25 | 890.88 | 170.62 | | | | | 17.16 | 9199.26 |
| Well Head Depletions | | 245.17 | 526.01 | 532.02 | 829.03 | 563.92 | 316.96 | 55.71 | | | | | 6.19 | 3075.01 |
| Depletion Factor | | 0.32 | 0.33 | 0.33 | 0.34 | 0.34 | 0.36 | 0.33 | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! | 0.36 | 0.33 |
| **Rocky Ford** | **11** | | | | | | | | | | | | | |
| Monthly Pumping | | 113.86 | 187.07 | 212.91 | 226.31 | 215.45 | 63.96 | 109.87 | | | | | 10.37 | 1139.80 |
| Well Head Depletions | | 38.92 | 65.32 | 72.21 | 78.23 | 71.03 | 24.14 | 40.50 | | | | | 4.97 | 395.32 |
| Depletion Factor | | 0.34 | 0.35 | 0.34 | 0.35 | 0.33 | 0.38 | 0.37 | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! | 0.48 | 0.35 |
| **Holbrook** | **12** | | | | | | | | | | | | | |
| Monthly Pumping | | 122.59 | 460.33 | 72.81 | 264.96 | 304.62 | 71.55 | 74.14 | | | | | 13.90 | 1384.90 |
| Well Head Depletions | | 51.67 | 143.64 | 25.41 | 110.03 | 103.55 | 24.90 | 22.24 | | | | | 4.17 | 485.61 |
| Depletion Factor | | 0.42 | 0.31 | 0.35 | 0.42 | 0.34 | 0.35 | 0.30 | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! | 0.30 | 0.35 |
| **LACC** | **13** | | | | | | | | | | | | | |
| Monthly Pumping | | 34.69 | 42.86 | 21.31 | 105.05 | 158.39 | 164.00 | 43.76 | | | | | 0.00 | 570.06 |
| Well Head Depletions | | 11.43 | 15.16 | 10.91 | 33.81 | 48.87 | 51.51 | 13.73 | | | | | 0.00 | 185.42 |
| Depletion Factor | | 0.33 | 0.35 | 0.51 | 0.32 | 0.31 | 0.31 | 0.31 | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! | 0.33 |
| **Baldwin-Stubbs** | **14** | | | | | | | | | | | | | |
| Monthly Pumping | | 489.59 | 862.04 | 2.17 | 1413.45 | 352.13 | 853.37 | 412.95 | | | | | 11.10 | 4396.80 |
| Well Head Depletions | | 244.80 | 431.02 | 1.08 | 706.73 | 176.06 | 426.68 | 206.47 | | | | | 5.55 | 2198.39 |
| Depletion Factor | | 0.50 | 0.50 | 0.50 | 0.50 | 0.50 | 0.50 | 0.50 | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! | 0.50 | 0.50 |
| **Keesee** | **16** | | | | | | | | | | | | | |
| Monthly Pumping | | 382.76 | 535.73 | 589.38 | 753.99 | 334.06 | 684.34 | 120.31 | 69.28 | | 0.11 | 0.07 | | 3470.02 |
| Well Head Depletions | | 114.83 | 160.72 | 176.81 | 226.20 | 100.22 | 205.30 | 36.09 | 20.78 | | 0.03 | 0.02 | | 1041.01 |
| Depletion Factor | | 0.30 | 0.30 | 0.30 | 0.30 | 0.30 | 0.30 | 0.30 | 0.30 | #DIV/0! | 0.30 | 0.30 | #DIV/0! | 0.30 |
| **Fort Lyon Downstream** | **20** | | | | | | | | | | | | | |
| Monthly Pumping | | 1017.47 | 1227.67 | 1264.52 | 1940.70 | 595.30 | 742.52 | 394.80 | | | | | 9.96 | 7192.94 |
| Well Head Depletions | | 487.68 | 525.71 | 583.47 | 821.30 | 256.08 | 381.51 | 206.44 | | | | | 9.85 | 3272.04 |

| User Group | User # | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | Jan | Feb | Mar | Annual |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Depletion Factor | | 0.48 | 0.43 | 0.46 | 0.42 | 0.43 | 0.51 | 0.52 | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! | 0.99 | 0.45 |

## Well Pumping 1986-1995

### Bessemer Ditch - User Group 1

| Year | Nov | Dec | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Annual |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1986 | 0 | 0 | 0 | 0 | 0 | 1,422 | 1,884 | 2,138 | 3,297 | 3,571 | 2,625 | 1,370 | 16,307 |
| 1987 | 0 | 0 | 0 | 0 | 0 | 592 | 913 | 1,373 | 2,287 | 3,452 | 1,535 | 833 | 10,984 |
| 1988 | 0 | 0 | 0 | 0 | 0 | 481 | 1,392 | 2,009 | 1,637 | 2,750 | 2,076 | 1,293 | 11,637 |
| 1989 | 0 | 0 | 0 | 0 | 0 | 1,243 | 1,839 | 1,593 | 2,935 | 3,591 | 2,481 | 1,621 | 15,302 |
| 1990 | 0 | 0 | 0 | 0 | 0 | 1,723 | 786 | 1,455 | 1,964 | 1,413 | 1,599 | 801 | 9,741 |
| 1991 | 0 | 0 | 0 | 0 | 0 | 1,177 | 1,718 | 1,874 | 2,921 | 2,235 | 2,268 | 970 | 13,162 |
| 1992 | 0 | 0 | 0 | 0 | 0 | 857 | 1,657 | 1,415 | 1,790 | 2,149 | 1,593 | 754 | 10,214 |
| 1993 | 0 | 0 | 0 | 0 | 0 | 789 | 1,161 | 988 | 1,813 | 1,699 | 1,496 | 654 | 8,599 |
| 1994 | 0 | 0 | 0 | 0 | 0 | 665 | 781 | 857 | 2,249 | 2,050 | 1,190 | 620 | 8,411 |
| 1995 | 0 | 0 | 0 | 0 | 0 | 1,617 | 697 | 757 | 1,550 | 2,287 | 1,848 | 575 | 9,331 |
| | | | | | | | | | | | | | |
| Average | 0 | 0 | 0 | 0 | 0 | 1,056 | 1,283 | 1,446 | 2,244 | 2,520 | 1,871 | 949 | 11,369 |
| Maximum | 0 | 0 | 0 | 0 | 0 | 1,723 | 1,884 | 2,138 | 3,297 | 3,591 | 2,625 | 1,621 | 16,307 |
| Minimum | 0 | 0 | 0 | 0 | 0 | 481 | 697 | 757 | 1,550 | 1,413 | 1,190 | 575 | 8,411 |

### Booth Orchard Ditch - User Group 2

| Year | Nov | Dec | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Annual |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1986 | 0 | 0 | 0 | 0 | 0 | 202 | 238 | 251 | 430 | 321 | 322 | 165 | 1,929 |
| 1987 | 0 | 0 | 0 | 0 | 0 | 147 | 190 | 211 | 161 | 210 | 267 | 119 | 1,304 |
| 1988 | 0 | 0 | 0 | 0 | 0 | 105 | 204 | 148 | 171 | 294 | 210 | 107 | 1,238 |
| 1989 | 0 | 0 | 0 | 0 | 0 | 120 | 280 | 195 | 415 | 239 | 233 | 70 | 1,552 |
| 1990 | 0 | 0 | 0 | 0 | 0 | 128 | 99 | 189 | 285 | 89 | 78 | 90 | 957 |
| 1991 | 0 | 0 | 0 | 0 | 0 | 192 | 147 | 239 | 623 | 129 | 355 | 93 | 1,778 |
| 1992 | 0 | 0 | 0 | 0 | 0 | 134 | 147 | 139 | 227 | 266 | 279 | 124 | 1,317 |
| 1993 | 0 | 0 | 0 | 0 | 0 | 141 | 115 | 74 | 204 | 155 | 91 | 94 | 874 |
| 1994 | 0 | 0 | 0 | 0 | 0 | 68 | 76 | 124 | 226 | 264 | 244 | 129 | 1,130 |
| 1995 | 0 | 0 | 0 | 0 | 0 | 136 | 57 | 51 | 90 | 225 | 189 | 164 | 912 |
| | | | | | | | | | | | | | |
| Average | 0 | 0 | 0 | 0 | 0 | 137 | 155 | 162 | 283 | 219 | 227 | 115 | 1,299 |
| Maximum | 0 | 0 | 0 | 0 | 0 | 202 | 280 | 251 | 623 | 321 | 355 | 165 | 1,929 |
| Minimum | 0 | 0 | 0 | 0 | 0 | 68 | 57 | 51 | 90 | 89 | 78 | 70 | 874 |

### Excelsior Ditch - User Group 3

| Year | Nov | Dec | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Annual |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1986 | 0 | 0 | 0 | 0 | 0 | 270 | 274 | 724 | 1,188 | 1,257 | 761 | 800 | 5,275 |
| 1987 | 0 | 0 | 0 | 0 | 0 | 560 | 152 | 529 | 904 | 932 | 471 | 646 | 4,195 |
| 1988 | 0 | 0 | 0 | 0 | 0 | 90 | 61 | 267 | 923 | 1,487 | 1,044 | 670 | 4,543 |
| 1989 | 0 | 0 | 0 | 0 | 0 | 395 | 595 | 496 | 987 | 1,323 | 1,055 | 390 | 5,241 |
| 1990 | 0 | 0 | 0 | 0 | 0 | 91 | 43 | 402 | 354 | 439 | 185 | 387 | 1,900 |
| 1991 | 0 | 0 | 0 | 0 | 0 | 101 | 102 | 1,175 | 1,001 | 418 | 681 | 734 | 4,211 |
| 1992 | 0 | 0 | 0 | 0 | 0 | 90 | 357 | 268 | 595 | 887 | 148 | 328 | 2,673 |
| 1993 | 0 | 0 | 0 | 0 | 0 | 63 | 114 | 290 | 603 | 512 | 231 | 279 | 2,091 |
| 1994 | 0 | 0 | 0 | 0 | 0 | 156 | 60 | 306 | 891 | 677 | 637 | 697 | 3,423 |
| 1995 | 0 | 0 | 0 | 0 | 0 | 281 | 123 | 132 | 246 | 478 | 512 | 313 | 2,085 |
| | | | | | | | | | | | | | |
| Average | 0 | 0 | 0 | 0 | 0 | 210 | 188 | 459 | 769 | 841 | 573 | 524 | 3,564 |
| Maximum | 0 | 0 | 0 | 0 | 0 | 560 | 595 | 1,175 | 1,188 | 1,487 | 1,055 | 800 | 5,275 |
| Minimum | 0 | 0 | 0 | 0 | 0 | 63 | 43 | 132 | 246 | 418 | 148 | 279 | 1,900 |

### Collier Ditch - User Group 4

| Year | Nov | Dec | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Annual |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1986 | 0 | 0 | 0 | 0 | 0 | 56 | 120 | 201 | 223 | 332 | 295 | 101 | 1,328 |
| 1987 | 0 | 0 | 0 | 0 | 0 | 33 | 9 | 124 | 114 | 346 | 142 | 1 | 768 |
| 1988 | 0 | 0 | 0 | 0 | 0 | 1 | 31 | 162 | 78 | 264 | 265 | 78 | 878 |
| 1989 | 0 | 0 | 0 | 0 | 0 | 81 | 92 | 40 | 418 | 162 | 415 | 152 | 1,359 |
| 1990 | 0 | 0 | 0 | 0 | 0 | 1 | 11 | 86 | 0 | 167 | 388 | 192 | 845 |
| 1991 | 0 | 0 | 0 | 0 | 0 | 335 | 295 | 312 | 234 | 243 | 133 | 49 | 1,601 |
| 1992 | 0 | 0 | 0 | 0 | 0 | 2 | 139 | 208 | 57 | 275 | 46 | 98 | 825 |
| 1993 | 0 | 0 | 0 | 0 | 0 | 0 | 52 | 135 | 152 | 63 | 56 | 14 | 472 |
| 1994 | 0 | 0 | 0 | 0 | 0 | 11 | 58 | 0 | 118 | 139 | 120 | 1 | 448 |
| 1995 | 0 | 0 | 0 | 0 | 0 | 28 | 64 | 13 | 14 | 195 | 114 | 9 | 437 |
| Average | 0 | 0 | 0 | 0 | 0 | 55 | 87 | 128 | 141 | 219 | 197 | 69 | 896 |
| Maximum | 0 | 0 | 0 | 0 | 0 | 335 | 295 | 312 | 418 | 346 | 415 | 192 | 1,601 |
| Minimum | 0 | 0 | 0 | 0 | 0 | 0 | 9 | 0 | 0 | 63 | 46 | 1 | 437 |

### Colorado Canal - User Group 5

| Year | Nov | Dec | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Annual |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1986 | 0 | 0 | 0 | 0 | 0 | 531 | 939 | 1,216 | 1,961 | 2,020 | 1,101 | 567 | 8,335 |
| 1987 | 0 | 0 | 0 | 0 | 0 | 551 | 472 | 529 | 1,274 | 1,277 | 438 | 369 | 4,910 |
| 1988 | 0 | 0 | 0 | 0 | 0 | 205 | 486 | 544 | 1,417 | 957 | 686 | 491 | 4,786 |
| 1989 | 0 | 0 | 0 | 0 | 0 | 403 | 888 | 902 | 1,618 | 1,882 | 1,453 | 297 | 7,443 |
| 1990 | 0 | 0 | 0 | 0 | 0 | 351 | 317 | 989 | 1,287 | 1,144 | 899 | 517 | 5,503 |
| 1991 | 0 | 0 | 0 | 0 | 0 | 399 | 947 | 1,265 | 1,938 | 1,436 | 929 | 323 | 7,236 |
| 1992 | 0 | 0 | 0 | 0 | 0 | 548 | 938 | 969 | 982 | 1,376 | 772 | 444 | 6,029 |
| 1993 | 0 | 0 | 0 | 0 | 0 | 296 | 988 | 920 | 1,637 | 1,639 | 444 | 322 | 6,247 |
| 1994 | 0 | 0 | 0 | 0 | 0 | 248 | 470 | 934 | 1,055 | 1,896 | 797 | 362 | 5,761 |
| 1995 | 0 | 0 | 0 | 0 | 0 | 336 | 149 | 240 | 512 | 899 | 620 | 306 | 3,062 |
| Average | 0 | 0 | 0 | 0 | 0 | 387 | 659 | 851 | 1,368 | 1,453 | 814 | 400 | 5,931 |
| Maximum | 0 | 0 | 0 | 0 | 0 | 551 | 988 | 1,265 | 1,961 | 2,020 | 1,453 | 567 | 8,335 |
| Minimum | 0 | 0 | 0 | 0 | 0 | 205 | 149 | 240 | 512 | 899 | 438 | 297 | 3,062 |

### Highline Canal - User Group 6

| Year | Nov | Dec | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Annual |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1986 | 0 | 0 | 0 | 0 | 0 | 1,343 | 1,235 | 1,710 | 2,064 | 2,433 | 2,374 | 1,278 | 12,437 |
| 1987 | 0 | 0 | 0 | 0 | 0 | 223 | 297 | 776 | 1,335 | 1,776 | 1,031 | 677 | 6,114 |
| 1988 | 0 | 0 | 0 | 0 | 0 | 541 | 907 | 936 | 1,217 | 1,851 | 1,994 | 692 | 8,138 |
| 1989 | 0 | 0 | 0 | 0 | 0 | 958 | 1,264 | 1,539 | 2,001 | 1,739 | 3,231 | 1,471 | 12,203 |
| 1990 | 0 | 0 | 0 | 0 | 0 | 1,863 | 875 | 1,179 | 1,795 | 1,721 | 1,898 | 1,019 | 10,349 |
| 1991 | 0 | 0 | 0 | 0 | 0 | 763 | 1,738 | 2,190 | 1,729 | 2,303 | 1,506 | 1,314 | 11,543 |
| 1992 | 0 | 0 | 0 | 0 | 0 | 1,172 | 1,554 | 1,720 | 1,064 | 1,665 | 1,422 | 910 | 9,506 |
| 1993 | 0 | 0 | 0 | 0 | 0 | 1,165 | 348 | 1,347 | 1,221 | 1,389 | 1,587 | 881 | 7,937 |
| 1994 | 0 | 0 | 0 | 0 | 0 | 1,673 | 886 | 780 | 2,079 | 1,895 | 1,858 | 877 | 10,048 |
| 1995 | 0 | 0 | 0 | 0 | 0 | 1,780 | 1,160 | 406 | 481 | 802 | 599 | 1,204 | 6,432 |
| Average | 0 | 0 | 0 | 0 | 0 | 1,148 | 1,026 | 1,258 | 1,498 | 1,757 | 1,750 | 1,032 | 9,471 |
| Maximum | 0 | 0 | 0 | 0 | 0 | 1,863 | 1,738 | 2,190 | 2,079 | 2,433 | 3,231 | 1,471 | 12,437 |
| Minimum | 0 | 0 | 0 | 0 | 0 | 223 | 297 | 406 | 481 | 802 | 599 | 677 | 6,114 |

Oxford Canal - User Group 7

| Year | Nov | Dec | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Annual |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1986 | 0 | 0 | 0 | 0 | 0 | 720 | 721 | 785 | 671 | 1,253 | 1,048 | 695 | 5,894 |
| 1987 | 0 | 0 | 0 | 0 | 0 | 204 | 219 | 152 | 490 | 665 | 441 | 155 | 2,325 |
| 1988 | 0 | 0 | 0 | 0 | 0 | 155 | 291 | 742 | 772 | 882 | 1,109 | 553 | 4,504 |
| 1989 | 0 | 0 | 0 | 0 | 0 | 454 | 1,337 | 853 | 467 | 1,771 | 1,142 | 1,078 | 7,101 |
| 1990 | 0 | 0 | 0 | 0 | 0 | 702 | 885 | 639 | 498 | 664 | 522 | 805 | 4,715 |
| 1991 | 0 | 0 | 0 | 0 | 0 | 676 | 1,326 | 936 | 313 | 1,191 | 378 | 727 | 5,547 |
| 1992 | 0 | 0 | 0 | 0 | 0 | 569 | 569 | 824 | 91 | 794 | 893 | 574 | 4,313 |
| 1993 | 0 | 0 | 0 | 0 | 0 | 587 | 165 | 467 | 281 | 386 | 766 | 218 | 2,869 |
| 1994 | 0 | 0 | 0 | 0 | 0 | 694 | 57 | 216 | 690 | 1,119 | 655 | 345 | 3,776 |
| 1995 | 0 | 0 | 0 | 0 | 0 | 548 | 344 | 139 | 349 | 379 | 266 | 185 | 2,210 |
| Average | 0 | 0 | 0 | 0 | 0 | 531 | 591 | 575 | 462 | 910 | 722 | 533 | 4,325 |
| Maximum | 0 | 0 | 0 | 0 | 0 | 720 | 1,337 | 936 | 772 | 1,771 | 1,142 | 1,078 | 7,101 |
| Minimum | 0 | 0 | 0 | 0 | 0 | 155 | 57 | 139 | 91 | 379 | 266 | 155 | 2,210 |

Otero Canal - User Group 8

| Year | Nov | Dec | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Annual |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1986 | 0 | 0 | 0 | 0 | 0 | 173 | 202 | 160 | 207 | 327 | 225 | 173 | 1,467 |
| 1987 | 0 | 0 | 0 | 0 | 0 | 26 | 31 | 1 | 74 | 266 | 87 | 39 | 524 |
| 1988 | 0 | 0 | 0 | 0 | 0 | 51 | 77 | 99 | 140 | 258 | 212 | 159 | 996 |
| 1989 | 0 | 0 | 0 | 0 | 0 | 228 | 208 | 128 | 240 | 280 | 216 | 245 | 1,545 |
| 1990 | 0 | 0 | 0 | 0 | 0 | 147 | 241 | 166 | 201 | 100 | 184 | 100 | 1,138 |
| 1991 | 0 | 0 | 0 | 0 | 0 | 156 | 239 | 264 | 165 | 201 | 133 | 149 | 1,306 |
| 1992 | 0 | 0 | 0 | 0 | 0 | 141 | 190 | 218 | 93 | 253 | 150 | 115 | 1,160 |
| 1993 | 0 | 0 | 0 | 0 | 0 | 140 | 128 | 64 | 80 | 137 | 133 | 111 | 792 |
| 1994 | 0 | 0 | 0 | 0 | 0 | 147 | 110 | 71 | 207 | 202 | 145 | 110 | 991 |
| 1995 | 0 | 0 | 0 | 0 | 0 | 165 | 55 | 44 | 139 | 166 | 229 | 276 | 1,074 |
| Average | 0 | 0 | 0 | 0 | 0 | 137 | 148 | 121 | 155 | 219 | 171 | 148 | 1,099 |
| Maximum | 0 | 0 | 0 | 0 | 0 | 228 | 241 | 264 | 240 | 327 | 229 | 276 | 1,545 |
| Minimum | 0 | 0 | 0 | 0 | 0 | 26 | 31 | 1 | 74 | 100 | 87 | 39 | 524 |

Catlin Canal - User Group 9

| Year | Nov | Dec | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Annual |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1986 | 0 | 0 | 0 | 0 | 0 | 460 | 653 | 613 | 999 | 1,267 | 798 | 490 | 5,280 |
| 1987 | 0 | 0 | 0 | 0 | 0 | 72 | 269 | 178 | 284 | 788 | 253 | 134 | 1,976 |
| 1988 | 0 | 0 | 0 | 0 | 0 | 97 | 214 | 277 | 457 | 739 | 510 | 643 | 2,936 |
| 1989 | 0 | 0 | 0 | 0 | 0 | 828 | 1,351 | 530 | 938 | 1,601 | 824 | 264 | 6,335 |
| 1990 | 0 | 0 | 0 | 0 | 0 | 819 | 515 | 477 | 1,231 | 721 | 1,088 | 703 | 5,554 |
| 1991 | 0 | 0 | 0 | 0 | 0 | 618 | 984 | 1,366 | 1,475 | 869 | 815 | 623 | 6,750 |
| 1992 | 0 | 0 | 0 | 0 | 0 | 478 | 823 | 496 | 499 | 1,050 | 731 | 429 | 4,506 |
| 1993 | 0 | 0 | 0 | 0 | 0 | 209 | 472 | 688 | 1,137 | 1,538 | 778 | 253 | 5,075 |
| 1994 | 0 | 0 | 0 | 0 | 0 | 916 | 444 | 1,062 | 2,427 | 1,846 | 1,205 | 421 | 8,321 |
| 1995 | 0 | 0 | 0 | 0 | 0 | 1,528 | 417 | 221 | 658 | 1,089 | 1,059 | 478 | 5,450 |
| Average | 0 | 0 | 0 | 0 | 0 | 602 | 614 | 591 | 1,010 | 1,151 | 806 | 444 | 5,218 |
| Maximum | 0 | 0 | 0 | 0 | 0 | 1,528 | 1,351 | 1,366 | 2,427 | 1,846 | 1,205 | 703 | 8,321 |
| Minimum | 0 | 0 | 0 | 0 | 0 | 72 | 214 | 178 | 284 | 721 | 253 | 134 | 1,976 |

### Fort Lyon Canal - User Group 10

| Year | Nov | Dec | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Annual |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1986 | 0 | 0 | 0 | 0 | 0 | 3,058 | 4,666 | 4,235 | 2,125 | 3,881 | 1,519 | 848 | 20,332 |
| 1987 | 0 | 0 | 0 | 0 | 0 | 171 | 835 | 1,275 | 2,115 | 4,110 | 3,250 | 2,281 | 14,037 |
| 1988 | 0 | 0 | 0 | 0 | 0 | 211 | 2,528 | 3,008 | 5,312 | 6,003 | 5,439 | 3,587 | 26,088 |
| 1989 | 0 | 0 | 0 | 0 | 0 | 2,655 | 5,195 | 3,451 | 2,703 | 7,476 | 7,421 | 5,096 | 33,996 |
| 1990 | 0 | 0 | 0 | 0 | 0 | 1,090 | 2,985 | 4,006 | 4,369 | 6,705 | 6,231 | 2,988 | 28,373 |
| 1991 | 0 | 0 | 0 | 0 | 0 | 2,083 | 4,642 | 4,154 | 4,578 | 8,249 | 3,141 | 5,301 | 32,149 |
| 1992 | 0 | 0 | 0 | 0 | 0 | 2,743 | 5,824 | 5,864 | 2,860 | 4,939 | 4,164 | 7,135 | 33,529 |
| 1993 | 0 | 0 | 0 | 0 | 0 | 200 | 1,946 | 3,272 | 3,329 | 5,014 | 4,828 | 4,089 | 22,676 |
| 1994 | 0 | 0 | 0 | 0 | 0 | 3,534 | 3,026 | 3,569 | 6,931 | 6,114 | 3,442 | 3,079 | 29,695 |
| 1995 | 0 | 0 | 0 | 0 | 0 | 3,726 | 1,335 | 424 | 1,473 | 3,397 | 3,382 | 1,561 | 15,298 |
| Average | 0 | 0 | 0 | 0 | 0 | 1,947 | 3,298 | 3,326 | 3,579 | 5,589 | 4,282 | 3,596 | 25,617 |
| Maximum | 0 | 0 | 0 | 0 | 0 | 3,726 | 5,824 | 5,864 | 6,931 | 8,249 | 7,421 | 7,135 | 33,996 |
| Minimum | 0 | 0 | 0 | 0 | 0 | 171 | 835 | 424 | 1,473 | 3,397 | 1,519 | 848 | 14,037 |

### Rocky Ford Canal - User Group 11

| Year | Nov | Dec | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Annual |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1986 | 0 | 0 | 0 | 0 | 0 | 187 | 257 | 246 | 516 | 568 | 325 | 135 | 2,233 |
| 1987 | 0 | 0 | 0 | 0 | 0 | 63 | 177 | 94 | 230 | 544 | 96 | 103 | 1,308 |
| 1988 | 0 | 0 | 0 | 0 | 0 | 48 | 106 | 252 | 315 | 356 | 360 | 30 | 1,466 |
| 1989 | 0 | 0 | 0 | 0 | 0 | 259 | 541 | 154 | 286 | 524 | 415 | 227 | 2,405 |
| 1990 | 0 | 0 | 0 | 0 | 0 | 167 | 218 | 153 | 531 | 229 | 253 | 97 | 1,648 |
| 1991 | 0 | 0 | 0 | 0 | 0 | 92 | 124 | 240 | 422 | 364 | 348 | 115 | 1,705 |
| 1992 | 0 | 0 | 0 | 0 | 0 | 128 | 156 | 172 | 199 | 263 | 162 | 117 | 1,196 |
| 1993 | 0 | 0 | 0 | 0 | 0 | 86 | 128 | 96 | 437 | 405 | 162 | 35 | 1,348 |
| 1994 | 0 | 0 | 0 | 0 | 0 | 250 | 94 | 205 | 456 | 464 | 97 | 67 | 1,632 |
| 1995 | 0 | 0 | 0 | 0 | 0 | 369 | 74 | 21 | 134 | 401 | 310 | 74 | 1,383 |
| Average | 0 | 0 | 0 | 0 | 0 | 165 | 187 | 163 | 352 | 412 | 253 | 100 | 1,632 |
| Maximum | 0 | 0 | 0 | 0 | 0 | 369 | 541 | 252 | 531 | 568 | 415 | 227 | 2,405 |
| Minimum | 0 | 0 | 0 | 0 | 0 | 48 | 74 | 21 | 134 | 229 | 96 | 30 | 1,196 |

### Holbrook Canal - User Group 12

| Year | Nov | Dec | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Annual |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1986 | 0 | 0 | 0 | 0 | 0 | 282 | 336 | 410 | 606 | 691 | 520 | 297 | 3,141 |
| 1987 | 0 | 0 | 0 | 0 | 0 | 120 | 132 | 204 | 366 | 507 | 260 | 156 | 1,745 |
| 1988 | 0 | 0 | 0 | 0 | 0 | 118 | 249 | 369 | 513 | 744 | 603 | 331 | 2,926 |
| 1989 | 0 | 0 | 0 | 0 | 0 | 388 | 595 | 476 | 787 | 985 | 866 | 422 | 4,519 |
| 1990 | 0 | 0 | 0 | 0 | 0 | 444 | 297 | 443 | 631 | 514 | 539 | 336 | 3,205 |
| 1991 | 0 | 0 | 0 | 0 | 0 | 286 | 475 | 657 | 731 | 606 | 518 | 340 | 3,614 |
| 1992 | 0 | 0 | 0 | 0 | 0 | 328 | 534 | 513 | 513 | 762 | 472 | 299 | 3,421 |
| 1993 | 0 | 0 | 0 | 0 | 0 | 292 | 305 | 412 | 607 | 639 | 454 | 232 | 2,941 |
| 1994 | 0 | 0 | 0 | 0 | 0 | 834 | 355 | 369 | 1,011 | 592 | 442 | 158 | 3,761 |
| 1995 | 0 | 0 | 0 | 0 | 0 | 598 | 243 | 123 | 254 | 484 | 481 | 245 | 2,428 |
| Average | 0 | 0 | 0 | 0 | 0 | 369 | 352 | 398 | 602 | 653 | 515 | 282 | 3,170 |
| Maximum | 0 | 0 | 0 | 0 | 0 | 834 | 595 | 657 | 1,011 | 985 | 866 | 422 | 4,519 |
| Minimum | 0 | 0 | 0 | 0 | 0 | 118 | 132 | 123 | 254 | 484 | 260 | 156 | 1,745 |

### Las Animas Consolidated Canal - User Group 13

| Year | Nov | Dec | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Annual |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1986 | 0 | 0 | 0 | 0 | 0 | 74 | 89 | 108 | 160 | 182 | 137 | 78 | 828 |
| 1987 | 0 | 0 | 0 | 0 | 0 | 57 | 62 | 96 | 172 | 239 | 122 | 74 | 823 |
| 1988 | 0 | 0 | 0 | 0 | 0 | 53 | 112 | 166 | 231 | 334 | 271 | 149 | 1,315 |
| 1989 | 0 | 0 | 0 | 0 | 0 | 162 | 248 | 198 | 328 | 411 | 361 | 176 | 1,884 |
| 1990 | 0 | 0 | 0 | 0 | 0 | 143 | 96 | 143 | 204 | 166 | 174 | 108 | 1,033 |
| 1991 | 0 | 0 | 0 | 0 | 0 | 109 | 181 | 251 | 279 | 232 | 198 | 130 | 1,380 |
| 1992 | 0 | 0 | 0 | 0 | 0 | 143 | 232 | 223 | 223 | 331 | 206 | 130 | 1,488 |
| 1993 | 0 | 0 | 0 | 0 | 0 | 108 | 113 | 152 | 225 | 236 | 168 | 86 | 1,088 |
| 1994 | 0 | 0 | 0 | 0 | 0 | 55 | 81 | 375 | 274 | 407 | 149 | 45 | 1,387 |
| 1995 | 0 | 0 | 0 | 0 | 0 | 71 | 6 | 11 | 43 | 251 | 203 | 35 | 620 |
| | | | | | | | | | | | | | |
| Average | 0 | 0 | 0 | 0 | 0 | 97 | 122 | 172 | 214 | 279 | 199 | 101 | 1,185 |
| Maximum | 0 | 0 | 0 | 0 | 0 | 162 | 248 | 375 | 328 | 411 | 361 | 176 | 1,884 |
| Minimum | 0 | 0 | 0 | 0 | 0 | 53 | 6 | 11 | 43 | 166 | 122 | 35 | 620 |

### Baldwin - Stubbs - User Group 14

| Year | Nov | Dec | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Annual |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1986 | 0 | 0 | 0 | 0 | 0 | 271 | 411 | 477 | 885 | 913 | 523 | 59 | 3,538 |
| 1987 | 0 | 0 | 0 | 0 | 0 | 15 | 114 | 207 | 520 | 594 | 429 | 44 | 1,924 |
| 1988 | 0 | 0 | 0 | 0 | 0 | 0 | 181 | 284 | 625 | 571 | 165 | 53 | 1,879 |
| 1989 | 0 | 0 | 0 | 0 | 0 | 308 | 308 | 162 | 446 | 673 | 539 | 38 | 2,474 |
| 1990 | 0 | 0 | 0 | 0 | 0 | 193 | 179 | 304 | 637 | 480 | 475 | 99 | 2,366 |
| 1991 | 0 | 0 | 0 | 0 | 0 | 285 | 399 | 310 | 577 | 438 | 404 | 50 | 2,462 |
| 1992 | 0 | 0 | 0 | 0 | 0 | 239 | 312 | 363 | 612 | 682 | 118 | 0 | 2,325 |
| 1993 | 0 | 0 | 0 | 0 | 0 | 245 | 346 | 503 | 571 | 778 | 209 | 0 | 2,652 |
| 1994 | 0 | 0 | 0 | 0 | 0 | 273 | 456 | 476 | 728 | 654 | 489 | 11 | 3,088 |
| 1995 | 0 | 0 | 0 | 0 | 0 | 81 | 181 | 385 | 479 | 1,050 | 720 | 233 | 3,129 |
| | | | | | | | | | | | | | |
| Average | 0 | 0 | 0 | 0 | 0 | 191 | 289 | 347 | 608 | 683 | 407 | 59 | 2,584 |
| Maximum | 0 | 0 | 0 | 0 | 0 | 308 | 456 | 503 | 885 | 1,050 | 720 | 233 | 3,538 |
| Minimum | 0 | 0 | 0 | 0 | 0 | 0 | 114 | 162 | 446 | 438 | 118 | 0 | 1,879 |

### Keesee - User Group 16

| Year | Nov | Dec | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Annual |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1986 | 0 | 0 | 0 | 0 | 0 | 84 | 128 | 116 | 58 | 106 | 42 | 23 | 556 |
| 1987 | 0 | 0 | 0 | 0 | 0 | 4 | 18 | 27 | 45 | 87 | 69 | 48 | 297 |
| 1988 | 0 | 0 | 0 | 0 | 0 | 14 | 161 | 192 | 339 | 383 | 347 | 229 | 1,665 |
| 1989 | 0 | 0 | 0 | 0 | 0 | 91 | 178 | 118 | 92 | 256 | 254 | 174 | 1,162 |
| 1990 | 0 | 0 | 0 | 0 | 0 | 30 | 81 | 109 | 119 | 183 | 170 | 81 | 773 |
| 1991 | 0 | 0 | 0 | 0 | 0 | 97 | 216 | 193 | 213 | 383 | 146 | 246 | 1,494 |
| 1992 | 0 | 0 | 0 | 0 | 0 | 187 | 398 | 401 | 195 | 338 | 285 | 488 | 2,291 |
| 1993 | 0 | 0 | 0 | 0 | 0 | 23 | 223 | 376 | 382 | 576 | 554 | 470 | 2,604 |
| 1994 | 0 | 0 | 0 | 0 | 0 | 559 | 351 | 148 | 701 | 337 | 1 | 0 | 2,097 |
| 1995 | 0 | 0 | 0 | 0 | 0 | 309 | 483 | 249 | 158 | 8 | 360 | 69 | 1,656 |
| | | | | | | | | | | | | | |
| Average | 0 | 0 | 0 | 0 | 0 | 140 | 224 | 193 | 230 | 266 | 225 | 183 | 1,460 |
| Maximum | 0 | 0 | 0 | 0 | 0 | 559 | 483 | 401 | 701 | 576 | 554 | 488 | 2,604 |
| Minimum | 0 | 0 | 0 | 0 | 0 | 4 | 18 | 27 | 45 | 8 | 1 | 0 | 297 |

Total Pumping all User Groups

| Year | Nov | Dec | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Annual |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1986 | 0 | 0 | 0 | 0 | 0 | 9,133 | 12,151 | 13,390 | 15,391 | 19,123 | 12,614 | 7,079 | 88,880 |
| 1987 | 0 | 0 | 0 | 0 | 0 | 2,837 | 3,889 | 5,775 | 10,371 | 15,793 | 8,891 | 5,679 | 53,234 |
| 1988 | 0 | 0 | 0 | 0 | 0 | 2,169 | 6,999 | 9,454 | 14,144 | 17,874 | 15,291 | 9,064 | 74,995 |
| 1989 | 0 | 0 | 0 | 0 | 0 | 8,571 | 14,918 | 10,833 | 14,660 | 22,913 | 20,907 | 11,720 | 104,521 |
| 1990 | 0 | 0 | 0 | 0 | 0 | 7,890 | 7,627 | 10,741 | 14,105 | 14,734 | 14,680 | 8,324 | 78,100 |
| 1991 | 0 | 0 | 0 | 0 | 0 | 7,368 | 13,534 | 15,426 | 17,196 | 19,297 | 11,953 | 11,164 | 95,938 |
| 1992 | 0 | 0 | 0 | 0 | 0 | 7,759 | 13,829 | 13,793 | 9,998 | 16,030 | 11,440 | 11,944 | 84,793 |
| 1993 | 0 | 0 | 0 | 0 | 0 | 4,342 | 6,603 | 9,784 | 12,677 | 15,166 | 11,957 | 7,736 | 68,265 |
| 1994 | 0 | 0 | 0 | 0 | 0 | 10,081 | 7,305 | 9,492 | 20,043 | 18,657 | 11,471 | 6,921 | 83,969 |
| 1995 | 0 | 0 | 0 | 0 | 0 | 11,573 | 5,388 | 3,216 | 6,580 | 12,111 | 10,912 | 5,727 | 55,507 |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Average | 0 | 0 | 0 | 0 | 0 | 7,172 | 9,224 | 10,190 | 13,517 | 17,170 | 13,011 | 8,536 | 78,820 |
| Maximum | 0 | 0 | 0 | 0 | 0 | 11,573 | 14,918 | 15,426 | 20,043 | 22,913 | 20,907 | 11,944 | 104,521 |
| Minimum | 0 | 0 | 0 | 0 | 0 | 2,169 | 3,889 | 3,216 | 6,580 | 12,111 | 8,891 | 5,679 | 53,234 |

Includes the following User Groups: 1-16 from the pump.dat file of the HI model.

## Wellhead Depletions 1986-1995

### Bessemer Ditch - User Group 1

| Year | Nov | Dec | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Annual |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1986 | 0 | 0 | 0 | 0 | 0 | 583 | 772 | 876 | 1,352 | 1,464 | 1,076 | 562 | 6,686 |
| 1987 | 0 | 0 | 0 | 0 | 0 | 243 | 374 | 563 | 938 | 1,415 | 629 | 341 | 4,503 |
| 1988 | 0 | 0 | 0 | 0 | 0 | 197 | 571 | 823 | 671 | 1,127 | 851 | 530 | 4,771 |
| 1989 | 0 | 0 | 0 | 0 | 0 | 509 | 754 | 653 | 1,203 | 1,472 | 1,017 | 664 | 6,274 |
| 1990 | 0 | 0 | 0 | 0 | 0 | 707 | 322 | 597 | 805 | 579 | 655 | 328 | 3,994 |
| 1991 | 0 | 0 | 0 | 0 | 0 | 482 | 704 | 768 | 1,197 | 916 | 930 | 398 | 5,396 |
| 1992 | 0 | 0 | 0 | 0 | 0 | 351 | 679 | 580 | 734 | 881 | 653 | 309 | 4,188 |
| 1993 | 0 | 0 | 0 | 0 | 0 | 323 | 476 | 405 | 743 | 697 | 613 | 268 | 3,526 |
| 1994 | 0 | 0 | 0 | 0 | 0 | 272 | 320 | 351 | 922 | 840 | 488 | 254 | 3,449 |
| 1995 | 0 | 0 | 0 | 0 | 0 | 663 | 286 | 310 | 636 | 938 | 758 | 236 | 3,826 |
| Average | 0 | 0 | 0 | 0 | 0 | 433 | 526 | 593 | 920 | 1,033 | 767 | 389 | 4,661 |
| Maximum | 0 | 0 | 0 | 0 | 0 | 707 | 772 | 876 | 1,352 | 1,472 | 1,076 | 664 | 6,686 |
| Minimum | 0 | 0 | 0 | 0 | 0 | 197 | 286 | 310 | 636 | 579 | 488 | 236 | 3,449 |

### Booth Orchard Ditch - User Group 2

| Year | Nov | Dec | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Annual |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1986 | 0 | 0 | 0 | 0 | 0 | 123 | 145 | 153 | 262 | 196 | 197 | 101 | 1,177 |
| 1987 | 0 | 0 | 0 | 0 | 0 | 89 | 116 | 129 | 98 | 128 | 163 | 73 | 795 |
| 1988 | 0 | 0 | 0 | 0 | 0 | 64 | 124 | 90 | 104 | 180 | 128 | 65 | 755 |
| 1989 | 0 | 0 | 0 | 0 | 0 | 73 | 171 | 119 | 253 | 146 | 142 | 43 | 947 |
| 1990 | 0 | 0 | 0 | 0 | 0 | 78 | 60 | 115 | 174 | 54 | 47 | 55 | 584 |
| 1991 | 0 | 0 | 0 | 0 | 0 | 117 | 90 | 146 | 380 | 79 | 216 | 57 | 1,085 |
| 1992 | 0 | 0 | 0 | 0 | 0 | 82 | 90 | 85 | 139 | 162 | 170 | 76 | 803 |
| 1993 | 0 | 0 | 0 | 0 | 0 | 86 | 70 | 45 | 125 | 94 | 56 | 57 | 533 |
| 1994 | 0 | 0 | 0 | 0 | 0 | 41 | 46 | 75 | 138 | 161 | 149 | 78 | 689 |
| 1995 | 0 | 0 | 0 | 0 | 0 | 83 | 35 | 31 | 55 | 137 | 115 | 100 | 556 |
| Average | 0 | 0 | 0 | 0 | 0 | 84 | 95 | 99 | 173 | 134 | 138 | 70 | 792 |
| Maximum | 0 | 0 | 0 | 0 | 0 | 123 | 171 | 153 | 380 | 196 | 216 | 101 | 1,177 |
| Minimum | 0 | 0 | 0 | 0 | 0 | 41 | 35 | 31 | 55 | 54 | 47 | 43 | 533 |

### Excelsior Ditch - User Group 3

| Year | Nov | Dec | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Annual |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1986 | 0 | 0 | 0 | 0 | 0 | 181 | 184 | 485 | 796 | 842 | 510 | 536 | 3,534 |
| 1987 | 0 | 0 | 0 | 0 | 0 | 375 | 102 | 355 | 606 | 625 | 315 | 433 | 2,811 |
| 1988 | 0 | 0 | 0 | 0 | 0 | 61 | 41 | 179 | 618 | 997 | 700 | 449 | 3,044 |
| 1989 | 0 | 0 | 0 | 0 | 0 | 264 | 399 | 333 | 662 | 886 | 707 | 261 | 3,511 |
| 1990 | 0 | 0 | 0 | 0 | 0 | 61 | 29 | 269 | 237 | 294 | 124 | 259 | 1,273 |
| 1991 | 0 | 0 | 0 | 0 | 0 | 67 | 69 | 787 | 670 | 280 | 456 | 492 | 2,821 |
| 1992 | 0 | 0 | 0 | 0 | 0 | 61 | 239 | 179 | 398 | 594 | 99 | 220 | 1,791 |
| 1993 | 0 | 0 | 0 | 0 | 0 | 42 | 76 | 194 | 404 | 343 | 155 | 187 | 1,401 |
| 1994 | 0 | 0 | 0 | 0 | 0 | 104 | 40 | 205 | 597 | 454 | 427 | 467 | 2,293 |
| 1995 | 0 | 0 | 0 | 0 | 0 | 188 | 82 | 88 | 165 | 320 | 343 | 210 | 1,397 |
| Average | 0 | 0 | 0 | 0 | 0 | 140 | 126 | 307 | 515 | 563 | 384 | 351 | 2,388 |
| Maximum | 0 | 0 | 0 | 0 | 0 | 375 | 399 | 787 | 796 | 997 | 707 | 536 | 3,534 |
| Minimum | 0 | 0 | 0 | 0 | 0 | 42 | 29 | 88 | 165 | 280 | 99 | 187 | 1,273 |

Collier Ditch - User Group 4

| Year | Nov | Dec | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Annual |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1986 | 0 | 0 | 0 | 0 | 0 | 17 | 36 | 60 | 67 | 99 | 88 | 30 | 398 |
| 1987 | 0 | 0 | 0 | 0 | 0 | 10 | 3 | 37 | 34 | 104 | 43 | 0 | 230 |
| 1988 | 0 | 0 | 0 | 0 | 0 | 0 | 9 | 49 | 23 | 79 | 79 | 23 | 263 |
| 1989 | 0 | 0 | 0 | 0 | 0 | 24 | 28 | 12 | 125 | 49 | 124 | 45 | 408 |
| 1990 | 0 | 0 | 0 | 0 | 0 | 0 | 3 | 26 | 0 | 50 | 116 | 58 | 254 |
| 1991 | 0 | 0 | 0 | 0 | 0 | 100 | 88 | 94 | 70 | 73 | 40 | 15 | 480 |
| 1992 | 0 | 0 | 0 | 0 | 0 | 1 | 42 | 62 | 17 | 83 | 14 | 30 | 248 |
| 1993 | 0 | 0 | 0 | 0 | 0 | 0 | 16 | 41 | 46 | 19 | 17 | 4 | 142 |
| 1994 | 0 | 0 | 0 | 0 | 0 | 3 | 17 | 0 | 36 | 42 | 36 | 0 | 134 |
| 1995 | 0 | 0 | 0 | 0 | 0 | 8 | 19 | 4 | 4 | 59 | 34 | 3 | 131 |
| Average | 0 | 0 | 0 | 0 | 0 | 16 | 26 | 38 | 42 | 66 | 59 | 21 | 269 |
| Maximum | 0 | 0 | 0 | 0 | 0 | 100 | 88 | 94 | 125 | 104 | 124 | 58 | 480 |
| Minimum | 0 | 0 | 0 | 0 | 0 | 0 | 3 | 0 | 0 | 19 | 14 | 0 | 131 |

Colorado Canal - User Group 5

| Year | Nov | Dec | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Annual |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1986 | 0 | 0 | 0 | 0 | 0 | 234 | 413 | 535 | 863 | 889 | 484 | 249 | 3,667 |
| 1987 | 0 | 0 | 0 | 0 | 0 | 242 | 208 | 233 | 561 | 562 | 193 | 162 | 2,160 |
| 1988 | 0 | 0 | 0 | 0 | 0 | 90 | 214 | 239 | 624 | 421 | 302 | 216 | 2,106 |
| 1989 | 0 | 0 | 0 | 0 | 0 | 177 | 391 | 397 | 712 | 828 | 639 | 131 | 3,275 |
| 1990 | 0 | 0 | 0 | 0 | 0 | 154 | 139 | 435 | 566 | 503 | 396 | 227 | 2,421 |
| 1991 | 0 | 0 | 0 | 0 | 0 | 175 | 417 | 557 | 853 | 632 | 409 | 142 | 3,184 |
| 1992 | 0 | 0 | 0 | 0 | 0 | 241 | 413 | 426 | 432 | 606 | 340 | 195 | 2,653 |
| 1993 | 0 | 0 | 0 | 0 | 0 | 130 | 435 | 405 | 720 | 721 | 195 | 142 | 2,749 |
| 1994 | 0 | 0 | 0 | 0 | 0 | 109 | 207 | 411 | 464 | 834 | 351 | 159 | 2,535 |
| 1995 | 0 | 0 | 0 | 0 | 0 | 148 | 66 | 106 | 225 | 396 | 273 | 135 | 1,347 |
| Average | 0 | 0 | 0 | 0 | 0 | 170 | 290 | 374 | 602 | 639 | 358 | 176 | 2,610 |
| Maximum | 0 | 0 | 0 | 0 | 0 | 242 | 435 | 557 | 863 | 889 | 639 | 249 | 3,667 |
| Minimum | 0 | 0 | 0 | 0 | 0 | 90 | 66 | 106 | 225 | 396 | 193 | 131 | 1,347 |

Highline Canal - User Group 6

| Year | Nov | Dec | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Annual |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1986 | 0 | 0 | 0 | 0 | 0 | 430 | 395 | 547 | 661 | 778 | 760 | 409 | 3,980 |
| 1987 | 0 | 0 | 0 | 0 | 0 | 71 | 95 | 248 | 427 | 568 | 330 | 217 | 1,956 |
| 1988 | 0 | 0 | 0 | 0 | 0 | 173 | 290 | 299 | 389 | 592 | 638 | 221 | 2,604 |
| 1989 | 0 | 0 | 0 | 0 | 0 | 307 | 405 | 492 | 640 | 556 | 1,034 | 471 | 3,905 |
| 1990 | 0 | 0 | 0 | 0 | 0 | 596 | 280 | 377 | 574 | 551 | 607 | 326 | 3,312 |
| 1991 | 0 | 0 | 0 | 0 | 0 | 244 | 556 | 701 | 553 | 737 | 482 | 420 | 3,694 |
| 1992 | 0 | 0 | 0 | 0 | 0 | 375 | 497 | 550 | 340 | 533 | 455 | 291 | 3,042 |
| 1993 | 0 | 0 | 0 | 0 | 0 | 373 | 111 | 431 | 391 | 444 | 508 | 282 | 2,540 |
| 1994 | 0 | 0 | 0 | 0 | 0 | 535 | 284 | 250 | 665 | 606 | 595 | 281 | 3,215 |
| 1995 | 0 | 0 | 0 | 0 | 0 | 570 | 371 | 130 | 154 | 257 | 192 | 385 | 2,058 |
| Average | 0 | 0 | 0 | 0 | 0 | 367 | 328 | 403 | 480 | 562 | 560 | 330 | 3,031 |
| Maximum | 0 | 0 | 0 | 0 | 0 | 596 | 556 | 701 | 665 | 778 | 1,034 | 471 | 3,980 |
| Minimum | 0 | 0 | 0 | 0 | 0 | 71 | 95 | 130 | 154 | 257 | 192 | 217 | 1,956 |

### Oxford Canal - User Group 7

| Year | Nov | Dec | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Annual |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1986 | 0 | 0 | 0 | 0 | 0 | 230 | 231 | 251 | 215 | 401 | 335 | 222 | 1,886 |
| 1987 | 0 | 0 | 0 | 0 | 0 | 65 | 70 | 49 | 157 | 213 | 141 | 49 | 744 |
| 1988 | 0 | 0 | 0 | 0 | 0 | 49 | 93 | 238 | 247 | 282 | 355 | 177 | 1,441 |
| 1989 | 0 | 0 | 0 | 0 | 0 | 145 | 428 | 273 | 149 | 567 | 365 | 345 | 2,272 |
| 1990 | 0 | 0 | 0 | 0 | 0 | 225 | 283 | 204 | 159 | 213 | 167 | 258 | 1,509 |
| 1991 | 0 | 0 | 0 | 0 | 0 | 216 | 424 | 299 | 100 | 381 | 121 | 233 | 1,775 |
| 1992 | 0 | 0 | 0 | 0 | 0 | 182 | 182 | 264 | 29 | 254 | 286 | 184 | 1,380 |
| 1993 | 0 | 0 | 0 | 0 | 0 | 188 | 53 | 149 | 90 | 123 | 245 | 70 | 918 |
| 1994 | 0 | 0 | 0 | 0 | 0 | 222 | 18 | 69 | 221 | 358 | 210 | 110 | 1,208 |
| 1995 | 0 | 0 | 0 | 0 | 0 | 175 | 110 | 44 | 112 | 121 | 85 | 59 | 707 |
| Average | 0 | 0 | 0 | 0 | 0 | 170 | 189 | 184 | 148 | 291 | 231 | 171 | 1,384 |
| Maximum | 0 | 0 | 0 | 0 | 0 | 230 | 428 | 299 | 247 | 567 | 365 | 345 | 2,272 |
| Minimum | 0 | 0 | 0 | 0 | 0 | 49 | 18 | 44 | 29 | 121 | 85 | 49 | 707 |

### Otero Canal - User Group 8

| Year | Nov | Dec | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Annual |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1986 | 0 | 0 | 0 | 0 | 0 | 57 | 67 | 53 | 68 | 108 | 74 | 57 | 484 |
| 1987 | 0 | 0 | 0 | 0 | 0 | 9 | 10 | 0 | 24 | 88 | 29 | 13 | 173 |
| 1988 | 0 | 0 | 0 | 0 | 0 | 17 | 25 | 33 | 46 | 85 | 70 | 53 | 329 |
| 1989 | 0 | 0 | 0 | 0 | 0 | 75 | 69 | 42 | 79 | 92 | 71 | 81 | 510 |
| 1990 | 0 | 0 | 0 | 0 | 0 | 48 | 80 | 55 | 66 | 33 | 61 | 33 | 376 |
| 1991 | 0 | 0 | 0 | 0 | 0 | 51 | 79 | 87 | 54 | 66 | 44 | 49 | 431 |
| 1992 | 0 | 0 | 0 | 0 | 0 | 47 | 63 | 72 | 31 | 83 | 49 | 38 | 383 |
| 1993 | 0 | 0 | 0 | 0 | 0 | 46 | 42 | 21 | 26 | 45 | 44 | 37 | 261 |
| 1994 | 0 | 0 | 0 | 0 | 0 | 48 | 36 | 23 | 68 | 67 | 48 | 36 | 327 |
| 1995 | 0 | 0 | 0 | 0 | 0 | 54 | 18 | 15 | 46 | 55 | 76 | 91 | 354 |
| Average | 0 | 0 | 0 | 0 | 0 | 45 | 49 | 40 | 51 | 72 | 57 | 49 | 363 |
| Maximum | 0 | 0 | 0 | 0 | 0 | 75 | 80 | 87 | 79 | 108 | 76 | 91 | 510 |
| Minimum | 0 | 0 | 0 | 0 | 0 | 9 | 10 | 0 | 24 | 33 | 29 | 13 | 173 |

### Catlin Canal - User Group 9

| Year | Nov | Dec | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Annual |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1986 | 0 | 0 | 0 | 0 | 0 | 198 | 281 | 264 | 429 | 545 | 343 | 211 | 2,270 |
| 1987 | 0 | 0 | 0 | 0 | 0 | 31 | 116 | 76 | 122 | 339 | 109 | 57 | 850 |
| 1988 | 0 | 0 | 0 | 0 | 0 | 42 | 92 | 119 | 196 | 318 | 219 | 276 | 1,262 |
| 1989 | 0 | 0 | 0 | 0 | 0 | 356 | 581 | 228 | 403 | 688 | 354 | 114 | 2,724 |
| 1990 | 0 | 0 | 0 | 0 | 0 | 352 | 221 | 205 | 529 | 310 | 468 | 302 | 2,388 |
| 1991 | 0 | 0 | 0 | 0 | 0 | 266 | 423 | 587 | 634 | 374 | 351 | 268 | 2,903 |
| 1992 | 0 | 0 | 0 | 0 | 0 | 205 | 354 | 213 | 214 | 452 | 314 | 185 | 1,938 |
| 1993 | 0 | 0 | 0 | 0 | 0 | 90 | 203 | 296 | 489 | 661 | 335 | 109 | 2,182 |
| 1994 | 0 | 0 | 0 | 0 | 0 | 394 | 191 | 457 | 1,044 | 794 | 518 | 181 | 3,578 |
| 1995 | 0 | 0 | 0 | 0 | 0 | 657 | 179 | 95 | 283 | 468 | 455 | 206 | 2,344 |
| Average | 0 | 0 | 0 | 0 | 0 | 259 | 264 | 254 | 434 | 495 | 347 | 191 | 2,244 |
| Maximum | 0 | 0 | 0 | 0 | 0 | 657 | 581 | 587 | 1,044 | 794 | 518 | 302 | 3,578 |
| Minimum | 0 | 0 | 0 | 0 | 0 | 31 | 92 | 76 | 122 | 310 | 109 | 57 | 850 |

Fort Lyon Canal Upstream - User Group 10

| Year | Nov | Dec | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Annual |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1986 | 0 | 0 | 0 | 0 | 0 | 535 | 816 | 741 | 372 | 679 | 266 | 148 | 3,556 |
| 1987 | 0 | 0 | 0 | 0 | 0 | 30 | 146 | 223 | 370 | 719 | 568 | 399 | 2,455 |
| 1988 | 0 | 0 | 0 | 0 | 0 | 37 | 442 | 526 | 929 | 1,050 | 951 | 627 | 4,563 |
| 1989 | 0 | 0 | 0 | 0 | 0 | 464 | 909 | 604 | 473 | 1,307 | 1,298 | 891 | 5,946 |
| 1990 | 0 | 0 | 0 | 0 | 0 | 191 | 522 | 701 | 764 | 1,173 | 1,090 | 523 | 4,962 |
| 1991 | 0 | 0 | 0 | 0 | 0 | 364 | 812 | 726 | 801 | 1,443 | 549 | 927 | 5,623 |
| 1992 | 0 | 0 | 0 | 0 | 0 | 480 | 1,019 | 1,026 | 500 | 864 | 728 | 1,248 | 5,864 |
| 1993 | 0 | 0 | 0 | 0 | 0 | 35 | 340 | 572 | 582 | 877 | 844 | 715 | 3,966 |
| 1994 | 0 | 0 | 0 | 0 | 0 | 618 | 529 | 624 | 1,212 | 1,069 | 602 | 539 | 5,194 |
| 1995 | 0 | 0 | 0 | 0 | 0 | 652 | 233 | 74 | 258 | 594 | 592 | 273 | 2,676 |
| Average | 0 | 0 | 0 | 0 | 0 | 341 | 577 | 582 | 626 | 977 | 749 | 629 | 4,480 |
| Maximum | 0 | 0 | 0 | 0 | 0 | 652 | 1,019 | 1,026 | 1,212 | 1,443 | 1,298 | 1,248 | 5,946 |
| Minimum | 0 | 0 | 0 | 0 | 0 | 30 | 146 | 74 | 258 | 594 | 266 | 148 | 2,455 |

Rocky Ford Canal - User Group 11

| Year | Nov | Dec | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Annual |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1986 | 0 | 0 | 0 | 0 | 0 | 65 | 90 | 86 | 181 | 199 | 114 | 47 | 781 |
| 1987 | 0 | 0 | 0 | 0 | 0 | 22 | 62 | 33 | 81 | 190 | 34 | 36 | 458 |
| 1988 | 0 | 0 | 0 | 0 | 0 | 17 | 37 | 88 | 110 | 125 | 126 | 11 | 513 |
| 1989 | 0 | 0 | 0 | 0 | 0 | 90 | 189 | 54 | 100 | 183 | 145 | 79 | 842 |
| 1990 | 0 | 0 | 0 | 0 | 0 | 59 | 76 | 54 | 186 | 80 | 88 | 34 | 577 |
| 1991 | 0 | 0 | 0 | 0 | 0 | 32 | 43 | 84 | 148 | 127 | 122 | 40 | 597 |
| 1992 | 0 | 0 | 0 | 0 | 0 | 45 | 54 | 60 | 70 | 92 | 57 | 41 | 419 |
| 1993 | 0 | 0 | 0 | 0 | 0 | 30 | 45 | 33 | 153 | 142 | 57 | 12 | 472 |
| 1994 | 0 | 0 | 0 | 0 | 0 | 87 | 33 | 72 | 160 | 162 | 34 | 23 | 571 |
| 1995 | 0 | 0 | 0 | 0 | 0 | 129 | 26 | 7 | 47 | 140 | 109 | 26 | 484 |
| Average | 0 | 0 | 0 | 0 | 0 | 58 | 66 | 57 | 123 | 144 | 88 | 35 | 571 |
| Maximum | 0 | 0 | 0 | 0 | 0 | 129 | 189 | 88 | 186 | 199 | 145 | 79 | 842 |
| Minimum | 0 | 0 | 0 | 0 | 0 | 17 | 26 | 7 | 47 | 80 | 34 | 11 | 419 |

Holbrook Canal - User Group 12

| Year | Nov | Dec | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Annual |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1986 | 0 | 0 | 0 | 0 | 0 | 99 | 118 | 143 | 212 | 242 | 182 | 104 | 1,099 |
| 1987 | 0 | 0 | 0 | 0 | 0 | 42 | 46 | 72 | 128 | 178 | 91 | 55 | 611 |
| 1988 | 0 | 0 | 0 | 0 | 0 | 41 | 87 | 129 | 180 | 260 | 211 | 116 | 1,024 |
| 1989 | 0 | 0 | 0 | 0 | 0 | 136 | 208 | 167 | 276 | 345 | 303 | 148 | 1,582 |
| 1990 | 0 | 0 | 0 | 0 | 0 | 155 | 104 | 155 | 221 | 180 | 189 | 118 | 1,122 |
| 1991 | 0 | 0 | 0 | 0 | 0 | 100 | 166 | 230 | 256 | 212 | 181 | 119 | 1,265 |
| 1992 | 0 | 0 | 0 | 0 | 0 | 115 | 187 | 179 | 179 | 267 | 165 | 105 | 1,197 |
| 1993 | 0 | 0 | 0 | 0 | 0 | 102 | 107 | 144 | 212 | 224 | 159 | 81 | 1,029 |
| 1994 | 0 | 0 | 0 | 0 | 0 | 292 | 124 | 129 | 354 | 207 | 155 | 55 | 1,316 |
| 1995 | 0 | 0 | 0 | 0 | 0 | 209 | 85 | 43 | 89 | 169 | 168 | 86 | 850 |
| Average | 0 | 0 | 0 | 0 | 0 | 129 | 123 | 139 | 211 | 228 | 180 | 99 | 1,110 |
| Maximum | 0 | 0 | 0 | 0 | 0 | 292 | 208 | 230 | 354 | 345 | 303 | 148 | 1,582 |
| Minimum | 0 | 0 | 0 | 0 | 0 | 41 | 46 | 43 | 89 | 169 | 91 | 55 | 611 |

### Las Animas Consolidated Canal - User Group 13

| Year | Nov | Dec | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Annual |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1986 | 0 | 0 | 0 | 0 | 0 | 25 | 29 | 36 | 53 | 60 | 45 | 26 | 273 |
| 1987 | 0 | 0 | 0 | 0 | 0 | 19 | 20 | 32 | 57 | 79 | 40 | 24 | 272 |
| 1988 | 0 | 0 | 0 | 0 | 0 | 17 | 37 | 55 | 76 | 110 | 89 | 49 | 434 |
| 1989 | 0 | 0 | 0 | 0 | 0 | 53 | 82 | 65 | 108 | 136 | 119 | 58 | 622 |
| 1990 | 0 | 0 | 0 | 0 | 0 | 47 | 32 | 47 | 67 | 55 | 57 | 36 | 341 |
| 1991 | 0 | 0 | 0 | 0 | 0 | 36 | 60 | 83 | 92 | 76 | 65 | 43 | 455 |
| 1992 | 0 | 0 | 0 | 0 | 0 | 47 | 77 | 74 | 74 | 109 | 68 | 43 | 491 |
| 1993 | 0 | 0 | 0 | 0 | 0 | 36 | 37 | 50 | 74 | 78 | 55 | 28 | 359 |
| 1994 | 0 | 0 | 0 | 0 | 0 | 18 | 27 | 124 | 90 | 134 | 49 | 15 | 458 |
| 1995 | 0 | 0 | 0 | 0 | 0 | 23 | 2 | 4 | 14 | 83 | 67 | 12 | 205 |
| | | | | | | | | | | | | | |
| Average | 0 | 0 | 0 | 0 | 0 | 32 | 40 | 57 | 71 | 92 | 66 | 33 | 391 |
| Maximum | 0 | 0 | 0 | 0 | 0 | 53 | 82 | 124 | 108 | 136 | 119 | 58 | 622 |
| Minimum | 0 | 0 | 0 | 0 | 0 | 17 | 2 | 4 | 14 | 55 | 40 | 12 | 205 |

### Baldwin - Stubbs - User Group 14

| Year | Nov | Dec | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Annual |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1986 | 0 | 0 | 0 | 0 | 0 | 136 | 206 | 238 | 442 | 456 | 261 | 29 | 1,769 |
| 1987 | 0 | 0 | 0 | 0 | 0 | 8 | 57 | 103 | 260 | 297 | 215 | 22 | 962 |
| 1988 | 0 | 0 | 0 | 0 | 0 | 0 | 90 | 142 | 312 | 285 | 83 | 27 | 940 |
| 1989 | 0 | 0 | 0 | 0 | 0 | 154 | 154 | 81 | 223 | 337 | 270 | 19 | 1,237 |
| 1990 | 0 | 0 | 0 | 0 | 0 | 96 | 90 | 152 | 318 | 240 | 237 | 50 | 1,183 |
| 1991 | 0 | 0 | 0 | 0 | 0 | 143 | 199 | 155 | 288 | 219 | 202 | 25 | 1,231 |
| 1992 | 0 | 0 | 0 | 0 | 0 | 119 | 156 | 182 | 306 | 341 | 59 | 0 | 1,163 |
| 1993 | 0 | 0 | 0 | 0 | 0 | 122 | 173 | 252 | 286 | 389 | 105 | 0 | 1,326 |
| 1994 | 0 | 0 | 0 | 0 | 0 | 137 | 228 | 238 | 364 | 327 | 244 | 6 | 1,544 |
| 1995 | 0 | 0 | 0 | 0 | 0 | 41 | 91 | 193 | 240 | 525 | 360 | 117 | 1,565 |
| | | | | | | | | | | | | | |
| Average | 0 | 0 | 0 | 0 | 0 | 96 | 144 | 174 | 304 | 342 | 204 | 29 | 1,292 |
| Maximum | 0 | 0 | 0 | 0 | 0 | 154 | 228 | 252 | 442 | 525 | 360 | 117 | 1,769 |
| Minimum | 0 | 0 | 0 | 0 | 0 | 0 | 57 | 81 | 223 | 219 | 59 | 0 | 940 |

### Keesee - User Group 16

| Year | Nov | Dec | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Annual |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1986 | 0 | 0 | 0 | 0 | 0 | 25 | 38 | 35 | 17 | 32 | 12 | 7 | 167 |
| 1987 | 0 | 0 | 0 | 0 | 0 | 1 | 5 | 8 | 13 | 26 | 21 | 14 | 89 |
| 1988 | 0 | 0 | 0 | 0 | 0 | 4 | 48 | 58 | 102 | 115 | 104 | 69 | 500 |
| 1989 | 0 | 0 | 0 | 0 | 0 | 27 | 53 | 35 | 28 | 77 | 76 | 52 | 349 |
| 1990 | 0 | 0 | 0 | 0 | 0 | 9 | 24 | 33 | 36 | 55 | 51 | 24 | 232 |
| 1991 | 0 | 0 | 0 | 0 | 0 | 29 | 65 | 58 | 64 | 115 | 44 | 74 | 448 |
| 1992 | 0 | 0 | 0 | 0 | 0 | 56 | 119 | 120 | 59 | 101 | 85 | 146 | 687 |
| 1993 | 0 | 0 | 0 | 0 | 0 | 7 | 67 | 113 | 115 | 173 | 166 | 141 | 781 |
| 1994 | 0 | 0 | 0 | 0 | 0 | 168 | 105 | 44 | 210 | 101 | 0 | 0 | 629 |
| 1995 | 0 | 0 | 0 | 0 | 0 | 93 | 145 | 75 | 47 | 2 | 114 | 21 | 497 |
| | | | | | | | | | | | | | |
| Average | 0 | 0 | 0 | 0 | 0 | 42 | 67 | 58 | 69 | 80 | 67 | 55 | 438 |
| Maximum | 0 | 0 | 0 | 0 | 0 | 168 | 145 | 120 | 210 | 173 | 166 | 146 | 781 |
| Minimum | 0 | 0 | 0 | 0 | 0 | 1 | 5 | 8 | 13 | 2 | 0 | 0 | 89 |

Fort Lyon Canal Downstream - User Group 20

| Year | Nov | Dec | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Annual |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1986 | 0 | 0 | 0 | 0 | 0 | 647 | 987 | 896 | 449 | 821 | 321 | 179 | 4,300 |
| 1987 | 0 | 0 | 0 | 0 | 0 | 36 | 177 | 270 | 447 | 869 | 687 | 482 | 2,969 |
| 1988 | 0 | 0 | 0 | 0 | 0 | 45 | 535 | 636 | 1,123 | 1,270 | 1,150 | 759 | 5,518 |
| 1989 | 0 | 0 | 0 | 0 | 0 | 562 | 1,099 | 730 | 572 | 1,581 | 1,570 | 1,078 | 7,190 |
| 1990 | 0 | 0 | 0 | 0 | 0 | 230 | 631 | 847 | 924 | 1,418 | 1,318 | 632 | 6,001 |
| 1991 | 0 | 0 | 0 | 0 | 0 | 441 | 982 | 879 | 968 | 1,745 | 664 | 1,121 | 6,800 |
| 1992 | 0 | 0 | 0 | 0 | 0 | 580 | 1,232 | 1,240 | 605 | 1,045 | 881 | 1,509 | 7,091 |
| 1993 | 0 | 0 | 0 | 0 | 0 | 42 | 411 | 692 | 704 | 1,060 | 1,021 | 865 | 4,796 |
| 1994 | 0 | 0 | 0 | 0 | 0 | 747 | 640 | 755 | 1,466 | 1,293 | 728 | 651 | 6,280 |
| 1995 | 0 | 0 | 0 | 0 | 0 | 788 | 282 | 90 | 312 | 718 | 715 | 330 | 3,236 |
| | | | | | | | | | | | | | |
| Average | 0 | 0 | 0 | 0 | 0 | 412 | 698 | 703 | 757 | 1,182 | 906 | 761 | 5,418 |
| Maximum | 0 | 0 | 0 | 0 | 0 | 788 | 1,232 | 1,240 | 1,466 | 1,745 | 1,570 | 1,509 | 7,190 |
| Minimum | 0 | 0 | 0 | 0 | 0 | 36 | 177 | 90 | 312 | 718 | 321 | 179 | 2,969 |

Total Wellhead Depletions for User Groups 1-16 and 20 ( No Pre Compact or APOD allowance made)

| Year | Nov | Dec | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Annual |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1986 | 0 | 0 | 0 | 0 | 0 | 3,584 | 4,807 | 5,400 | 6,440 | 7,812 | 5,070 | 2,918 | 36,029 |
| 1987 | 0 | 0 | 0 | 0 | 0 | 1,293 | 1,607 | 2,430 | 4,323 | 6,399 | 3,607 | 2,379 | 22,038 |
| 1988 | 0 | 0 | 0 | 0 | 0 | 854 | 2,736 | 3,703 | 5,751 | 7,296 | 6,057 | 3,667 | 30,066 |
| 1989 | 0 | 0 | 0 | 0 | 0 | 3,418 | 5,917 | 4,284 | 6,006 | 9,251 | 8,236 | 4,480 | 41,593 |
| 1990 | 0 | 0 | 0 | 0 | 0 | 3,009 | 2,897 | 4,273 | 5,628 | 5,787 | 5,671 | 3,262 | 30,527 |
| 1991 | 0 | 0 | 0 | 0 | 0 | 2,865 | 5,178 | 6,241 | 7,129 | 7,475 | 4,876 | 4,422 | 38,187 |
| 1992 | 0 | 0 | 0 | 0 | 0 | 2,987 | 5,402 | 5,313 | 4,127 | 6,466 | 4,423 | 4,618 | 33,337 |
| 1993 | 0 | 0 | 0 | 0 | 0 | 1,653 | 2,662 | 3,844 | 5,159 | 6,091 | 4,575 | 2,998 | 26,981 |
| 1994 | 0 | 0 | 0 | 0 | 0 | 3,797 | 2,846 | 3,828 | 8,011 | 7,451 | 4,633 | 2,856 | 33,422 |
| 1995 | 0 | 0 | 0 | 0 | 0 | 4,482 | 2,031 | 1,308 | 2,685 | 4,983 | 4,455 | 2,288 | 22,232 |
| | | | | | | | | | | | | | |
| Average | 0 | 0 | 0 | 0 | 0 | 2,794 | 3,608 | 4,062 | 5,526 | 6,901 | 5,160 | 3,389 | 31,441 |
| Maximum | 0 | 0 | 0 | 0 | 0 | 4,482 | 5,917 | 6,241 | 8,011 | 9,251 | 8,236 | 4,618 | 41,593 |
| Minimum | 0 | 0 | 0 | 0 | 0 | 854 | 1,607 | 1,308 | 2,685 | 4,983 | 3,607 | 2,288 | 22,038 |

Includes the following User Groups: 1-16 from the pump.dat file of the HI model.

## Summary of Account Model Outputs
(values in acre-feet)

| Item | Nov | Dec | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Annual |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Stream Depletions | 3,051 | 2,454 | 2,089 | 1,816 | 1,592 | 1,722 | 2,135 | 2,473 | 2,917 | 3,499 | 3,788 | 3,618 | 31,154 |
| Project Return Flow | 1,174 | 1,010 | 884 | 788 | 712 | 767 | 831 | 751 | 1,857 | 2,390 | 1,825 | 1,412 | 14,400 |
| Net Stream Depletions | 1,877 | 1,444 | 1,205 | 1,028 | 880 | 955 | 1,304 | 1,722 | 1,060 | 1,109 | 1,963 | 2,206 | 16,754 |
| | | | | | | | | | | | | | |
| Based on 40% of the 1986-95 allocations | | | | | | | | | | | | | |
| Project Return Flows | 798 | 687 | 601 | 536 | 484 | 521 | 565 | 510 | 1,262 | 1,625 | 1,241 | 960 | 9,790 |

```
C  Well head deletions using the 1997 average depletion factor per user group and the pumping data within
C  YEAR  MO  BESS        B O         EXC         COLL        COLO        RF H        OXF         OTE
     1996    1          0           0           0           0           0           0           0           0
     1996    2          0           0           0           0           0           0           0           0
     1996    3          0           0           0           0           0           0           0           0
     1996    4        433          84         140          16         170         367         170          45
     1996    5        526          95         126          26         290         328         189          49
     1996    6        593          99         307          38         374         403         184          40
     1996    7        920         173         515          42         602         480         148          51
     1996    8       1033         134         563          66         639         562         291          72
     1996    9        767         138         384          59         358         560         231          57
     1996   10        389          70         351          21         176         330         171          49
     1996   11          0           0           0           0           0           0           0           0
     1996   12          0           0           0           0           0           0           0           0
C    1996 AN         4661         792        2388         269        2610        3031        1384         363
```

the pump.dat file of the HI model.  (This is in free format for Account3.exe)

| CAT | FL U/S | RF | HOL | LA | B/S | FB | KEE | AMI |
|---|---|---|---|---|---|---|---|---|
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 259 | 341 | 58 | 129 | 32 | 96 | 0 | 0 | 0 |
| 264 | 577 | 66 | 123 | 40 | 144 | 0 | 0 | 0 |
| 254 | 582 | 57 | 139 | 57 | 174 | 0 | 0 | 0 |
| 434 | 626 | 123 | 211 | 71 | 304 | 0 | 0 | 0 |
| 495 | 977 | 144 | 228 | 92 | 342 | 0 | 0 | 0 |
| 347 | 749 | 88 | 180 | 66 | 204 | 0 | 0 | 0 |
| 191 | 629 | 35 | 99 | 33 | 29 | 0 | 0 | 0 |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2244 | 4480 | 571 | 1110 | 391 | 1292 | 0 | 0 | 0 |

| L/M | HYD | FL D/S | X-Y | BUFF | SISS | S L | TOTAL |
|---|---|---|---|---|---|---|---|
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 0 | 0 | 412 | 0 | 0 | 0 | 0 | 2752 |
| 0 | 0 | 698 | 0 | 0 | 0 | 0 | 3541 |
| 0 | 0 | 703 | 0 | 0 | 0 | 0 | 4005 |
| 0 | 0 | 757 | 0 | 0 | 0 | 0 | 5457 |
| 0 | 0 | 1182 | 0 | 0 | 0 | 0 | 6822 |
| 0 | 0 | 906 | 0 | 0 | 0 | 0 | 5093 |
| 0 | 0 | 761 | 0 | 0 | 0 | 0 | 3334 |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 0 | 0 | 5418 | 0 | 0 | 0 | 0 | 31003 |

Φ GEI Consultants, Inc.

# SECWCD/ARKANSAS BASIN
# FUTURE WATER AND STORAGE NEEDS ASSESSMENT

Submitted to:

**SECWCD/Assessment Enterprise**
**Pueblo, Colorado**

Prepared by:

**GEI CONSULTANTS, INC.**

*In Association with:*

**Helton & Williamsen, P.C.**
**David Bamberger & Associates**

6950 South Potomac Street, Suite 200
Englewood, CO 80112
(303) 662-0100

December 10, 1998
Project 97411

# SECWCD/ARKANSAS BASIN
# WATER AND STORAGE NEEDS ASSESSMENT

**December 10, 1998**

Submitted to:

**SECWCD/Assessment Enterprise**
**905 Highway 50 West**
**Pueblo, Colorado 81002**

Prepared by:

GEI Consultants, Inc.
6950 South Potomac Street, Suite 200
Englewood, CO 80112
(303) 662-0100

Project 97411

COLORADO REGISTERED PROFESSIONAL ENGINEER
RICHARD A. WESTMORE
24931

Richard A. Westmore, P.E.
Project Manager

# EXECUTIVE SUMMARY

The Southeastern Colorado Water Storage Needs Assessment Enterprise, under the auspices of the Southern Colorado Water Conservancy District (the District) commissioned a study in June 1997 to assess the water and storage needs of District members. The draft study was completed in September 1998.

The following entities joined with the Assessment Enterprise as "local participants" in the project:

Arkansas Groundwater Users Association
Catlin Canal Company
City of Canon City
City of Florence
City of La Junta
City of Las Animas
City of Salida
Colorado Water Protection and Development Association
Holbrook Mutual Irrigation Company
Pueblo Board of Water Works
Public Service Company
Security Water and Sanitation District
Widefield Water and Sanitation District
Bessemer Ditch Company
City of Aurora
City of Colorado Springs
City of Fountain
City of Lamar
City of Rocky Ford
Colorado Canal Company
Fort Lyon Canal Company
Lower Arkansas Water Management Association
Pueblo West Metro District
St. Charles Mesa Water
Southeastern Colorado Water Conservancy District
Stratmoor Hills Water and Sanitation District
Upper Arkansas Water Conservancy District

Each local participant committed cash and/or in-kind contributions to the Assessment Enterprise for the purpose of conducting the Assessment Project. In addition, the Colorado Water Conservation Board (CWCB) joined the partnership and provided financial and technical staff contributions to the Project.

As part of the planning process, the District assembled a Storage Study Committee (SSC) comprised of District members interested in identifying ways to meet the growing water needs of the municipal sector while maintaining current levels of agricultural water use and production. The SSC provided extensive guidance to the work, as well as reviews of many interim work products.

This report presents the findings from the study, which is termed the SECWCD/Arkansas Basin Water and Storage Needs Assessment Project. The study was conducted by a team of engineers and specialists, including GEI Consultants, Inc., Helton and Williamsen, P.C., and David Bamberger & Associates. The study included a review of existing water supplies available to the

District water users; projection of future populations and demands for water in the municipal sector; an assessment of historic agricultural water use; assessment of water and storage needs; and evaluation of potential water supply storage and management options for the District to consider. The District is shown on Figure ES-1.

The District entities currently use an average approximately 1 million acre-feet (af) per year of which 80 percent is for irrigation. If agricultural use is held constant, total water use in the District is projected to increase to nearly 1.2 million af per year under a "high growth" scenario.

**Key findings** of the Assessment Project studies are summarized below:

1. District population, Figure ES-2, is expected to increase by 572,000 to 1,006,000 persons, depending on whether a "base" or "high" forecast is used. Municipal water demands in the District's service area are expected to be approximately 95,000 to 187,000 af higher than the current levels, Figure ES-3. The larger incremental water demand is based on a population growth rate equivalent to 2.3 percent per year.

2. The major municipal water supply entities in the District, and many of the smaller entities, have adopted water conservation measures that meet or exceed requirements established by the CWCB's Office of Water Conservation. Typical conservation measures implemented in the municipal sector include water meters, water-efficient fixtures and appliances, public education, water use audits, water efficiency ordinances, water reuse, and other measures. The water demand forecasts prepared for the Assessment Project included a reduction in future per capita water use to reflect successful conservation efforts. On a District-wide basis, current per capita use averages 213 gallons per capita per day (gcd); future use is estimated to be 182 gcd, reflecting over a 10 percent reduction in per capita use.

3. Water resources available to municipal entities are generally adequate to meet demands for the base case scenario (97,000 af of additional demand), except for certain entities in the Fountain Valley and several towns West of Pueblo. Approximately 21,300 af of additional water supply will be needed (under base projections), unless other entities are willing to reallocate water supplies that exceed their forecast needs.

4. For the high growth scenario (187,000 af of additional water demand), the total additional water supply need is estimated to be 81,800 af, as shown in the table below, primarily in Colorado Springs, the other Fountain Valley Authority (FVA) entities, and several towns west of Pueblo. The Colorado Springs/FVA demands

represent the bulk of this potential water supply need. The supply/demand comparisons have assumed that the Fry-Ark Project yield is 80,400 af per year. Historical yield has been closer to 60,000 af per year. As municipal demand increases, municipal entities will begin using greater amounts of Fry-Ark Project water. Under the forecast, municipal entities will begin to use their Fry-Ark supplies more heavily, approaching their 51 percent allocation by the year 2020. This will impact current uses of Project water by agricultural users for supplemental irrigation and replacement supplies for well depletions.

| | **Forecast Deficit (Acre-Feet) High Forecast** | | | | |
|---|---|---|---|---|---|
| **Region Year:** | **Current** | **2010** | **2020** | **2030** | **2040** |
| Entities West of Pueblo | 0 | 0 | 0 | 400 | 2,100 |
| Pueblo West | 0 | 0 | 0 | 0 | 0 |
| Pueblo | 0 | 0 | 0 | 0 | 0 |
| Fountain Valley | 0 | 500 | 24,800 | 50,400 | 79,700 |
| Entities East of Pueblo | 0 | 0 | 0 | 0 | 0 |
| Total (High): | 0 | 500 | 24,800 | 50,800 | 81,800 |

A water supply/demand comparison was performed for each municipal entity as described in Section 6 of the main report. The above tabulation summarizes results for the high demand forecast.

5. Most of the municipal water supply entities have water rights to meet their 2040 needs. However, storage capacity is needed to provide firm yield and to facilitate water exchanges and management of imported water reuse.

6. Average annual agricultural water use in the District is estimated to be 825,000 af (for ditches and canals between Pueblo and John Martin reservoirs). Agriculture relies heavily on supplemental sources including transmountain water, Fry-Ark water, Winter Water, storage reservoirs, and ground water, as indicated on Figure ES-4. (Direct flow water accounts of 86 percent of agricultural use in a "wet" year, but only 65 percent in a "dry" year). As municipal demands increase, the amount of Project water now available to agricultural entities will decline, as indicated in Figure ES-5. Also, agricultural well users will need sources of replacement water to offset well pumping effects on the Arkansas River. A third supply source that may not be available to agricultural interests during the planning horizon is transmountain water currently being purchased by the irrigation companies from municipal entities. As municipal water use increases, this water, estimated to be

22,000 af per year, will not be available for irrigation uses. In summary, the potential deficits in agricultural supplies may total 59,000 af, as indicated below:

| | |
|---|---|
| Reduced availability of Fry-Ark project water | 20,000 |
| Replacement water to offset well pumping | 17,000 |
| Reduced availability of water currently purchased from municipal entities | 22,000 |
| **Total** | 59,000 af |

Under this pressure, it will be vitally important for agricultural users to have dedicated storage space for Winter Water. Storage may be needed to provide a reliable source of replacement water for well pumping.

7. Studied storage needs in the District are projected to be 139,000 af. This storage need includes dedicated Project storage capacity for Winter Water of 40,000 af. If other identified storage needs of water supply entities (as independently studied) are included, an additional storage need of 34,000 af may develop. Therefore, planning studies should focus on a storage need of 173,000 af, as shown below:

| Entity | Forecast Storage Need (af) |
|---|---|
| Colorado Springs Utilities | 45,000 |
| Other FVA entities | 22,000 |
| Entities West of Pueblo | 3,700 |
| Florence | 2,300 |
| Winter Water Program | 40,000 |
| Storage to Regulate Replacement Water for Well Pumping | 26,000 |
| Subtotal (A) | 139,000 |
| Pueblo Water Works | 20,000 |
| Public Service Company | 5,000 |
| Pueblo West MD | 5,500 |
| St. Charles Mesa | 3,600 |
| Subtotal (B) | 34,100 |
| Total | 173,100 |

NOTE: Subtotal (A) represents specific storage needs addressed in the Assessment Project. Subtotal (B) is the storage need identified by water supply entities based on their own planning efforts.
TBD = To be determined.

The storage need identified above is for the high growth forecast, and could be less under the base forecast.

Additional storage capacity could benefit non-District entities who have water interests in the Arkansas Basin, as well as District entities who desire more storage to enhance water management and provide drought protection. Additional East Slope storage also may enable additional Fry-Ark Project imports to be made. Currently, Fry-Ark imports can be curtailed due to unavailable East Slope storage capacity. These "foregone" diversions from the West Slope have totaled approximately 200,000 af since the project began operation.

8. The 31 storage/water management options were subjected to a qualitative evaluation in order to develop a list of 14 options for more-detailed review. These 14 options then were evaluated using a decision analysis framework to identify 8 options that appear to have better overall performance in terms of cost, operational effectiveness, and environmental/social factors. The evaluation process is preliminary in nature and is not intended to be fully compliant with NEPA guidelines. However, the basic structure of the process is designed to be expanded and refined in subsequent more detailed levels of study and evaluation of alternatives. The eight alternatives are summarized in the following table in the order of their priority ranking in the alternatives analysis:

| Storage Option | Potential Volume (1) |
|---|---|
| Lake Meredith Enlargement | 80,000 |
| Fry-Ark Project Reoperation | 90,000(2) |
| Turquoise Lake Enlargement | 9,000 |
| Clear Creek Reservoir (New) | 100,000 |
| Tennessee Creek Reservoir | 28,000 |
| Pueblo Reservoir Enlargement | 75,000 |
| Williams Creek Reservoir | 16,000 |
| Gravel Lakes Storage | 13,000 |

---

(1) Estimated maximum volume of storage based on initial configurations.

(2) Estimated potential volume available without consideration of East Slope decrees. Volume may not be available in all years.

Various combinations of these options, and potentially other options, should be evaluated in greater detail to identify a preferred plan and several alternatives for evaluation during compliance with requirements of the National Environmental Policy Act (NEPA). Storage costs are estimated to range from $150 per af (Turquoise Enlargement) to $3,000 per af (Gravel Lakes Storage). Depending on how the alternative storage options are combined, total costs to develop 173,000 af of additional storage could range from $41 to $199 million. The lower cost is heavily dependent on whether "reoperation" can be technically and legally accomplished or whether all of the storage must be developed in new or enlarged reservoirs.

**In summary,** municipal water demands, primarily developing in the Fountain Valley area (Colorado Springs, Fountain Security, Widefield, and Stratmoor Hills) of the District, will require development of additional water storage capacity. Agricultural water supply deficits are expected to occur up to 59,000 af (or more) as municipal demands on Fry-Ark Project water and other water resources in the Basin increase over time. This means that dedicated storage for the Winter Water Storage Program will be increasingly important for agricultural water users. Coupled with dedicated storage for the Winter Water Program and other potential partners, the storage need for District entities is estimated to be 155,000 af. This need will begin to develop over the next 10 to 20 years. Therefore, studies should be initiated in the near future to further evaluate alternative storage options in terms of technical and environmental performance.

Reoperation of Fry-Ark Project storage is likely to be an important element of an overall water management strategy. Coupled with possibilities for enlarging Project reservoirs, this means that detailed discussions with the Bureau of Reclamation should be undertaken soon, in order to fully assess the feasibility, costs, NEPA compliance requirements, and institutional/legal issues associated with these options.

**Public Comments:** The Assessment Project was conducted with opportunities for public input. The SSC meetings were open to the public and three public meetings were held (Buena Vista, LaJunta, and Leadville) to present the draft Report. The public expressed concerns about additional water development, particularly in the Upper Basin, in the absence of more-intensive conservation in the municipal sector. Concerns also were expressed about the environmental and social impacts of additional water development and the need for more-detailed environmental and social impact evaluations. Comments from the public are acknowledged in the final report for the Assessment Project. These comments will be considered during subsequent phases of investigation.

**Recommendations:** Based on studies for the Water and Storage Needs Assessment Project, additional water development will be required to meet the year 2040 needs of District water supply entities. In order to initiate this development, the following actions are recommended:

1. The District should focus its initial deliberations on the Lake Meredith Enlargement, Fry-Ark Project Reoperation, Turquoise Lake Enlargement, Pueblo Reservoir Enlargement, Gravel Lakes storage, and non-structural alternatives. These alternatives involve Project facilities or options that work conjunctively with Project facilities.

2. Execute a Memorandum of Agreement with Colorado Springs to allow collaboration and technical oversight by the District in their technical review/NEPA compliance study.

3. Update and refine the existing Fry-Ark operations model to include storage of Winter Water, "if-and-when" water, and East Slope Project water.

4. Continue discussions with the U.S. Bureau of Reclamation relative to "reoperation" and Project reservoir enlargements.

5. Hold meeting(s) with SSC to evaluate financing options.

6. Further evaluate the "Valley Pipeline" concept.

7. Conduct follow-up information meetings with constituent groups.

8. Maintain the Storage Study Committee process.

9. Conduct system operations studies for various combinations of storage options. This should include evaluation of operations scenarios that would enhance instream flows and recreational opportunities. These studies also should consider potential water quality impacts, particularly related to reoperation.

10. Conduct preliminary environmental studies to assess potential "fatal flaws."

11. Review identified non-structural water management options that could be integrated into a preferred plan of water development.

12. Undertake legal/institutional reviews relative to the identified storage/reoperations alternatives.

Colorado Springs is proceeding with assessment of permitting issues associated with their identified storage needs. In order to avoid duplication of efforts, we recommend that the District and Colorado Springs work cooperatively.

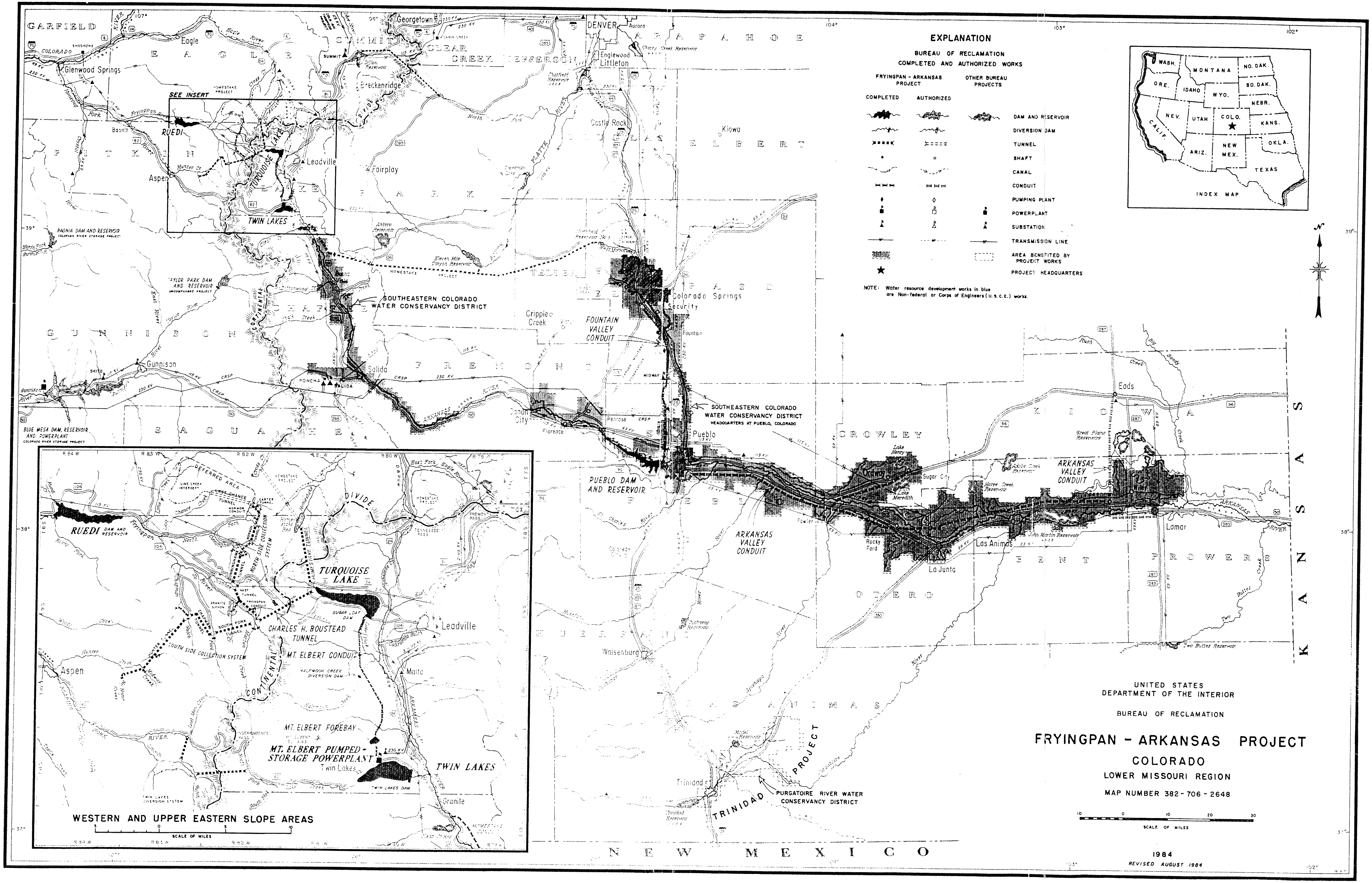
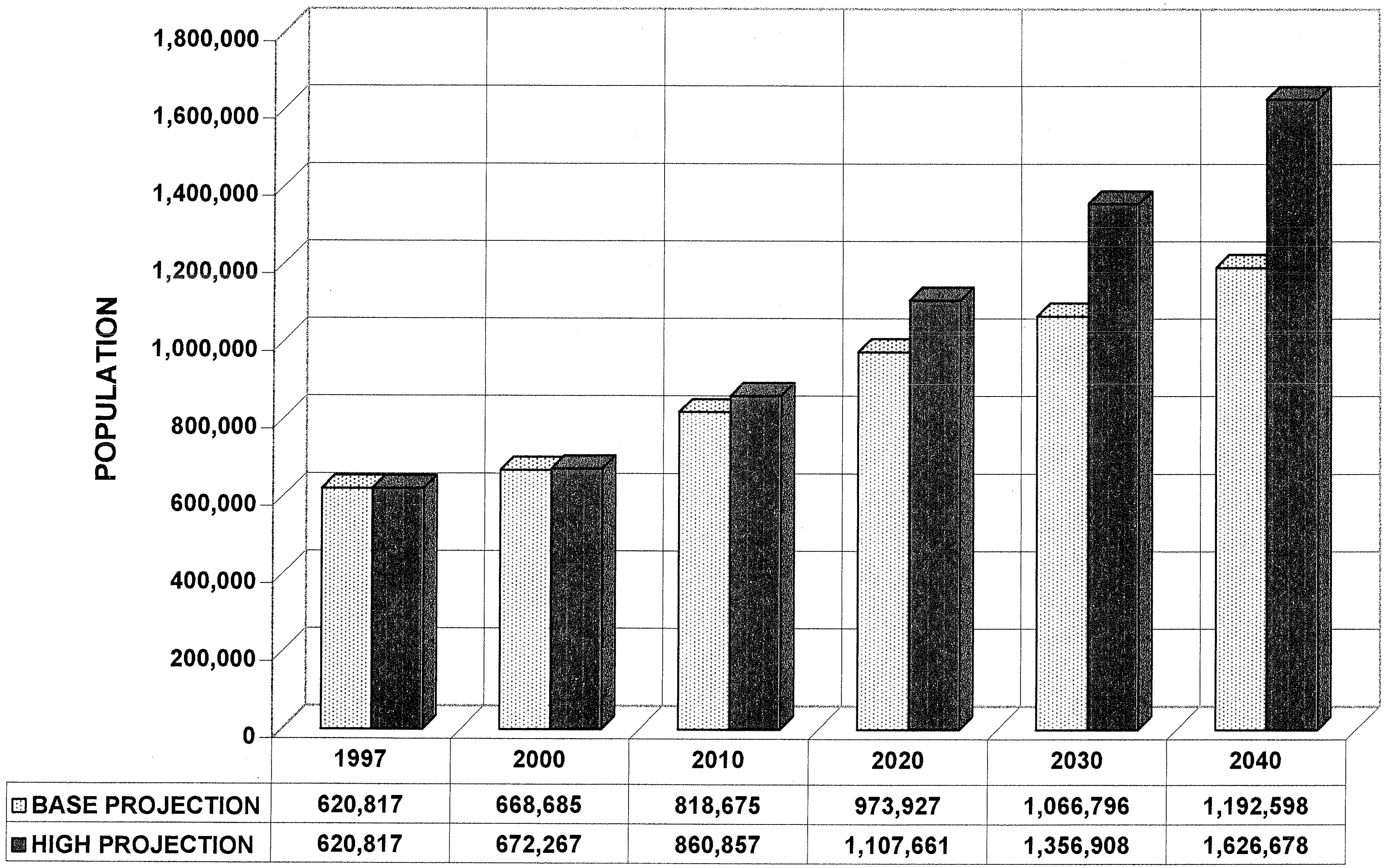

EXPLANATION
BUREAU OF RECLAMATION
COMPLETED AND AUTHORIZED WORKS
FRYINGPAN - ARKANSAS PROJECT
OTHER BUREAU PROJECTS
COMPLETED
AUTHORIZED
DAM AND RESERVOIR
DIVERSION DAM
TUNNEL
SHAFT
CANAL
CONDUIT
PUMPING PLANT
POWERPLANT
SUBSTATION
TRANSMISSION LINE
AREA BENEFITED BY PROJECT WORKS
PROJECT HEADQUARTERS
NOTE: Water resource development works in blue are Non-federal or Corps of Engineers (U.S.C.E.) works.
INDEX MAP
WASH.
MONTANA
NO. DAK.
ORE.
IDAHO
WYO.
SO. DAK.
NEBR.
NEV.
UTAH
COLO.
KANS.
CALIF.
ARIZ.
NEW MEX.
OKLA.
TEXAS
GARFIELD
EAGLE
SUMMIT
CLEAR CREEK
JEFFERSON
DENVER
ARAPAHOE
PITKIN
LAKE
PARK
DOUGLAS
ELBERT
TELLER
EL PASO
GUNNISON
CHAFFEE
FREMONT
SAGUACHE
CROWLEY
KIOWA
PUEBLO
OTERO
BENT
PROWERS
HUERFANO
LAS ANIMAS
KANSAS
NEW MEXICO
Glenwood Springs
Eagle
Georgetown
Breckenridge
Englewood
Littleton
Aurora
Basalt
Aspen
Leadville
Fairplay
Castle Rock
Kiowa
Colorado Springs
Security
Fountain
Cripple Creek
Buena Vista
Salida
Poncha
Gunnison
Canon City
Florence
Penrose
Pueblo
Ordway
Sugar City
Fowler
Rocky Ford
La Junta
Las Animas
Eads
Lamar
Walsenburg
Trinidad
SEE INSERT
RUEDI
TURQUOISE LAKE
TWIN LAKES
HOMESTAKE PROJECT
PAONIA DAM AND RESERVOIR
COLORADO RIVER STORAGE PROJECT
TAYLOR PARK DAM AND RESERVOIR
UNCOMPAHGRE PROJECT
BLUE MESA DAM, RESERVOIR AND POWERPLANT
COLORADO RIVER STORAGE PROJECT
SOUTHEASTERN COLORADO WATER CONSERVANCY DISTRICT
FOUNTAIN VALLEY CONDUIT
SOUTHEASTERN COLORADO WATER CONSERVANCY DISTRICT
HEADQUARTERS AT PUEBLO, COLORADO
PUEBLO DAM AND RESERVOIR
ARKANSAS VALLEY CONDUIT
ARKANSAS VALLEY CONDUIT
Lake Henry
Lake Meredith
Great Plains Reservoirs
Adobe Creek Reservoir
Horse Creek Reservoir
John Martin Reservoir
Two Buttes Reservoir
Antero Reservoir
Eleven Mile Canyon Reservoir
Chatfield Reservoir
Cherry Creek Reservoir
TRINIDAD PROJECT
PURGATOIRE RIVER WATER CONSERVANCY DISTRICT
Arkansas River
Fryingpan
Colorado
230 KV
115 KV
CRSP
107°
106°
105°
104°
103°
102°
39°
38°
37°
WESTERN AND UPPER EASTERN SLOPE AREAS
RUEDI DAM AND RESERVOIR
TURQUOISE LAKE
SUGAR LOAF DAM
CHARLES H. BOUSTEAD TUNNEL
MT. ELBERT CONDUIT
HALFMOON CREEK DIVERSION DAM
MT. ELBERT FOREBAY
MT. ELBERT PUMPED-STORAGE POWERPLANT
TWIN LAKES
TWIN LAKES DAM
TWIN LAKES DIVERSION SYSTEM
SOUTH SIDE COLLECTION SYSTEM
NORTH SIDE COLLECTION SYSTEM
DEFERRED AREA
LIME CREEK INTERCEPT
CARTER TUNNEL
BOUSTEAD TUNNEL
FRYINGPAN TUNNEL
SOUTH FORK TUNNEL
CONTINENTAL DIVIDE
Leadville
Malta
Aspen
Granite
Twin Lakes
HOMESTAKE PROJECT
R 84 W
R 83 W
R 82 W
R 81 W
R 80 W
R 79 W
SCALE OF MILES
0
5
10
UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION
FRYINGPAN - ARKANSAS PROJECT
COLORADO
LOWER MISSOURI REGION
MAP NUMBER 382 - 706 - 2648
10
0
10
20
30
SCALE OF MILES
1984
REVISED AUGUST 1984

FIGURE ES-1

**Base and High Population Projections**
Southeastern Colorado Water Conservancy District

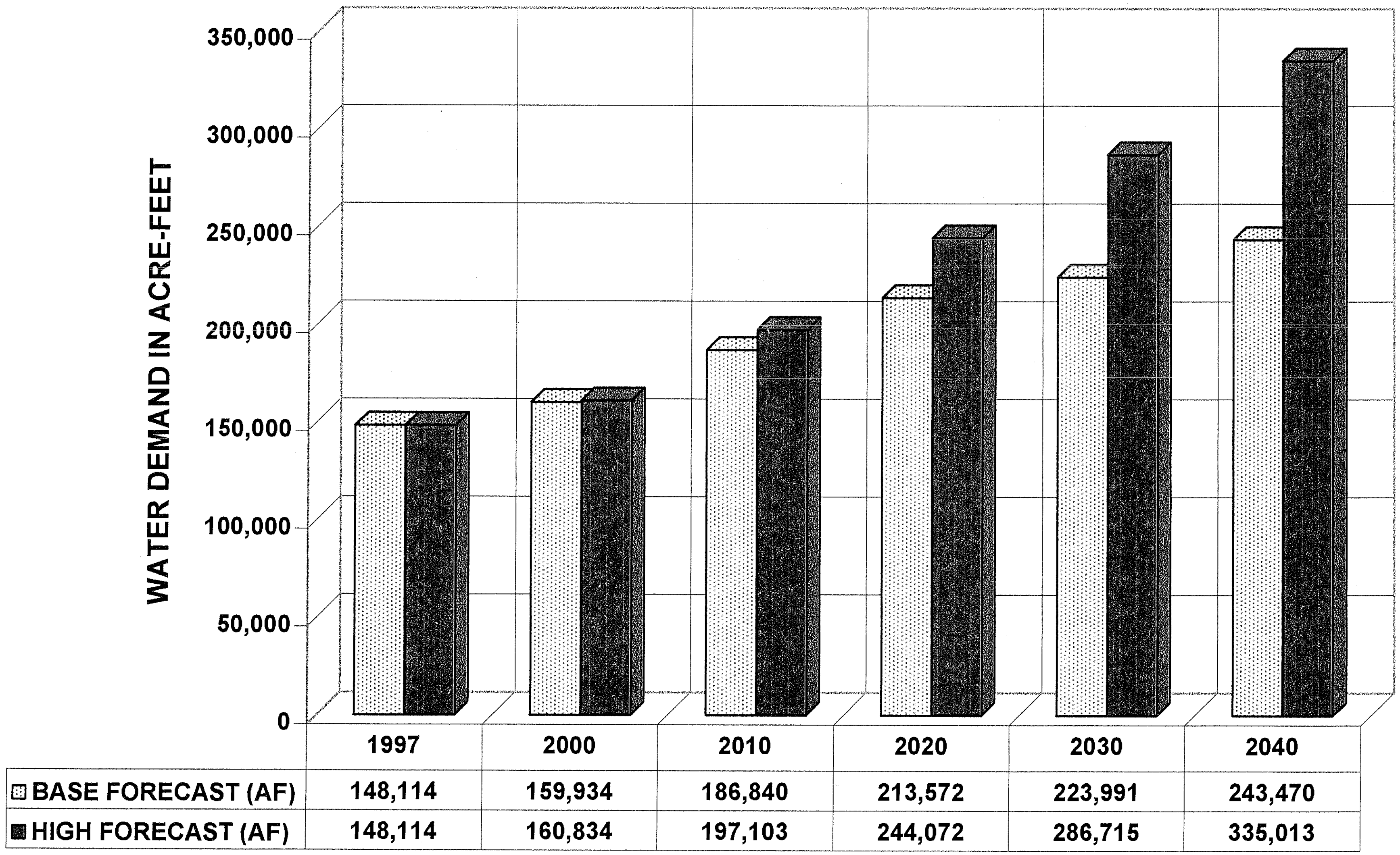


| | 1997 | 2000 | 2010 | 2020 | 2030 | 2040 |
|---|---|---|---|---|---|---|
| ▨ BASE PROJECTION | 620,817 | 668,685 | 818,675 | 973,927 | 1,066,796 | 1,192,598 |
| ■ HIGH PROJECTION | 620,817 | 672,267 | 860,857 | 1,107,661 | 1,356,908 | 1,626,678 |

**FIGURE ES-2**
**POPULATION PROJECTIONS**

sumdem_graphs.xls/POPULATION (ES)

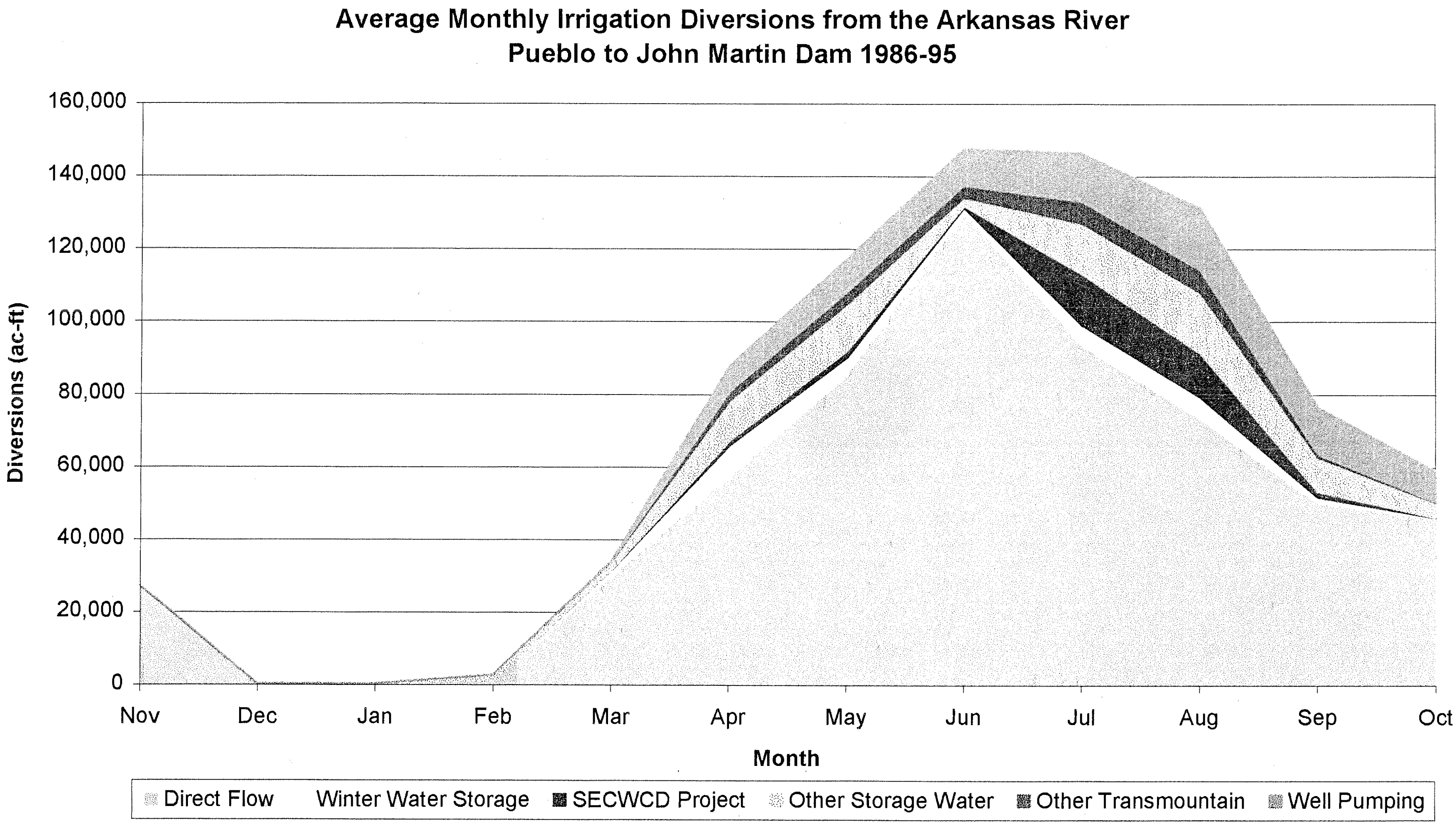
## Base and High Water Demand Forecasts
(With Conservation)



| | 1997 | 2000 | 2010 | 2020 | 2030 | 2040 |
|---|---|---|---|---|---|---|
| ▨ BASE FORECAST (AF) | 148,114 | 159,934 | 186,840 | 213,572 | 223,991 | 243,470 |
| ■ HIGH FORECAST (AF) | 148,114 | 160,834 | 197,103 | 244,072 | 286,715 | 335,013 |

sumdem_graphs.xls/WATER DEMANDS (ES)

**FIGURE ES-3**
**WATER DEMAND FORECASTS**

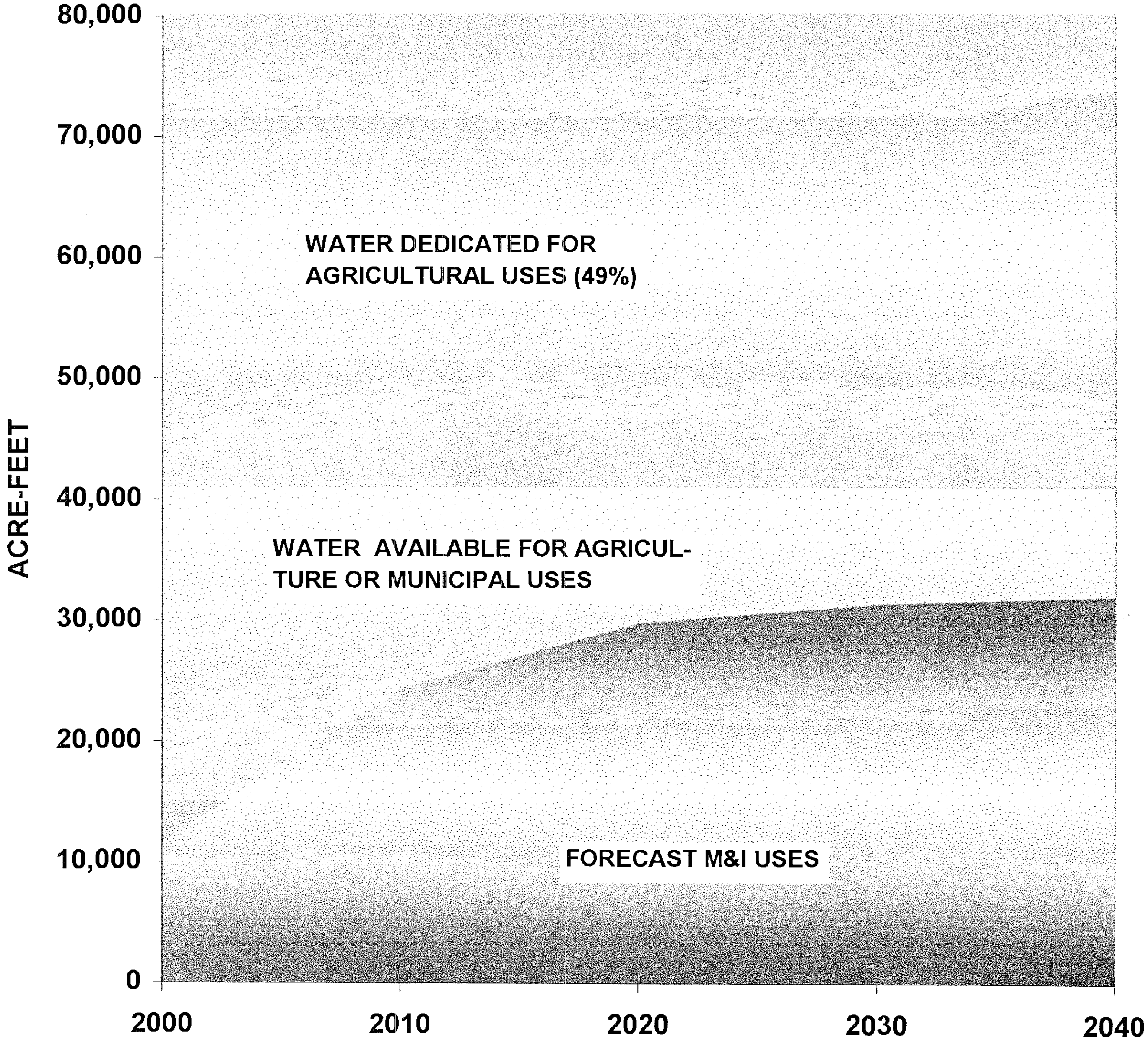


Note: Includes the Bessemer, Excelsior, Colorado, Highline, Oxford, Otero, Catlin, Fort Lyon, Rocky Ford, Holbrook, Las Animas Consolidated and Keesee Canals. Winter water includes only the water stored in Pueblo Reservoir for the direct flow ditches and in John Martin Reservoir for the Las Animas Consolidated and Fort Lyon Canals. Data was compiled from the State Engineer's records.

**FIGURE ES-4**
**AGRICULTURAL WATER USE**

Divsum1.xls/All Ditches Chart

## FUTURE USE OF FRY-ARK PROJECT WATER
(HIGH FORECAST WITH CONSERVATION)



**<u>FIGURE ES-5</u>**
**FORECAST FRY-ARK WATER USE - BASED ON ESTIMATED ANNUAL YIELD**

GEI CONSULTANTS, INC
12/8/98

svd_final_high.xls/
FRY-ARK USE - 80,400 af (ES)

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Section 1

# 1. INTRODUCTION

## 1.1 Scope of Work

Water use throughout the west and particularly in the Arkansas Basin (Figure 1.1) is experiencing a higher level of competition for water resources. This situation is exacerbated by traditional natural drought cycles and increasing population. Water managers now labor under the increased burden of man-made or regulatory-imposed water demands that further stress limited resources. Therefore, a carefully defined assessment of future water supply needs in the Basin was deemed to be critical. This assessment includes identification of potential storage alternatives to meet future needs of Basin water users, while protecting major recreational and environmental interests. The goal of the Assessment Project is to establish future water demands in the District, coupled with developing alternative strategies on how to meet future needs for the municipal and agricultural water users.

The Southeastern Colorado Water Conservancy District (SECWCD)/Arkansas Basin Future Water and Storage Needs Assessment Project (the "Assessment Project") was initiated in July 1997. The work was conducted by a team of consultants headed by GEI Consultants, Inc. (GEI) and subconsultants Helton and Williamsen, P.C., and David Bamberger & Associates. The GEI team operated under an Agreement between the Southeastern Colorado Water and Storage Needs Assessment Enterprise and GEI, which was executed on June 26, 1997.

The scope of work for the Assessment Project included the following major tasks:

| **Task No.** | **Description** |
|---|---|
| 1 | Data Collection and Review |
| 2 | Description of Water Systems |
| 3 | Population Projections |
| 4 | Agricultural Water Use |
| 5 | Current and Potential Water Conservation Efforts |
| 6 | Water Demand Forecasts |
| 7 | Supply and Demand Comparison |
| 8 | Need for Additional Water Supplies |
| 9 | Storage Requirements |
| 10 | Assessment of Fryingpan-Arkansas Project Supplies |
| 11 | Water Storage and Supply Alternatives |

| | |
|---|---|
| 12 | Evaluation of Alternatives |
| 13 | Meetings and Presentations |
| 14 | Progress Reports |
| 15 | Draft and Final Assessment Report |

## 1.2 Conduct of Investigation

The Assessment Project has a clear and achievable goal - **to identify the best option(s) for meeting the future water supply and storage needs of the District's constituents, while protecting existing interests in the Fryingpan-Arkansas Project.** Successfully achieving this goal involves meeting four main objectives:

1. Prepare an accurate assessment of the future needs of water users within the District boundaries.

2. Evaluate the ability of existing water supply facilities to meet future water supply needs within the District.

3. Identify and rank opportunities for developing additional water supplies, including "reoperation" of existing reservoirs and conveyance facilities and implementation of new storage projects.

4. Provide a clear communications channel to obtain input from water providers and user groups within the District, including the public.

The GEI project team conducted the study generally following the detailed scope of work included in the previously referenced Agreement. Work was coordinated with staff of the SECWCD and with a Storage Study Committee (SSC), which was created to provide guidance and direction for the Assessment Project.

## 1.3 Acknowledgments

The following entities joined with the Assessment Enterprise as "local participants" in the project:

Arkansas Groundwater Users Association
Catlin Canal Company
City of Canon City
City of Florence
City of La Junta
Bessemer Ditch Company
City of Aurora
City of Colorado Springs
City of Fountain
City of Lamar

City of Las Animas
City of Salida
Colorado Water Protection and Development Association
Holbrook Mutual Irrigation Company
Pueblo Board of Water Works
Public Service Company
Security Water and Sanitation District
Widefield Water and Sanitation District
City of Rocky Ford
Colorado Canal Company
Fort Lyon Canal Company
Lower Arkansas Water Management Association
Pueblo West Metro District
St. Charles Mesa Water
Southeastern Colorado Water Conservancy District
Stratmoor Hills Water and Sanitation District
Upper Arkansas Water Conservancy District

Each local participant committed cash and/or in-kind contributions to the Assessment Enterprise for the purpose of conducting the Assessment Project. In addition, the Colorado Water Conservation Board (CWCB) joined the partnership and provided financial and technical staff contributions to the Project.

The consultant team wishes to acknowledge and thank the staff of the District, particularly Steve Arveschoug, Tom Simpson, and Kelly Brace for their support in completing this study and report. We appreciate the guidance offered by the Storage Study Committee and the District Board members. We also wish to thank the staff of the Colorado Water Conservation Board, particularly Steve Miller, for their support and constructive inputs during the course of the study. The water users of the District are acknowledged for sharing their water resources data and providing the data base needed for conducting the study.

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# 2. DESCRIPTIONS OF EXISTING WATER SYSTEMS

## 2.1 Primary Water Supply Sources

Water users in the SECWCD obtain water from three primary sources: 1) native surface water supplies, 2) imported water supplies from the Fryingpan-Arkansas (Fry-Ark) Project and other transmountain diversions, and 3) ground water, including springs, alluvial wells, and non-tributary wells. A general description of these sources is provided in Sections 2.1.1 through 2.1.4. In Section 2.2, water supply sources and general system characteristics are presented for 25 larger municipal and industrial (M&I) water supply entities (23 larger municipal entities in the SECWCD, plus Public Service Company of Colorado and the City of Aurora) and summarized for the numerous smaller M&I entities within the SECWCD. The City of Aurora, while not located within the SECWCD, has extensive water holdings in the Basin. Similar discussions are provided in Section 2.3 for the agricultural water supply entities. Like many river basins in Colorado, the majority of water use in the Arkansas Basin is for irrigated agriculture. The arrangement of canal and ditch systems, and the development of alluvial wells for irrigation, has resulted in a substantial amount of agricultural "re-use" in the lower Basin, because irrigation return flows are made available to down-gradient irrigation systems.

As population growth continues (Section 3), M&I water use is projected to increase in proportion to agricultural water use, which is anticipated to remain fairly constant (or decline somewhat) over the planning horizon (year 2040). This situation may result in the need to develop additional water supplies and to change how existing water sources and supply facilities are operated.

### 2.1.1 Native Surface Water Supplies

As shown on Figure 2.1, which serves as a key map for this report, the Arkansas River rises in the Rocky Mountains, near Leadville, in central Colorado. From its source to Canon City, Colorado, the stream is a typical mountain torrent, descending from Elevation 11,500 to Elevation 5,300. This section is characterized by a succession of narrow valleys separated by short canyon sections. Between Canon City and Pueblo, the valley widens slightly and is flanked by foothills as it descends to Elevation 4,700 at Pueblo. Here the river emerges into a plains section and the stream course is characterized by low banks and a broad, sandy bed that shifts frequently. Elevation of the streambed at John Martin Dam is 3,765 feet and from there descends gradually to 1,800 feet at Great Bend, Kansas. Slopes vary from a maximum of about 110 feet per mile in the mountain reaches to about 7 feet per mile in the plains section. Above John Martin Dam, these slopes result in flood flows characterized by rapid rise, high peak discharge, and short duration, while the more moderate slopes between the dam and state line tend to flatten the peaks and extend the duration of a flood wave. The river above John Martin Dam is 300 miles in length and drains an area of 18,915 square miles of which 18,130 square miles are contributing drainage area. Above John Martin Dam, four principal tributaries enter the mainstream from the south. They are St. Charles, Huerfano, Apishapa, and Purgatoire Rivers. Tributaries entering from the north are Fountain River, Chico Creek, and Horse Creek. The state line is about 58 miles below John Martin Dam. Drainage area from John Martin to the state line is 6,485 square miles. Big Sandy Creek is the principal north side tributary. Tributaries from the south are Caddoa Creek, Mud Creek, Dry Creek, Willow Creek, Clay Creek, and Two Buttes Creek.

Average annual yield of native water in the Arkansas Basin is estimated to be approximately 875,000 acre-feet (af) (Montgomery Watson, 1997: Study for Farm Bureau). Imported water has averaged approximately 131,500 af/yr (1986-1995) from nine transmountain diversions (see Section 2.1.2).

Major storage reservoirs in the Basin above John Martin include (from upstream to downstream) Turquoise Lake, Twin Lakes, Clear Creek, and Pueblo in the upper Basin, and Lake Meredith, Lake Henry, Dye, Holbrook, Horse Creek, and Adobe in the lower Basin. The upper Basin reservoirs regulate native flows, as well as transmountain imports of water. Turquoise Lake, Twin Lakes, and Pueblo Reservoir are storage features in the Fry-Ark Project. The lower Basin reservoirs regulate native flows and return flows, and several provide important exchange capabilities that enhance overall water supplies for entities in the SECWCD.

### 2.1.2 Imported Water Sources

There are nine sources of imported water into the Arkansas Basin. All of these transmountain diversions are in the upper Basin and they include:

| Transmountain Diversion | 1986-1995 Average Delivery[1] (af/yr) | Water Apportioned to or Owned by[2]: |
|---|---|---|
| • Fry-Ark Project (Boustead Tunnel) | 48,715 | Ditch Companies/Fountain Valley/ Others |
| • Hoosier Pass Tunnel | 10,125 | Colorado Springs |
| • Columbine Ditch | 1,590 | Pueblo |

| **Transmountain Diversion** | **1986-1995 Average Delivery[1] (af/yr)** | **Water Apportioned to[2]:** |
|---|---|---|
| • Ewing Ditch | 1,012 | Pueblo |
| • Wurtz Ditch | 2,549 | Pueblo |
| • Homestake Tunnel | 22,187 | Aurora/Colorado Springs |
| • Busk-Ivanhoe Tunnel | 4,808 | Pueblo/Aurora |
| • Twin Lakes Tunnel | 40,349 | Colorado Springs/Pueblo/Others |
| • Larkspur Ditch | 129 | Catlin Canal Company |
|  | 131,464 |  |

(1) Source: Upper Colorado River Commission 1995 Annual Report.
(2) Arkansas River Basin Study Phase I Report (Boyle, 1988).

A key transmountain diversion for the SECWCD service area is the Fry-Ark Project, which began diversion operations in 1972. Water is diverted from the mainstream of the Fryingpan River and its tributaries and delivered through the Charles H. Boustead Tunnel to the Lake Fork of Arkansas River. Imported water is stored in Turquoise Reservoir on the Lake Fork and in Twin Lakes via conveyance through the Mt. Elbert Conduit. Terminal storage for Fry-Ark water is provided at Pueblo Reservoir. Turquoise Reservoir also regulates transmountain diversions through the Busk-Ivanhoe Tunnel and the Homestake Tunnel. Twin Lakes Reservoir stores water imported through the Boustead Tunnel, as well as water imported through the Homestake Tunnel. During 1986-1995, an average of 48,715 af/yr was imported to the Arkansas Basin through the Boustead Tunnel. In 1995, a wet year, 90,460 af was brought through the tunnel and stored in available reservoir space. In 1996, only 36,000 af was brought through the tunnel because of carry-over in East Slope storage from 1995. **Details on operations of the Fry-Ark Project are provided in Section 7.0 of this report.**

### 2.1.3 Operation of the Fryingpan-Arkansas Project

Operation of the Fry-Ark Project was originally defined in the report authorizing the Project and has evolved over time. Currently, Project operations, which are implemented by the USBR, can be summarized as follows:

1. Adequate vacant space is created in Turquoise Lake and Twin Lakes by the end of April, in anticipation of the current year diversions of Project and non-Project water from the west slope. This is accomplished through the release of Project water from the upper two reservoirs and conveyance of such water down the

Arkansas River to Pueblo Reservoir during the preceding months of October, November, December, January, February, March, and April.

2. All west slope water available is diverted to the Project to the east slope, subject to the Operating Principles, limits of reservoir storage capacity, contractual arrangements, and demand for direct delivery of Project water.

3. As much of the newly diverted west slope Project water as possible is stored in the upper reservoirs, subject to the limits of reservoir storage capacity and contractual arrangements.

4. Newly diverted west slope Project water, which cannot be stored in the upper reservoirs, is conveyed down the Arkansas River to Pueblo Reservoir, subject to the limits of reservoir storage capacity and contractual arrangements.

5. Project water is released from the upper reservoirs to meet the demands of Project water users who are located in the District upstream of Pueblo Reservoir. These releases may occur in any month throughout the year.

6. Project water is released from Pueblo Reservoir to the Arkansas River, the Fountain Valley Conduit, and the Bessemer Ditch to meet the demands of Project water users that may be served from Pueblo Reservoir. Releases to the Arkansas River and Fountain Valley Conduit may occur in any month throughout the year. Releases to the Bessemer Ditch are during the irrigation season.

The conveyance of water from the upper reservoirs to Pueblo Reservoir is managed to try to meet a variety of instream flow objectives within the overall legal constraints of water law and contractual requirements and in accordance with the voluntary annual flow agreement between the Bureau of Reclamation and Colorado Department of Natural Resources. These objectives include:

- Maintaining a minimum year-round flow of 250 cfs (at the Wellsville Gage) to protect the fishery.

- Maintaining optimum flows for fish spawning during specific periods of the year. This set of flows is relatively complex, involving target flows during fish spawning, incubation, and hatching periods.

- Providing at least 700 cfs (at the Wellsville Gage) during the July 1 - August 15 period primarily to support rafting.

- Limiting daily changes in flows to 10 - 15 percent.

The District has concurred with the flow management plan outlined above but has indicated that releases from Project storage should be limited to 10,000 af, unless the District approves more and releases should be subject to water availability and storage space limitations.

### 2.1.4 Ground Water

Ground water in the Arkansas Basin occurs in the valley fill alluvial aquifer, alluvial aquifers along tributaries to the river, the High Plains aquifer, and bedrock aquifers. The valley fill and High Plains aquifers have characteristics that support significant development for large M&I and irrigation supplies. The High Plains aquifer is administered under the Colorado Ground Water Management Act of 1965, based on a modified doctrine of prior appropriation. Alluvial ground water is generally considered to be tributary to surface streams and is administered as such. Prior to 1996, ground water in the Dakota and Cheyenne Formations east of Canon City was not administered as part of the surface systems. Stream depletions caused by new wells require replacement pursuant to an administratively approved substitute water supply plan or a judicially approved augmentation plan. Ground water in the Denver Basin aquifers in the area of Colorado Springs is governed by rules and regulations and a permit system promulgated in 1985. As described later in Section 2, various water supply entities rely extensively on non-tributary and tributary wells for their water supplies. The majority of ground water use in the Basin is, however, for irrigation.

Development of the valley fill aquifer primarily for irrigation supplies increased steadily from 1940 to 1965 between Pueblo and John Martin Reservoir. Since 1965, the number of wells has held fairly constant. Mean annual pumping of the valley fill aquifer was estimated to average 100,000 af/yr between 1974 and 1985 from wells located between Pueblo and John Martin Reservoir, based on studies reported on by Boyle Engineering (1988). In 1995, the Colorado State Engineer amended the rules governing the diversion and use of tributary ground water in the Arkansas Basin. The amended rules were upheld by court decree in 1996. Under these regulations, well owners must furnish water to replace depletions with respect to senior ditches in Colorado and to usable flow at the Colorado-Kansas state line, pursuant to a decreed augmentation of substitute supply plan. These rules apply to the valley fill aquifer of the Arkansas River between Pueblo and the state line and the alluvium of Fountain Creek. As part of the rules and regulations, well owners have been required to submit monthly pumping or power use records.

## 2.2 Municipal Water Supply Entities

Information on the existing municipal water systems, which rely on water resources of the Arkansas River Basin and the SECWCD, was obtained from several sources, as identified below:

- The 1996 Survey Questionnaire issued by the District and completed by municipal water supply entities within the District.
- In-person interviews with the water resources staffs of the larger municipal entities.
- Telephone interviews with the other municipal water supply entities, identified by the District during the scoping phase of the study.
- Review of published reports and water resources planning documents listed in the "References" section of this report.

The 1996 Survey Questionnaire was mailed to all water supply entities in the District. Responses were obtained from the entities identified in "**bold**" in the following tabulation:

MUNICIPAL WATER USER ENTITY SECWCD SURVEY RESPONSES

**Major Municipal Entities**

Town of Buena Vista
**City of Salida**
**City of Canon City**
Park Center Water District
City of Florence
**Penrose Water District**
**Colorado Springs Utilities**
**Stratmoor Hills Water District**
**Widefield Water and Sanitation District**
**Security Water District**

**Town of Las Animas**
**City of Lamar**
**May Valley Water Association**

**Major Municipal Entities (Continued)**

**City of Fountain**
**Pueblo Board of Water Works**
**Pueblo West Metropolitan District**
**St. Charles Mesa Water District**
Crowley County Water Association
Town of Ordway
**Town of Fowler**
**City of Rocky Ford**
**City of La Junta**
Bents Fort Water Association

**Otero County**
Town of Cheraw
Town of Manzanola

**Fountain Valley Authority**(1)
**El Paso County Parks Department**(2)

(1) Responded to SECWCD's questionnaire. The FVA supplies Fry-Ark water to several municipal entities.
(2) Responded to SECWCD's questionnaire, but is not a municipal entity. Water is used for park irrigation.

**Other Municipal Entities (Aggregated in Their Respective Counties):**

**Chaffee County**
**Upper Arkansas Water Conservancy District**
Town of Poncha Springs

**Fremont County**
**Upper Arkansas Water Conservancy District**
Orchard Park Water Company
East Florence Water Company
Brookside Water Company

**Pueblo County**
Avondale Water and Sanitation District
**Town of Boone**
O'Neal Water Works
Joseph Water Company
Sunset View Water Association

**Crowley County**
**Crowley County Water System**
Town of Crowley
96 Pipeline
**Town of Olney Springs**
Town of Sugar City
**Sugar City Pipeline Company**
Town of Swink
Beehive Water Company
**East End Water Company**
Eureka Water Company
Fayette Water Association
Hancock Water Company
Hilltop Water Company
Holbrook Center Soft Water
Homestead Improvement
Hunnicutt Water Company
**Newdale-Grand Valley Water Company**
North Holbrook Water Company
Parkdale Water Company
Patterson Valley Water Association
**Riverside Water Company**
**Southside Water Association**
**South Swink Water Company**
Valley Water Company
Vroman Water Company
**West Grand Valley Inc.**

**Bent County**
Fort Lyon VA Medical Center
Hasty Water Company
McClave Water Association

**Prowers & Kiowa Counties**
Town of Eads
Town of Wiley
Prosperity Lane Water Association

**Industrial Entities**
Public Service Company

The amount of information and its level of detail contained in responses to the Survey Questionnaire generally was greater for the larger water supply entities in comparison to the smaller entities.

Each of the 23 larger municipal entities in the SECWCD was contacted either in person or by phone to obtain additional information and to supplement their responses to the questionnaire. Many of the smaller municipal entities were also contacted to obtain information, especially those that had not responded to the questionnaire.

### 2.2.1 Larger Systems

The following sections describe the larger municipal water systems in the District, with a brief description of the Fountain Valley Authority. The locations of these systems are shown on Figure 2.2. A summary of information obtained during the surveys and contacts with the 23 entities is provided in Table 2.1. A key element in planning for future water needs is the assessment of current yield from existing water rights. For the Assessment Project, we relied on information provided by the water supply entities relative to the firm yield of existing water resources, recognizing that each entity may define firm yield somewhat differently and that, where appropriate, firm yields may be affected by water delivery or other constraints, including storage.

# TABLE 2.1
# SUMMARY OF DATA FROM SURVEYS OF THE 23 LARGER MUNICIPAL WATER SUPPLY ENTITIES

| Water Supply Entity | Year | Population persons | Water Demand af | Unit Demand gpcd/day | Avg. Unit Demand gpcd/day | Firm Yield, af/yr | | Fry-Ark Water Use af/yr | Basin/District Storage, af | | Conservation Measures | Other Information |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Surface Water | Wells | | Entity's System | Fry-Ark Project | | |
| Buena Vista | 1980 | 2,075 | 1,113 | 479 | | | | | | | | Water rights in Cottonwood Creek |
| | 1985 | | 1,015 | | | | | | | | | Basin. Senior agricultural rights |
| | 1990 | 1,752 | 792 | 404 | | | | | | | | changed to municipal use. |
| | 1995 | | 818 | | | | | | | | | |
| | Current | 2,039 | 1,048 | 459 | | | | | | | | |
| | | | | | 447 | 2,809 | | | | | | |
| Salida | 1980 | 4,950 | | | | | | | | | Yes- Variety | North Fork Reservoir shared with |
| | 1985 | 4,990 | | | | | | | | | of measures | UAWCD. 375 af to Salida 200 af |
| | 1990 | 4,400 | 2,444 | 496 | | | | | | | in place or | to UAWCD. |
| | 1995 | 5,200 | 2,272 | 390 | | | | | | | planned. | |
| | Current | 5,600 | 2,400 | 383 | | | | | | | | |
| | | | | | 423 | 2,240 | | 2,500 | | | | |
| Canon City | 1980 | | | | | | | | | | Yes- Variety | City has senior rights on Arkansas R. |
| | 1985 | | | | | | | | | | of measures | Limited use of Fry-Ark water (614 af) |
| | 1990 | 22,255 | 4,834 | 194 | | | | | | | in place or | from 1985 to 1994 |
| | 1995 | 23,974 | 5,246 | 195 | | | | | | | planned. | |
| | Current | 24,333 | 6,005 | 220 | | | | | | | | |
| | | | | | 203 | 23,891 | | | | | | |
| Park Center Water | 1980 | | | | | | | | | | | Storage in Pisgah Reservoir (200 af) |
| District | 1985 | | | | | | | | | | | not used as yet. |
| | 1990 | | | | | | | | | | | |
| | 1995 | | | | | | | | | | | |
| | Current | 2,800 | 430 | 137 | | | | | | | | |
| | | | | | 137 | 1,131 | | 40 | | | | |
| Florence | 1980 | 3,625 | 1,057 | 260 | | | | | | | | City is considering construction of |
| | 1985 | 3,712 | 1,082 | 260 | | | | | | | | Oak Creek Reservoir (2250 af) to meet |
| | 1990 | 3,801 | 1,108 | 260 | | | | | | | | its longer term needs. |
| | 1995 | 5,148 | 1,504 | 261 | | | | | | | | |
| | Current | 5,860 | 1,670 | 254 | | | | | | | | |
| | | | | | 259 | 4,835 | | 9 | | | | |
| Penrose Water District | 1980 | | | | | | | | | | | Primary source of supply is leased |
| | 1985 | | | | | | | | | | | water from Beaver Park Water Inc. |
| | 1990 | | 403 | | | | | | | | | Firm yield is based on contracted |
| | 1995 | | 464 | | | | | | | | | water. |
| | Current | 3,499 | 464 | 118 | | | | | | | | |
| | | | | | 118 | 100 | | | | | | |
| Colorado Springs Utilities | 1980 | 215,105 | 56,144 | 233 | | | | | | | Yes- Variety | City has 1100 af of developed non- |
| | 1985 | 262,889 | 65,577 | 223 | | | | | | | of measures | potable supplies and 67,100 af of un- |
| | 1990 | 281,140 | 65,395 | 208 | | | | | | | in place or | developed supplies. A long-range |
| | 1995 | 335,413 | 68,588 | 183 | | | | | | | planned. | water resources plan has been |
| | Current | 341,810 | 78,517 | 205 | | | | | | | | prepared and is guiding infrastructure |
| | | | | | 210 | 113,647 | | 1,200 | 89,541 | 57,090 | | development. |

# TABLE 2.1
## SUMMARY OF DATA FROM SURVEYS OF THE 23 LARGER MUNICIPAL WATER SUPPLY ENTITIES

| Water Supply Entity | Year | Population persons | Water Demand af | Unit Demand gpcd/day | Avg. Unit Demand gpcd/day | Firm Yield, af/yr | | Fry-Ark Water Use af/yr | Basin/District Storage, af | | Conserva-tion Measures | Other Information |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Surface Water | Wells | | Entity's System | Fry-Ark Project | | |
| Stratmoor Hills Water and | 1980 | 5,500 | 832 | 135 | | | | | | | | City can pump 770 af/yr without |
| Sanitation District | 1985 | 5,800 | 775 | 119 | | | | | | | | recharge and 1270 af with recharge. |
| | 1990 | 5,850 | 818 | 125 | | | | | | | | City has wells in Widefield Aquifer. |
| | 1995 | 6,000 | 829 | 123 | | | | | | | | |
| | Current | 6,100 | 880 | 129 | | | | | | | | |
| | | | | | 126 | | 770 | 601 | | | | |
| Widefield Water and | 1980 | 15,500 | 3,000 | 173 | | | | | | | Yes- Variety | Water supplied by Widefield Homes |
| Sanitation District | 1985 | 18,000 | 2,900 | 144 | | | | | | | of measures | Water Company. Ground water |
| | 1990 | 20,000 | 2,800 | 125 | | | | | | | in place or | is supplemented by Fry-Ark water from |
| | 1995 | 20,000 | 2,900 | 129 | | | | | | | planned. | the FVA. |
| | Current | 20,000 | 3,100 | 138 | | | | | | | | |
| | | | | | 142 | | 2,475 | 1,500 | | 5,693 | | |
| Security Water District | 1980 | 9,500 | 2,831 | 266 | | | | | | | Yes- Variety | Yield shown is with full augmentation |
| | 1985 | 10,000 | 2,731 | 244 | | | | | | | of measures | of pumping from wells. |
| | 1990 | 12,000 | 3,110 | 231 | | | | | | | in place or | |
| | 1995 | 15,000 | 3,096 | 184 | | | | | | | planned. | |
| | Current | 16,000 | 2,319 | 129 | | | | | | | | |
| | | | | | 211 | | 3,336 | 1,640 | | 6,500 | | |
| Fountain | 1980 | 6,000 | 800 | 119 | | | | | | | | Firm delivery from FVA up to |
| | 1985 | 8,000 | 909 | 101 | | | | | | | | 2000 af/yr. Currently 1330 af/yr is taken. |
| | 1990 | | 1,370 | | | | | | | | | City plans to add wells in the Fountain |
| | 1995 | | 1,569 | | | | | | | | | Creek Aquifer. Fry-Ark water is used |
| | Current | 12,000 | 1,700 | 126 | | | | | | | | for augmentation. |
| | | | | | 116 | | 3,300 | 1,600 | | 5,200 | | |
| Board of Water Works | 1980 | 101,686 | 27,691 | 243 | | | | | | | Yes- Variety | Pueblo has senior direct flow rights on |
| Pueblo | 1985 | 97,910 | 23,917 | 218 | | | | | | | of measures | the Arknsas R. , transmountain water, and |
| | 1990 | 98,640 | 24,752 | 224 | | | | | | | in place or | storage in the Upper Basin. Storage on |
| | 1995 | 102,319 | 24,703 | 216 | | | | | | | planned. | Tennessee Creek is being investigated. |
| | Current | 103,200 | 20,468 | 177 | | | | | | | | Some water is leased to PSCo. |
| | | | | | 216 | 74,032 | | | 26,775 | 31,200 | | |
| Pueblo West | 1980 | 2,660 | 900 | 302 | | | | | | | Yes- Variety | Physically can now take 2400 af of |
| Metropolitan District | 1985 | 3,286 | 1,047 | 284 | | | | | | | of measures | 7956 af of non-tributary water rights. |
| | 1990 | 4,595 | 1,294 | 251 | | | | | | | in place or | Twin Lakes shares yield 5732 af before |
| | 1995 | 7,862 | 1,561 | 177 | | | | | | | planned. | transit losses. Also have 237 shares of |
| | Current | 9,395 | 1,700 | 162 | | | | | | | | Colorado Canal Co. water. |
| | | | | | 235 | 5,700 | 7,956 | | | | | |
| St. Charles Mesa | 1980 | 8,343 | 1,304 | 140 | | | | | | | | |
| Water District | 1985 | 8,973 | 1,518 | 151 | | | | | | | | |
| | 1990 | 9,456 | 1,692 | 160 | | | | | | | | |
| | 1995 | 10,140 | 1,999 | 176 | | | | | | | | |
| | Current | 10,263 | 2,020 | 176 | | | | | | | | |
| | | | | | 160 | | | | 690 | 1,800 | | |
| Crowley County | 1980 | | | | | | | | | | | Wells could yield up to 1315 af/yr. |
| Water Association | 1985 | | | | | | | | | | | Crowley County leases up to 750 af/yr |
| | 1990 | 3,196 | 597 | 167 | | | | | | | | of Fry-Ark water to augment their wells. |
| | 1995 | 3,483 | 625 | 160 | | | | | | | | |
| | Current | 3,595 | 598 | 149 | | | | | | | | |
| | | | | | 158 | | 644 | 750 | | 1,248 | | |

# TABLE 2.1
# SUMMARY OF DATA FROM SURVEYS OF THE 23 LARGER MUNICIPAL WATER SUPPLY ENTITIES

| Water Supply Entity | Year | Population persons | Water Demand af | Unit Demand gpcd/day | Avg. Unit Demand gpcd/day | Firm Yield, af/yr | | Fry-Ark Water Use af/yr | Basin/District Storage, af | | Conservation Measures | Other Information |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Surface Water | Wells | | Entity's System | Fry-Ark Project | | |
| Ordway | 1980 | | | | | | | | | | | Ordway purchases its water from the |
| | 1985 | | | | | | | | | | | Crowley County Water Association. |
| | 1990 | | | | | | | | | | | Population and water demand figures |
| | 1995 | | | | | | | | | | | are included in the figures for the |
| | Current | | | | | | | | | | | Crowley County Water Association. |
| | | | | | | | | | | | | |
| Fowler | 1980 | | | | | | | | | | | Shallow wells with augmentation using |
| | 1985 | | | | | | | | | | | Fry-Ark supplies. |
| | 1990 | 1,154 | 352 | 272 | | | | | | | | |
| | 1995 | 1,173 | 370 | 282 | | | | | | | | |
| | Current | 1,184 | 370 | 279 | | | | | | | | |
| | | | | | 278 | | 155 | 49 | | 305 | | |
| Rocky Ford | 1980 | 4,804 | | | | | | | | | | |
| | 1985 | 4,542 | | | | | | | | | | |
| | 1990 | 4,162 | 1,200 | 257 | | | | | | | | |
| | 1995 | 4,344 | 1,500 | 308 | | | | | | | | |
| | Current | 4,400 | | | | | | | | | | |
| | | | | | 283 | 2,385 | | 30 | | | | |
| La Junta | 1980 | | 2,631 | | | | | | | | Yes- Variety | City has 18,073 af of adjudicated |
| | 1985 | | 2,250 | | | | | | | | of measures | ground water rights. Fry-Ark water is |
| | 1990 | | 2,536 | | | | | | | | in place or | used to augment well pumping. |
| | 1995 | 7,876 | 2,921 | 331 | | | | | | | planned. | |
| | Current | 8,040 | 3,000 | 333 | | | | | | | | |
| | | | | | 332 | | 3,000 | | | 1,500 | | |
| Bents Fort Water Association | 1980 | | | | | | | | | | | Currently adding 2 new wells. |
| | 1985 | | | | | | | | | | | |
| | 1990 | | | | | | | | | | | |
| | 1995 | | | | | | | | | | | |
| | Current | 1,400 | 123 | 78 | | | | | | | | |
| | | | | | 78 | | 116 | | | | | |
| Las Animas | 1980 | 2,500 | 450 | 161 | | | | | | | | Las Animas uses Fry-Ark water |
| | 1985 | 2,500 | 450 | 161 | | | | | | | | to augment well pumping. |
| | 1990 | 2,500 | 450 | 161 | | | | | | | | |
| | 1995 | 2,500 | 539 | 192 | | | | | | | | |
| | Current | 2,675 | 600 | 200 | | | | | | | | |
| | | | | | 175 | | 538 | | | 1,097 | | |
| Lamar | 1980 | 7,713 | 2,381 | 276 | | | | | | | | Lamar uses Fry-Ark water and Fort |
| | 1985 | 8,360 | 2,666 | 285 | | | | | | | | Bent ditch water to augment well |
| | 1990 | 8,343 | 2,355 | 252 | | | | | | | | pumping. |
| | 1995 | 8,307 | 2,604 | 280 | | | | | | | | |
| | Current | | | | | | | | | | | |
| | | | | | 273 | | 1,100 | 2,100 | | | | |
| May Valley Water Assn. | 1980 | | | | | | | | | | | Water primarily for domestic use. |
| | 1985 | | | | | | | | | | | Some water is used at feedlot for |
| | 1990 | | | | | | | | | | | domestic purposes. |
| | 1995 | | | | | | | | | | | |
| | Current | 1,500 | 624 | 371 | | | | | | | | |
| | | | | | 371 | | 686 | | | | | |

### *2.2.1.1 Town of Buena Vista*

The Town of Buena Vista obtains its water from North Cottonwood and Cottonwood Creeks. Senior water rights total 3.88 cfs. Firm yield is estimated to be 2,809 af per year. An additional transfer of agricultural rights to municipal use could increase divertable supply to 5.88 cfs. This water portfolio reportedly could support a population of 5,880 persons. Water currently is provided to 1,101 residential and commercial taps and a population of 2,039 persons. Current per capita use is 459 gpcd. Water is obtained from an infiltration gallery with disinfection provided prior to distribution. During the summer irrigation season, watering restrictions have lowered water consumption on peak days by up to 50 percent. Construction plans include a new 625,000 gallon storage tank, adding a new ground water well and infiltration gallery and developing the ability to store more water in Rainbow Lake and Cottonwood Lake. With these added resources, the current water system appears to be sufficient to meet long-range needs.

### *2.2.1.2 City of Salida*

The City of Salida relies primarily on surface water supplemented by ground water rights. Raw water is stored in North Fork Reservoir (storage right of 375 af) and 1 to 3 af/yr of Fry-Ark water is used for well augmentation. Firm yield from Salida's surface water rights is estimated to be 2,240 af per year.

Current water use is estimated to be 2,400 af/yr, including a large irrigation component. Per capita use in 1996 was 383 gpcd. Salida forecasts a need for up to 200 af/yr of Fry-Ark water by the year 2020.

### *2.2.1.3 City of Canon City*

Canon City derives its raw water supply from the Upper Arkansas River. Direct flow water rights (Hydraulic Ditch, Old Water Works, F. Mayol Ditch) are more than adequate to supply a 22 mgd water treatment plant. The City reports an annual firm yield of 7,784 mg/yr (23,891 af/yr). Canon City currently has ample direct flow rights, but reportedly could benefit from storage capacity. Current and future use of Fry-Ark water is reported to be minimal. The City has used total Fry-Ark Project allocations totaling 614 af from 1985 to 1994. Water use in 1996 was approximately 6,000 af. Per capita use is 203 gpcd.

### *2.2.1.4 Park Center Water District (WD)*

The Park Center WD currently serves a population of 2,800 persons (500 water taps). Potable water use was reported to be approximately 140 mg/yr (430 af/yr), indicating per capita use of 137 gpcd. Park Center WD, located northeast of Canon City, has a dual water system. Irrigation water (approximately 189 af/yr) is diverted from Four Mile Creek. Potable water is obtained from an artesian well with a reported capacity of 1,131 af/yr. Park Center WD obtained 200 af of Fry-Ark Project water in 1995 and has storage rights in Pisgah Reservoir (200 af). The firm yield of Park Center's surface water rights is estimated to be 389 af per year.

### *2.2.1.5 City of Florence*

Florence derives its water supply from diversions on the Arkansas River and several tributaries. Florence supplies water to a regional water system, which includes the City of Florence, Town of Coal Creek, Town of Williamsburg, and Town of Rockvale. The direct flow rights can yield between 4,835 and 9,524 af/yr, with an average of 6,700 af/yr. The firm yield is taken to be 4,835 af/yr. Florence currently has 464 af of raw water storage at two sites (North and South Raw Water Reservoirs), each with two storage cells. Florence also has a 2,250 af conditional storage right on Oak Creek. This project, if developed, would store diversions from the Arkansas River, as well as direct runoff from Adobe, Mineral, and Newlin Creeks. Florence also is considering the possibility of using District storage for its water rights. The yield from storage on Oak Creek is not included in the 6,700 af/yr average yield. Modeling studies indicate that a demand of 5,100 af/yr could be met, with development of Oak Creek Reservoir, without appreciable shortages. Water use in 1996 was approximately 1,670 af/yr for a population of 5,860 persons (254 gpcd). Florence used 21 af of Fry-Ark Project water in 1996.

### *2.2.1.6 Penrose Water District (WD)*

The Penrose WD currently leases surface water from Beaver Park Water, Inc. Current water use is 488 af/yr. Service area population is 3,499 persons and per capita use is 118 gpcd. The maximum water supply from Beaver Park Reservoir that could be obtained by Penrose WD is 1,000 af. This is considered to be the firm yield. Penrose is considering acquisition of direct flow water rights on the Arkansas River and is evaluating its diversion and storage options.

### *2.2.1.7 Fountain Valley Authority*

The Fountain Valley Authority (FVA) was created to take delivery of Fry-Ark Project water from Pueblo Reservoir via the Fountain Valley Conduit to the communities of Stratmoor Hills, Widefield, Security, Fountain, and Colorado Springs. The Fountain Valley Conduit has capacity to deliver up to 20,100 af per year of Project water to the five member entities of the FVA.

### *2.2.1.8 Colorado Springs Utilities*

Colorado Springs Utilities provides water to a service area population of 341,810. Water is supplied from four major sources: local supplies from Pikes Peak watershed; the Blue River Pipeline; the Homestake Creek Pipeline; and the Fryingpan-Arkansas Project via the Fountain Valley Pipeline. Other supplies include Denver Basin wells and the Colorado Canal Exchange Program. Developed supplies total 128,000 af per year of firm yield (144,600 af average yield). Water resources owned by Colorado Springs Utilities include "reusable" supplies and "native" supplies, as identified below:

| | | Average Yield (af) | Firm Yield (af) |
|---|---|---|---|
| **Developed "Reusable" Supplies** | | | |
| Blue River/Homestake | | 27,700 | 24,000 |
| Fry-Ark/Twin Lakes | | 42,900 | 40,000 |
| Arkansas Basin | | 15,600 | 13,800 |
| Return Flows | | 24,800 | 21,200 |
| | **Subtotal** | **111,000** | **99,000** |
| **Developed "Native" Supplies** | | | |
| Arkansas Basin | | 9,800 | 9,200 |
| Local Supplies | | 22,700 | 18,700 |
| | **Subtotal** | **32,500** | **27,900** |
| **Developed Non-Potable** | | **1,100** | **1,100** |
| | **TOTAL (DEVELOPED)** | **144,600** | **128,000** |
| **Undeveloped Supplies** | | **76,300** | **67,100** |
| | **TOTAL** | **220,900** | **195,100** |

The firm yield numbers presented in the above table are constrained only by local conveyance limitations and water rights. However, because of the integration of the Colorado Springs raw water collection system, firm yield is significantly impacted by additional factors including storage capacity, non-local conveyance capacity and the relative timing of supply and demand. The combined impact of these factors can only be assessed through detailed modeling of the system with a network flow model such as MODSIM. Results of such a modeling effort are presented in the *1998 Operations and Yield Model Report* by Montgomery Watson. In that report, a term called "Effective Firm Yield" is defined as the maximum demand level for which water can be supplied over the entire 30 years of hydrologic data (1966-1995) with no shortages in the system. The Effective Firm Yield for the Colorado Springs system using this approach is **97,065 ac-ft**.

Colorado Springs Utilities has over 230,000 af of reservoir storage. Of this total, approximately 147,000 af is associated with Arkansas Basin and Fryingpan-Arkansas Project supplies, as indicated below:

| | Storage Volume (af) |
|---|---|
| Turquoise (Homestake Project) | 15,000 |
| CF&I | 17,416 |
| Twin Lakes | 29,756 |
| Pueblo (Fry-Ark Space) | 57,090 |
| Lake Meredith | 20,660 |
| Lake Henry | 6,709 |
| | **146,631** |

In 1996, water demand was 78,517 af, indicating a per capita demand of 210 gpcd. A water supply master plan [Black & Veatch, 1996] has identified several projects for implementation by the year 2010. Colorado Springs Utilities has an in-place water conservation program and is implementing non-potable water re-use, supplemented with ground water development. Improvements to the existing raw water delivery systems also are being implemented to increase conveyance capacity. The fourth element of the long-range plan is construction of the Southern Supply System, consisting of a new pipeline from Pueblo Reservoir to a terminal storage reservoir. The new pipeline will parallel the existing Fountain Valley Pipeline and will have a capacity of 53 mgd. Future demand for Fryingpan-Arkansas Project water is estimated to be 14,350 af/yr, with storage needs of 19,000 af in the year 2000, and 42,000 af in the year 2010. Colorado Springs Utilities is currently developing a System Optimization Model that will more accurately determine storage needs. In addition, the City is planning to construct storage on Williams Creek (18,000 af) or Jimmy Camp Creek (28,000 af). These reservoirs would be terminal storage for water that would be conveyed from Pueblo Reservoir via the new Fountain Valley Pipeline (Southern Supply System).

#### *2.2.1.9 Stratmoor Hills WD*

The Stratmoor Hills WD obtains its water from the Fountain Valley Authority and from tributary ground water (Widefield Aquifer). Current use is approximately 880 af/yr for a population of 6,100 (126 gpcd). Approximately 75 percent of the demand is met from Fountain Valley Authority (Fry-Ark) supplies, with the remainder from wells. Stratmoor Hills WD will continue to obtain 600 af/yr from the Fry-Ark Project, with the remainder of its demand met from its ground water resources, which can yield 1,270 af/yr with effective recharge and 770 af/yr without recharge.

### *2.2.1.10 Widefield Water and Sanitation District (WSD)*

The Widefield WSD has two sources of water -- ground water and Fry-Ark Project supplies. Current population is 20,000 persons. Water demand has varied from 2,800 to 3,100 af/yr (approximately 142 gpcd). Currently, 1,500 af of Project water and 1,600 af of ground water is provided to customers within the Widefield WSD. In the future, the full allocation of Project water (1,500 af), re-use of Project water return flows, ground water (both existing and new wells), and artificial recharge facilities will be used to meet water demands. The firm yield of ground water sources is estimated to be 4,900 af/yr. Widefield has storage in Fry-Ark facilities of up to 5,693 af.

### *2.2.1.11 Security Water District (WD)*

The Security WD currently serves a population of approximately 16,000 persons. Water use was 2,319 af in 1996 (129 gpcd). About one-fifth of the service area is unmetered. When full metering is implemented, a decrease in per tap water use of 10 percent is expected. (Security WD is committed to install 200 meters per year until all taps are metered.) Currently, Security WD obtains water from fully augmented ground water sources totaling 3,336 af/yr, including contracted supplies of 600 af. The District used 3,509 af of Fry-Ark project water in 1996 and is entitled to 1,646 af unless Project water is reallocated. Up to 6,500 af of storage is available to Security WD in Pueblo Reservoir. Project water is delivered to Security WD through the Fountain Valley Authority (FVA). The District does have a master plan for future water supply. Future supplies will come from Fry-Ark storage and development of additional ground sources.

### *2.2.1.12 City of Fountain*

The City of Fountain obtains water from two sources -- tributary wells in the Fountain Creek alluvium and a supply contract with the FVA. Fountain's contract with the FVA is for 2,000 af/yr. In 1996, Fountain took approximately 1,330 af through the FVA. Plans call for drilling additional municipal wells in the alluvial aquifer and use of decreed sources of replacement water to augment well pumping. Current population and annual water use are 12,000 persons and 1,700 af/yr, respectively. Per capita use is 126 gpcd. In 1996, 1,700 af of ground water was pumped and 1,330 af of Fry-Ark Project water was used for replacement. Up to 7,950 af of storage in Pueblo Reservoir is available to the City of Fountain. The City uses approximately 5,200 af of storage.

### *2.2.1.13 Pueblo Board of Water Works*

Water service to the City of Pueblo and several adjacent water users is provided by the Board of Water Works of Pueblo, Colorado (Pueblo Water Board). The adjacent users include an area located west of City Park and the Industrial Park near the Pueblo Airport. Virtually all of the water supplied by the Pueblo Water Board originates in the Arkansas Basin from senior water rights. The Pueblo Water Board's "Old Native" water rights on the Arkansas are seldom called out, and then only in part. This occurred during the 1977 and 1982 drought periods. Clear Creek Reservoir (11,500 af) in the upper Basin stores transmountain water diverted by the Columbine, Ewing, and Wurtz Ditches, as well as its native east slope decrees. A storage right of 5,000 af in Turquoise Reservoir is available for transmountain water from the Busk-Ivanhoe System and Homestake Project (which is obtained through an agreement with Aurora).

Water resources include:

| | Acre-feet |
|---|---|
| Direct Flow Rights (Up to 145 af per day - Arkansas River) | 52,925 |
| Transmountain Rights (Average, 1986-95) | |
| Columbine Ditch | 1,590 |
| Ewing Ditch | 1,012 |
| Wurtz Ditch and Extension | 2,549 |
| Busk-Ivanhoe | 2,404 |
| Homestake (Contract with Aurora) | 2,505 |
| Twin Lakes (Board owns 11,476 shares) | 9,280 |
| Storage Rights | |
| Clear Creek Reservoir | |
| East Slope (1902) | 9,400 |
| East Slope (1910) | 2,038 |
| Fry-Ark Project | |
| Storage | 31,200 |
| Water (10% of Annual Diversions) | 8,040 |
| Return Flows (Sewer and Lawn) | 19,750 |
| Storage | |
| Clear Creek Reservoir | 11,500 |
| Twin Lakes Reservoir | 12,275 |
| Turquoise Reservoir | 5,000 |
| Pueblo Reservoir (If and When) | 3,000 |

The Pueblo Board of Water Works has actively planned for and acquired water supplies to meet its long-range needs. Currently, the Pueblo Water Board has sufficient developed water supplies

(102,000 af) to meet the needs of approximately 370,000 people, based on per capita use of 250 gpcd. This per capita use consists of 188 gpcd residential and 62 gpcd commercial/industrial use, and is based on 1975-89 data. (In 1997, per capita use was 223 gpcd.) The current service area population is approximately 103,500 persons. To date, Pueblo has not needed to use Fry-Ark supplies to meet any portion of its water demands. Studies of water leasing potentials have been made to assess availability of water for base demand periods and potential markets for surplus supplies. Pueblo has stored up to 5,000 af in Pueblo Reservoir ("if and when" account). Depending on requirements for rehabilitation of Clear Creek Dam, Pueblo may request Project water in the near future.

The Pueblo Water Board will be preparing a water conservation plan to meet State requirements. All customers in the service area are metered, and system losses are estimated to be 7 percent, based on leak detection and related studies.

In addition to demands within its service area, the Pueblo Water Board has supplied from 5,100 to 11,300 af per year to the Comanche Power Plant, owned by Public Service Company of Colorado. Over the years, Pueblo Water Board has evaluated its storage needs, and in 1967 requested the USBR to provide dedicated storage of 17,000 af in Fry-Ark facilities. At that time, the USBR indicated that the request provided the required basis to start negotiations for a service contract and for discussions with the Pueblo Water Board on acquiring Clear Creek Reservoir from Pueblo. At one time, Clear Creek Reservoir was designed as the afterbay of the Otero power plant, which was not built. The Pueblo Water Board believes that 10,000 to 20,000 af of storage in the Arkansas Basin would be extremely beneficial. This would primarily be "carry-over" storage to facilitate regulation of both east and west slope supplies for use during drought periods. During recent wet years, some of the water available for diversion on the West Slope has not been diverted, because no storage space was available. A 28,000 af potential reservoir on West Tennessee Creek and enlargement of Clear Creek Reservoir have been identified as storage options, but have not been studied in detail.

#### *2.2.1.14 Pueblo West Metropolitan District*

Pueblo West has a current population of 9,500 persons and water use of 1,700 af/yr. Per capita use is 182 gpcd. Sources of water supply include transmountain water, non-tributary ground water, and tributary ground water. Transmountain water is from Twin Lake Reservoir, which provides a yield of 5,730 af/yr, prior to transit losses. Surface water is diverted by a pumping station located at Pueblo Reservoir. Non-tributary ground water sources can physically produce 2,400 af/yr. These wells are decreed for 7,956 af/yr. The District also has approximately 100 af of storage in Lake Meredith for return flows that are exchanged to Pueblo Reservoir. The District is evaluating water re-use options and purchasing Fry-Ark Project water. Pueblo West is forecasting the addition of 650 water taps per year.

### *2.2.1.15 St. Charles Mesa Water District (WD)*

Current population within the service area of the St. Charles Mesa WD is approximately 10,300 persons. Water use is approximately 2,020 af/yr, which corresponds to per capita use of 176 gpcd. Surface water accounts for 87 percent of the supply. The District has two raw water storage reservoirs, totaling 690 af, with plans to enlarge one reservoir to 1,200 af. Water sources include shallow wells, shares in the Bessemer Ditch, water rights from the St. Charles River, water rights from Cottonwood Creek (Buena Vista), and the Blende Townsite water rights from the Arkansas River. The District buys 300 to 350 af/yr of Fry-Ark Project Water. Over the long term (by the year 2020), the St. Charles Mesa Water District will probably increase its use of Project water, subject to availability, to 2,700 af/yr.

### *2.2.1.16 Crowley County Water System*

Crowley County wholesales water to the Crowley County Water Association (CCWA), 96 Pipeline, Town of Ordway, and the Town of Crowley. Crowley County also provides water service to the State Prison near the Town of Crowley. The main water transmission lines run from 2 miles southwest of Olney Springs to 2 miles east of Ordway in a 12-mile reach along the Arkansas River. Connected population in 1996 was 3,595 persons with total usage of 598 af. Water use is approximately 149 gpcd. Crowley County operates five wells with a potential volume limitation of 1,315 af/yr and has stored up to 1,834 af in Pueblo Reservoir. Project water use in 1996 was 750 af. Crowley county has identified a Project storage need of 2,500 af and has forecasted use of Project water to be 900 af in the year 2020. Current firm yield from available supplies is estimated to be 644 af. Crowley County has indicated a possible interest in having storage in Lake Meredith or in Lake Henry, if an upstream exchange is possible. Storage in Twin Lakes is also of interest to Crowley County.

### *2.2.1.17 Town of Ordway*

The Town of Ordway purchases water from the Crowley County Water System. Demand is approximately 90 af to a population of approximately 1,000 persons (80 gpcd).

### *2.2.1.18 Town of Fowler*

Population in the Town of Fowler is 1,180 persons, with current water use of 370 af for non-potable uses and 90 af/yr for potable use supplied from ground water sources. Fowler uses 305 af of Project storage for augmentation purposes, with the storage used projected to increase to 385 af. Water is obtained from several sources, including two springs and five operating alluvial wells. The two springs can provide 96 gpm (155 af/yr) of potable water with present facilities and are decreed for 471 af/yr. The alluvial wells can produce significantly more water for irrigation and other non-potable uses ("hard water system"). Current production capacity of the alluvial wells is 7,870 gpm (12,700 af/yr). One of the alluvial wells is equipped with chlorination facilities and provides supplemental water if needed. Prior to 1997, a total of 445 af of Project water was used (1972-1996).

#### *2.2.1.19 City of Rocky Ford*

Currently, the City of Rocky Ford has a population of 4400 persons and water use of 1240 af/yr. Water use is approximately 252 gpcd. Water sources include an alluvial well near the Arkansas River (800-850 gpm) and shares in the Catlin Canal and Rocky Ford Ditch. Approximately 75 percent of the City's total supply is from wells, including all potable water. The ground water resources available to the City could provide up to 1,700 gpm (2,740 af/yr). The City's plan is to use ground water and Catlin Canal supplies to meet the needs of 6,000 persons and then evaluate alternate sources of supply. In 1996, the City used 150 af of Project water to meet augmentation requirements. This need will increase somewhat over time.

#### *2.2.1.20 City of LaJunta*

The City of LaJunta has a current population of 8,040 persons and water use of 3,000 af/yr (333 gpcd). The City is in the process of developing a water resources plan and was able to provide an estimate of firm yield (8,789 af/yr), based on the ability to augment its wells with Fry-Ark water. The City has adjudicated ground water rights of 18,073 af developed from 14 alluvial wells along the Arkansas River. The City also owns 2,923 shares of Fry-Ark Project water, which is used, when water is available, to augment well pumping. In 1996, the City used 1,500 af of project water for augmentation. The City does not plan to add new wells, but will try to obtain additional Fry-Ark Project water to meet its future augmentation requirements. The City of LaJunta has a water conservation program (see Section 5 of the report).

#### *2.2.1.21 Bents Fort Water Association*

The Bents Fort Water Association provides water to 385 active taps (65 are inactive) and a population of 1,400 persons. In 1996, water demand was 123 af, approximately 78 gpcd. Water is obtained from approximately four wells completed in the Dakota and Cheyenne Formations. These wells can yield 72 gpm (116 af/yr). Current plans call for adding up to 40 taps. Two new wells are being added to the system. In-system storage totals 310,000 gallons.

### *2.2.1.22 City of Las Animas*

The City of Las Animas derives its supply from seven wells and a storage account (averaging approximately 1,100 af) in Pueblo Reservoir. Current use of Project water is reported to be 300 af/yr for augmentation purposes. Current population is 2,675 persons, with water use of 600 af/yr. This is equivalent to 200 gpcd. Ground water quality (hardness) has been an issue in the past. However, new treatment facilities have been constructed and hardness levels are now acceptable.

### *2.2.1.23 City of Lamar*

The City of Lamar obtains its water supplies used for municipal purposes from a well field located about 3 miles southeast of Lamar in the Clay Creek watershed, a tributary of the Arkansas River. The well field consists of 31 wells, which discharge through a common pipeline to a 6 mg storage tank. The water flows by gravity from the tank through a master meter and treatment facility to the City's distribution system. Additionally, the City has some small capacity wells that are used to supply irrigation water to the cemetery and three small parks.

The City owns stock in the Fort Bent Ditch Company and has a decreed plan for augmentation, which allows the City to use its Fort Bent Ditch water to recharge the Clay Creek aquifer. Additionally, the City uses its allocation of Project water for recharge purposes. Project water is conveyed from Pueblo Reservoir during favorable streamflow conditions (i.e., good quality and low losses) to John Martin Reservoir for re-regulation. Subsequently, this water is delivered through the Fort Bent Ditch to the recharge site. For 1975 through 1997, the City's municipal water usage averaged 2,339 af annually and ranged from 2,020 af in 1978 to 2,800 af in 1997. Average water use was 273 gpcd over this period.

The City recently completed a master plan for its water supply and distribution system. That report shows the present population as 8,440 and an annual growth rate of 0.5 percent since 1950. For planning purposes, the City uses an annual growth rate of 1 percent.

The City's Project water is re-regulated in John Martin Reservoir. Each year, Colorado's Division Engineer and Kansas' Water Commissioner must agree on the accounting for this water because there is no continuing storage account for this purpose. Accordingly, a permanent account or storage for re-regulation of Lamar's project water would be beneficial to the City.

### *2.2.1.24 May Valley Water Association*

The May Valley Water Association currently serves a population of 1,700 persons (568 taps), using the Dakota and Cheyenne aquifers. In 1996, water demand was 624 af, corresponding to a per capita use of 371 gpcd. May Valley has 10 active wells, with total capacity of 504 gpm

(813 af/yr continuous pumping). Current demand is 625 af/yr. In-system storage is 880,000 gallons. Additional wells are planned to meet future demand, unless the Valley Pipeline becomes a reality. Growth will require adding 10 to 13 new taps per year.

### *2.2.1.25 Public Service Company of Colorado (PSCo)*

PSCo requires approximately 9,000 to 10,000 af/yr of water for cooling and other uses at its Comanche Generating Station. Up to 10,000 af/yr may be needed by the year 2010. PSCo currently leases water from the Pueblo Water Board. At present, the minimum delivery obligation is 7,300 af/yr, but by 2010 Pueblo's obligation to PSCo will decline to 4,800 af/yr. Water is pumped from the Arkansas River to the Comanche Station at a diversion point just downstream of Pueblo Dam. Approximately 75 percent of the diverted water is consumed at the station. PSCo owns shares in several canal companies and also leases water from Pueblo West. Currently, PSCo plans to continue leasing water from Pueblo, while evaluating various options to meet supply requirements in light of declining minimum deliveries from Pueblo. Up to 5,000 af of storage capacity is estimated to be needed by PSCo for the storage of exchanged water and leased water supplies.

### *2.2.1.26 City of Aurora*

The City of Aurora has extensive water holdings within the Arkansas Basin and shares in transmountain projects that bring water into the Basin. The estimated annual yields of these water rights are:

| | | Estimated Yield (af/yr) |
|---|---|---|
| **Transmountain Water** | | |
| Homestake | | 11,800 |
| Twin Lakes | | 2,673 |
| Busk-Ivanhoe | | 3,217 |
| **Arkansas Basin** | | |
| Buffalo Park | | 260 |
| Burroughs | | 282 |
| Rocky Ford Ditch | | 8,250 |
| Colorado Canal | | 6,000 |
| | **TOTAL** | **32,482** |

Aurora has storage allocations in Turquoise Reservoir and Twin Lakes, which store water from the transmountain sources, prior to conveyance to the South Platte Basin, via the Twin Lakes Pipeline, Otero Pumping Station, and the South Park Pipeline. The Arkansas Basin water rights listed above are (or will be) used via exchange to upper Basin storage reservoirs. Aurora also has "if and when" storage in Pueblo Reservoir. During an interview, Aurora's water resources specialists indicated that additional storage in the Arkansas Basin is desirable to effectively manage existing water rights. Additional storage in the upper portion of the Basin, perhaps at an enlarged Clear Creek Reservoir, and in the lower Basin, perhaps at an enlarged Lake Meredith, were identified as potential projects.

### 2.2.2 Discussion of Smaller Water Supply Entities

#### *2.2.2.1 Chaffee County*

The Town of Poncha Springs and the Upper Arkansas Water Conservancy District (UAWCD) both operate within Chaffee County. The UAWCD was organized for the purpose of providing augmentation water for municipal water supply entities, as well as agricultural entities, located in Chaffee County and Fremont County. The population of their entities totals approximately 18,000 people, including Buena Vista and Salida. Depending on the year, the UAWCD can have up to 400 af stored in Twin Lakes Reservoir and/or Pueblo Reservoir. Water resources plans include the potential reconstruction of Boss Lake; enlargement of North Fork Reservoir, Rainbow Lake (150 af), Cottonwood Lake (50 af), and O'Haver Lake (300 af); and potential construction of storage in the Texas Creek drainage.

#### *2.2.2.2 Fremont County*

Small water supply entities in Fremont County include Orchard Park Water Company, East Florence Water Association, and Brookside Water. The UAWCD also operates in Fremont County. Sources of UAWCD water are described in Section 2.2.2.1. East Florence obtains water from the City of Florence. The other entities rely on ground water.

#### *2.2.2.3 Pueblo County*

In addition to the larger entities supplying water in Pueblo County (see Section 2.2.1), water service is also provided by the Avondale Water and Sanitation District, Town of Boone, O'Neal Water Works, Joseph Water Company, and Sunset View Water Association. The primary source of supply for these providers is ground water.

#### *2.2.2.4 Crowley County*

Smaller water supply entities in Crowley County include the Crowley County Water Association, Town of Crowley, 96 Pipeline, Town of Olney Springs, Town of Sugar City, and the Sugar City Pipeline Company. The Crowley County Water System is described in Section 2.2.1.16.

The water system for the Town of Olney Springs consists of a well, several springs, a 100,000 gallon storage tank, and a distribution system. Currently, there are 201 water taps, with 192 in use. Total annual water requirement for Olney Springs is 84 af, with an augmentation that uses shares from Twin Lakes Reservoir and Canal Company and some Fry-Ark Project water. Future needs are estimated at an annual supply of 168 af and 114 af of replacement water. The other small water entities rely almost entirely on regional ground water supplies.

#### *2.2.2.5 Otero County*

Smaller water supply entities in Otero County include the Town of Cheraw, Town of Manzanola, Town of Swink, Beehive Water Company, South Swink, East End Water Company, Eureka Water Company, Fayette Water Association, Hancock Water Company, Hilltop Water Company, Holbrook Center Soft Water, Homestead Improvement, Hunicutt Water Company, Newdale-Grand Valley Water Company, North Holbrook Water Company, Parkdale Water Company, Patterson Valley Water Association, Riverside Water Company, Southside Water Association, Valley Water Company, Vroman Water Company, and West Grand Valley, Inc. The entities responding to the SECWCD survey rely almost entirely on deep ground water sources of supply.

#### *2.2.2.6 Bent County*

Smaller water supply entities in Bent County include the Hasty Water Company and McClave Water Association. The Hasty Water Company and the McClave Water Association provide water to 100 taps and 164 taps, respectively, and populations of approximately 250 and 400 persons, respectively. In 1997, the Hasty Water Company's water demand was 33 af. In 1996, the McClave Water Association's water demand was 69 af. Each entity obtains water from three Dakota Aquifer wells. For both entities, well yields are approximately 100 gpm. Existing supplies are reported to be adequate for meeting anticipated future needs. The Hasty Water Company has storage in the form of three 30,000 gallon tanks. The McClave Water Association has two 50,000 gallon tanks and one 200,000 gallon tank.

#### *2.2.2.7 Powers County and Kiowa County*

Smaller water supply entities in Powers County and Kiowa County include the Town of Eads, Town of Wiley, and Prosperity Lane Water Association. These entities rely on ground water.

The Town of Eads provides water to 482 taps and a population of 900 persons. In 1996, water demand was 275 af. Water is obtained from 7 alluvial wells, with 3 back-up wells. These wells, located along Big Sandy Creek, yield 800 gpm. The Town is studying the use of treated effluent for cemetery irrigation, plus the possibility of constructing a prison facility that would be served by the Town water system. This would produce an estimated water demand of 112 af/yr. In-system storage totals 480,000 gallons.

The Town of Wiley provides water to 195 taps and a population of 450 persons. In 1997, the water demand was 62 af. Water is obtained from three Dakota Aquifer wells (only two are active). These wells yield 116 gpm. The Town foresees steady growth in water demand but within the capabilities of the current water system. In-system storage totals 200,000 gallons.

## 2.3 Agricultural Water Systems

Information on the existing agricultural water systems, which rely on water resources of the Arkansas River Basin and the SECWCD, was obtained from several sources.

- The District's 1996 Survey Questionnaire.
- In-person interviews with selected agricultural water supply entities to resolve known issues relative to irrigated acreage.
- Review and analysis of State Engineer diversion records for the 1986-96 period and comparison with earlier water diversion data (1945-1986).
- Review of published reports and data contained therein (see report sections entitled references).

Responders to the 1996 SECWCD survey are identified in "**bold**" below:

### AGRICULTURAL ENTITY SURVEY RESPONSES

**Bessemer Irrigating Ditch Company**
**Excelsior Irrigation Company**
**Colorado Canal Company**
**Rocky Ford High Line Canal Company**
Oxford Farmers Ditch Company
**Otero Ditch Company**
**Catlin Canal Company**
**Holbrook Mutual Irrigation Company**
**Fort Lyon Canal Company**
Las Animas Consolidated Ditch Company
**DeWeese-Dye Ditch and Reservoir Company**
**George L. Bender**
**Mac Rogers**
**Frost Livestock Company**
**Canon City and Oil Creek Ditch Company**
**Halem Ditch-Cogan Ranch**
**Wood Valley Ditch**
**Talcott-Cotton Ditch**
**Arkansas Ground Water Users Association**
**Colorado Water Protective and Development Association**

**Ewing-Koppe Ditch**
**Garden Park and Terry Ditches**
**Charob Ranch**
**Totten Ditch**
**Sundance Investments**
**McClave RE-2 Schools**

Fort Lyon Well Users Group
**Lower Arkansas Water Management Association**
**Vineland Well and Pump Users Association**

The Arkansas River provides irrigation water to over 250,000 acres of land. Most of the irrigation within the SECWCD occurs by diversion of water to 11 canal/ditch systems, located downstream of Pueblo Dam and upstream of Las Animas, which irrigate approximately 222,000 acres. Above Pueblo, approximately 19,500 acres are irrigated from the Arkansas River and its tributaries. Approximately 8,500 acres are irrigated from Fountain Creek.

### 2.3.1 Larger Ditch Systems

The 11 canal/ditch systems between Pueblo Dam and Las Animas include:

| System | 1985 Irrigated Area (acres) | 1965-1995 Average Diversion from Arkansas River (af/yr) | 1950-1985 Average Pumping (af/yr) |
|---|---|---|---|
| Bessemer | 17,713 | 61,746 | 8,589 |
| Excelsior | 1,509 | 1,754 | 3,251 |
| Colorado Canal(1) | 30,593 | 71,773 | 4,785 |
| Rocky Ford Highline (and Otero) | 21,132 | 86,206 | 5,025 |
| Oxford | 4,855 | 25,453 | 6,440 |
| Otero | 2,346 | 6,852 | 1,175 |
| Catlin (and Otero) | 18,847 | 91,092 | 8,578 |
| Holbrook | 14,191 | 39,209 | 3,510 |
| Rocky Ford(1) | 7,167 | 42,379 | 1,963 |
| Fort Lyon | 91,124 | 254,220 | 26,348 |
| Las Animas(2) | 6,502 | 28,701 | 4,148 |

(1) Portions of these supplies are and will be used for municipal purposes.
(2) Portions of this supply will be used for industrial purposes (Public Service of Colorado).

### *2.3.1.1 Bessemer Ditch*

The Bessemer Ditch is owned and operated by the Bessemer Ditch Irrigating Ditch Company. In 1996, the Company reported an irrigated area of 19,000 acres and a need for 10,000 af of storage for winter water. Winter storage in 1996 was 5,000 af. In 1992-1995, the Company stored 8,854 af of water in Pueblo Reservoir. In both 1994-1995 and 1995-1996, stored water was spilled. The Company reported a need for additional Project storage space for winter water to meet growing M&I needs while maintaining storage for agricultural users.

### *2.3.1.2 Excelsior Ditch*

The Excelsior Irrigation Company did not report its irrigated area on the SECWCD's survey form. The ditch was being rehabilitated in 1996. Since 1987, Excelsior has not requested Project water, but may do so in the future.

### *2.3.1.3 Colorado Canal*

The Colorado Canal Company provides irrigation water to 6,800 acres, with a reported water use of 8,500 af/yr. In the 1980s, Colorado Springs Utilities and Aurora purchased a majority interest in the Colorado Canal, Lake Henry, and Lake Meredith. Water is diverted into the Colorado Canal, stored in Lake Meredith, and then ultimately exchanged upstream to Twin Lakes, from which municipal water is delivered to Colorado Springs or Aurora through the Otero Pump Station on the Homestake Pipeline. Colorado Springs owns over half of the system and Aurora about one-quarter of the system. Irrigation was continued for re-vegetation purposes up to 1994. Average yield from Colorado Canal water rights to Aurora is reported to be 6,000 af/yr and to Colorado Springs is reported to be 14,800 af/yr.

### *2.3.1.4 Rocky Ford Highline Canal*

The Highline Canal Company reports an irrigated area of 22,500 acres, with no forecast of increased acreage or water use. Project water use was 5,000 af in 1996. The Company participates in the Winter Water Storage Program.

### *2.3.1.5 Oxford Ditch*

In 1985, the Oxford Ditch provided water to 4,855 acres.

### *2.3.1.6 Otero Ditch*

The Otero Ditch Company reports an irrigated area of 4,973 acres. Direct flow rights are supplemented by Fry-Ark Project water. The Company reports a Project water need of 2,500 af to meet minimum crop requirements in most years. Allocations of Fry-Ark water have steadily increased over the past 5 years to the 1996 allocation of 2,500 af.

### *2.3.1.7 Catlin Canal*

The Catlin Canal Company reports an irrigated area of 19,000 acres and water use of 100,000 af/yr and service population of 5,000 persons. No change in water use is predicted for the next 30 years. In 1996, 11,000 af of Project water was allocated to the Catlin Canal. In 1996-1997, the Company stored 14,558 af in Pueblo Reservoir under the Winter Water Storage Program. The Company predicts a storage need of 12,500 af and Project water use of 6,000 af/yr for the next 30 years.

### *2.3.1.8 Holbrook Ditch*

The Holbrook Mutual Irrigation Company reports an irrigated area of 16,000 acres, with water use of 45,000 to 60,000 af over the 1994-1996 period. Project water use varied from 2,000 to 3,500 af during the same period. In 1996, The SECWCD reports an allocation of Project water of 12,000 af. The Company had 5,000 af stored in Pueblo during the 1996-1997 season under the Winter Water Storage Program, as well as 6,247 af stored in non-Project reservoirs (Holbrook and Dye Reservoirs).

### *2.3.1.9 Rocky Ford Ditch*

Aurora has acquired a 58 percent interest in the Ditch and associated water rights, which are one of the most senior rights on the Arkansas River. The transfer from agricultural to municipal use was granted in late 1986. Currently, Aurora is applying irrigation water to re-vegetate the land with native grasses. As of 1997, 94 percent of the land was found to be fully re-vegetated. The land is expected to be completely re-vegetated by the year 2000, and the current re-vegetation completion is 92 percent. A corresponding portion of this water is available for municipal use. Aurora reports an eventual yield of 8,250 af/yr from the Rocky Ford water rights. Aurora owns Rocky Ford rights for municipal use. In 1997, 6,100 af were exchanged upstream to Twin Lakes.

### *2.3.1.10 Fort Lyon Canal*

The Fort Lyon Canal Company provides water to approximately 94,000 acres from its direct flow and storage rights on the Arkansas River. Water use is projected to be 250,000 af/yr, with 50,000 af/yr from the Fry-Ark Project. The Company requested 51,000 af of water in 1997 and plans maximum participation each year through the year 2020. In the 1996-1997 season, the Fort Lyon Canal Company stored 59,855 af in the Winter Water Storage Program in non-Project facilities (Horse Creek, Adobe Creek, and Thurston Reservoirs) and 4,598 af in John Martin Reservoir.

### *2.3.1.11 Las Animas Consolidated Canal*

The Las Animas Consolidated Canal (Consolidated) irrigated approximately 6,500 acres in 1985. PSCo has acquired approximately 81 percent of the water supply associated with this canal system. No allocations of Fry-Ark water have been made to Consolidated. In the 1996-1997 season, Consolidated stored 4,392 af in John Martin Reservoir under the Winter Water Storage Program.

### 2.3.2 Smaller Ditch Systems

There are 34 smaller ditch systems and agricultural entities within the District that have obtained Project water allocations in the 1972-1996 period. The owners of several systems responded to the District survey in 1996. The ditches using Fry-Ark water are believed to have a total irrigated area of approximately 1,000 acres (1985).

One of the larger entities that did respond was the DeWeese-Dye Ditch and Reservoir Company. This Company has not used Fry-Ark water in the past, but they have indicated a desire to store 500 af in Pueblo Reservoir for the Colorado Canal Company in order to facilitate a water exchange. DeWeese-Dye irrigates 1,100 acres. DeWeese Dam is the primary storage facility and plans call for the dam to be rehabilitated in the next several years.

### 2.3.3 Augmentation Organizations

There are four major ground water management/augmentation organizations within the District -- the Arkansas Groundwater Users Association (AGUA), the Colorado Water Protection and Development Association (CWPDA), the Lower Arkansas Water Management Association (LAWMA), and the Fort Lyon Well Users Group (FLWUG). There also are several smaller well user groups.

### *2.3.3.1 Arkansas Groundwater Users Association (AGUA)*

AGUA forecasts 9,000 af of water need by the year 2000, with constant demand beyond that time. Current use is 6,000 af/yr, including 600 af of Project water (100 af first use and 500 af of re-use, all on Fountain Creek). Future use of Project water is expected to be 2,000 af/yr. Augmentation water is obtained from the Excelsior Ditch and leasing of transmountain water from Aurora, Pueblo, and SECWCD.

### *2.3.3.2 Colorado Water Protection and Development Association (CWPDA)*

The projected range of pumping for CWPDA irrigation wells is estimated to be approximately 24,000 to 55,000 af with an average of 45,000 af. Projected pumping for municipal systems is approximately 6,000 to 7,000 af with an average of 6,500 af. CWPDA's total pumping estimate ranges from 30,000 to 62,000 af with a yearly average of 51,500 af.

Projected wellhead depletions for irrigation wells are estimated to be 10,100 to 23,100 af, averaging 18,900 af. Municipal wellhead depletions range from 5,400 to 6,300 af, averaging 5,850 af. Total association wellhead depletions range from 15,500 to 29,400 af with an average of 24,750 af.

Total stream depletions for irrigation wells, made without running the appropriate models, are estimated by CWPDA consultants to be 14,000 to 20,000 af, averaging 17,000 af. Municipal stream depletions are estimated to be approximately 6,000 af. Total stream depletions range from about 20,000 to 26,000 af with an average of 23,000 af.

### *2.3.3.3 Lower Arkansas Water Management Association (LAWMA)*

LAWMA provides water to the Arkansas River to replace depletions caused by its members' wells, located generally from Las Animas to the State line. LAWMA has 212 members with 634 wells, of which 492 wells are used for irrigation, 109 wells are used for municipal purposes, and 33 wells are used for commercial purposes.

Within the District, LAWMA covers 111 irrigation wells and 1 commercial well. In 1997, the pumpage by these wells totaled 13,163 af. Most of the irrigation wells supplement water deliveries by the Fort Lyon Canal and the Keesee Ditch. Accordingly, the pumpage and replacement requirements will fluctuate annually, depending on the canal deliveries. The replacement requirements for these wells will range from about 4,000 to 6,000 af annually.

LAWMA may purchase from the District the amount of water required to replace depletions caused only by the wells located within SECWCD. In 1997, LAWMA purchased 2,000 af of

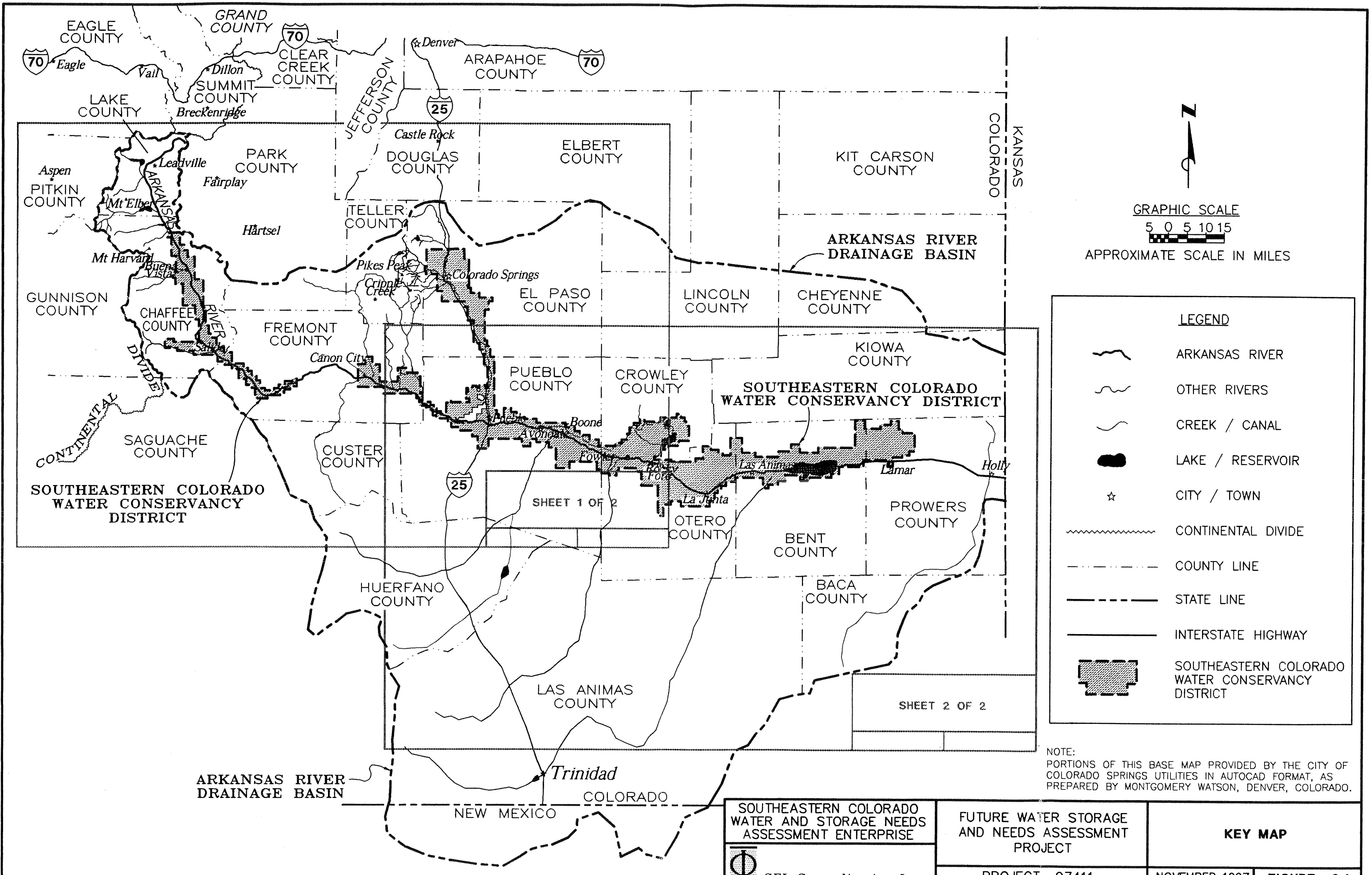
Project return flows from SECWCD. LAWMA's future requests for Project return flows probably will range from 2,000 to 5,000 af annually, depending on expected yield of LAWMA's other replacement sources.

#### *2.3.3.4 Fort Lyon Well Users Group (FLWUG)*

The FLWUG purchases water from the District to replace the river depletions caused by its members' wells. In 1997, there were 30 members with 67 irrigation wells. Each member owns stock in the Fort Lyon Canal Company, and the water supplies developed from their irrigation wells supplement their Fort Lyon Canal deliveries. Water storage is provided in John Martin Reservoir (Section II Accounts). The members' pumping volumes generally are inversely related to the amount of Fort Lyon Canal water received. In good streamflow years, such as 1996 and 1997, the wells were not used as much as other years.

The FLWUG submitted replacement plans to the Division Engineer in 1996 and 1997. These plans relied on return flows from Project water purchased from SECWCD to replace the depletions. Each member provides an estimate of the amount of well pumpage expected for the subsequent irrigation season. The estimate is multiplied by a presumptive depletion factor to determine the well head depletion, which is the basis of payment by the member. The actual pumping in 1997 totaled 2,659 af, and the well head depletions totaled 798 af.

FLWUG does not anticipate any significant changes to the number of members and wells. The pumping will fluctuate annually, depending on the Fort Lyon Canal deliveries. It is expected that the well pumpage will range from 2,600 to 5,000 af annually and that the depletions will range from 780 to 1,500 af annually.



NOTE:
PORTIONS OF THIS BASE MAP PROVIDED BY THE CITY OF COLORADO SPRINGS UTILITIES IN AUTOCAD FORMAT, AS PREPARED BY MONTGOMERY WATSON, DENVER, COLORADO.

SOUTHEASTERN COLORADO
WATER AND STORAGE NEEDS
ASSESSMENT ENTERPRISE

GEI Consultants, Inc.

FUTURE WATER STORAGE
AND NEEDS ASSESSMENT
PROJECT

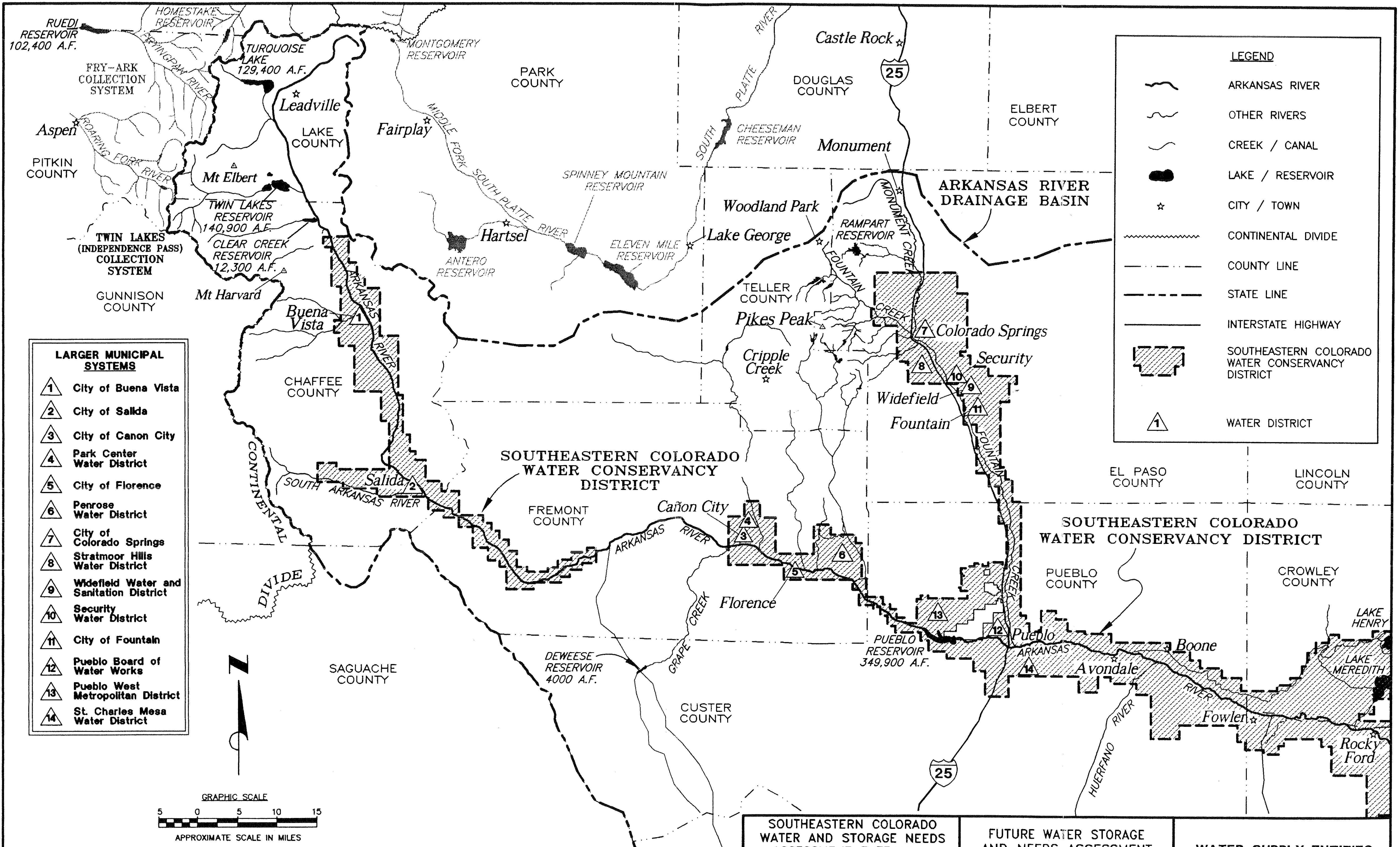
PROJECT 97411

**KEY MAP**

NOVEMBER 1997

**FIGURE 2.1**

FILE: P:\BIN\PROJECTS\97411\KEYMAP.DWG PLOT @ 1=125000 11/97



NOTE:
PORTIONS OF THIS BASE MAP PROVIDED BY THE CITY OF COLORADO SPRINGS UTILITIES IN AUTOCAD FORMAT, AS PREPARED BY MONTGOMERY WATSON, DENVER, COLORADO.

SOUTHEASTERN COLORADO WATER AND STORAGE NEEDS ASSESSMENT ENTERPRISE

GEI Consultants, Inc.

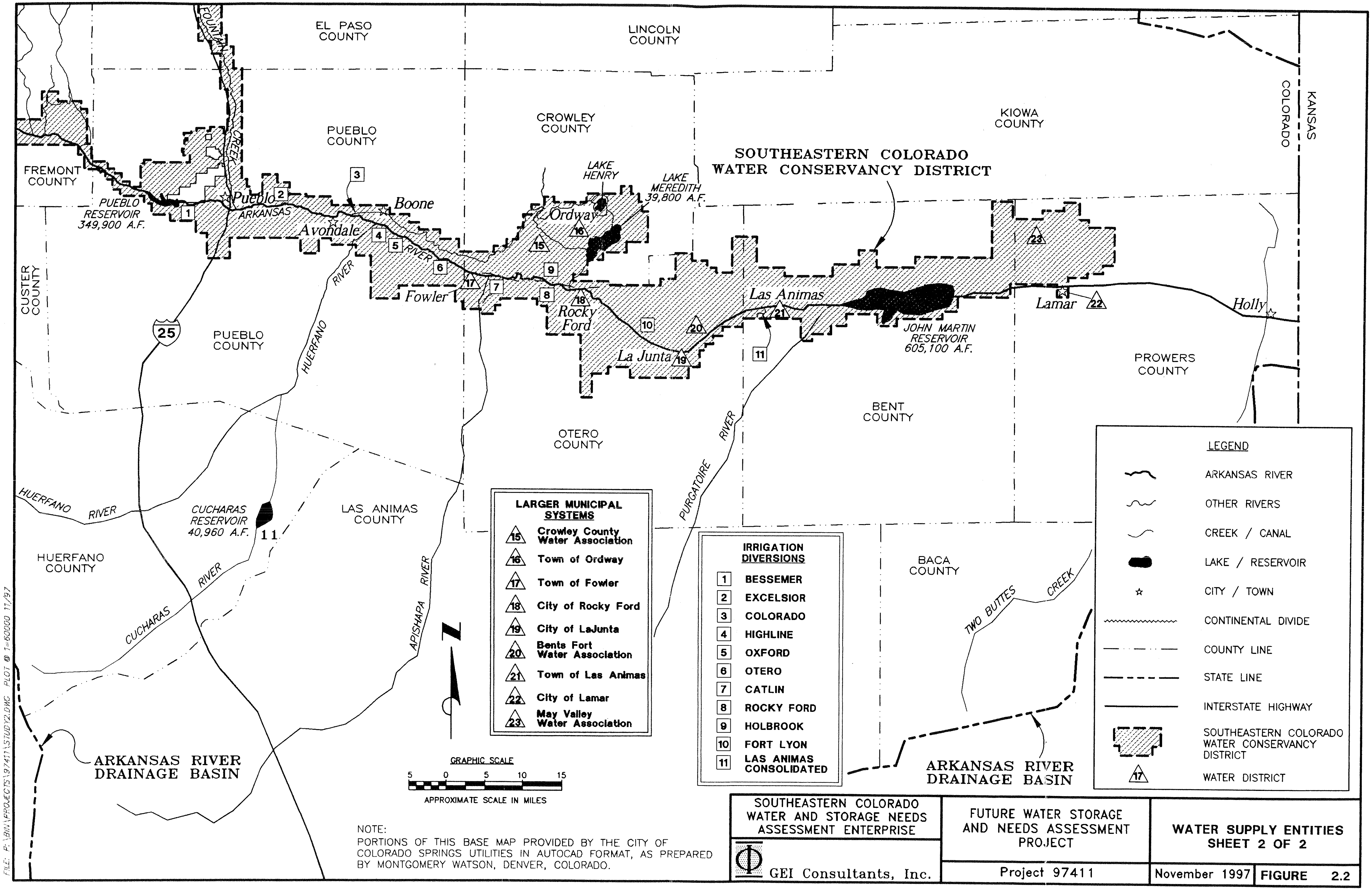
FUTURE WATER STORAGE AND NEEDS ASSESSMENT PROJECT

Project 97411

WATER SUPPLY ENTITIES
SHEET 1 OF 2

NOVEMBER 1997 **FIGURE 2.2**

FILE: P:\BIN\PROJECTS\97411\STUDY1.DWG PLOT @ 1=60000 11/97



**LARGER MUNICIPAL SYSTEMS**

| | |
|---|---|
| 15 | Crowley County Water Association |
| 16 | Town of Ordway |
| 17 | Town of Fowler |
| 18 | City of Rocky Ford |
| 19 | City of LaJunta |
| 20 | Bents Fort Water Association |
| 21 | Town of Las Animas |
| 22 | City of Lamar |
| 23 | May Valley Water Association |

**IRRIGATION DIVERSIONS**

| | |
|---|---|
| 1 | BESSEMER |
| 2 | EXCELSIOR |
| 3 | COLORADO |
| 4 | HIGHLINE |
| 5 | OXFORD |
| 6 | OTERO |
| 7 | CATLIN |
| 8 | ROCKY FORD |
| 9 | HOLBROOK |
| 10 | FORT LYON |
| 11 | LAS ANIMAS CONSOLIDATED |

NOTE:
PORTIONS OF THIS BASE MAP PROVIDED BY THE CITY OF COLORADO SPRINGS UTILITIES IN AUTOCAD FORMAT, AS PREPARED BY MONTGOMERY WATSON, DENVER, COLORADO.

SOUTHEASTERN COLORADO WATER AND STORAGE NEEDS ASSESSMENT ENTERPRISE

Φ GEI Consultants, Inc.

FUTURE WATER STORAGE AND NEEDS ASSESSMENT PROJECT

Project 97411

**WATER SUPPLY ENTITIES SHEET 2 OF 2**

November 1997

**FIGURE 2.2**

FILE: P:\BIN\PROJECTS\97411\STUDY2.DWG PLOT @ 1=63000 11/97

Φ

# 3. POPULATION PROJECTIONS FOR THE DISTRICT

## 3.1 Basis of Population Projections

Population projections for the District were prepared using data published by the State Demographer and locally prepared projections for many of the 23 larger municipal entities in the District. The local projections were obtained from three sources: 1) published planning documents; 2) response to the SECWCD's 1996 survey; and 3) follow-up discussions by GEI with the water supply entities.

Population projections for the District were prepared in four steps:

- ***Step 1*** - Comparison of locally developed population projections with projections prepared by the Colorado State Demographer.
- ***Step 2*** - Discussion of these projections by the Storage Study Committee in a work session. The committee decided to use locally developed base and high population projections.
- ***Step 3*** - Compilation and refinement of local base and high population projections and review of these projections by local entities.
- ***Step 4*** - Finalization of base and high population projections following review and additional input by local entities.

### 3.1.1 State Demographer Projections

The baseline population was derived by preparing estimates using the State Demographer's population figures, as follows:

- The most recent State Demographer's estimates for cities and towns within the District were summarized.
- We then prepared estimates for the "balance of the county" (i.e., those areas not within cities and towns). This estimate was based on the area in each county that is within the SECWCD boundaries and the State Demographer's population estimates for unincorporated areas of each county in the District. Estimates of area in the District were made by digitizing a map of District boundaries and

overlaying it on maps of county boundaries, municipal boundaries, and state and federal lands.

The results of the population analysis for baseline conditions are summarized on Figure 3.1. Total population in the District was estimated to be 620,000 persons. As shown on Figure 3.1, approximately 349,000 persons (56 percent) of the District's population resided in Colorado Springs and 103,000 persons (17 percent) in Pueblo. Approximately 154,000 persons (25 percent) resided in the other larger water supply entities, while the remaining 14,000 persons (2 percent) lived within smaller towns, districts, and unincorporated areas of each county.

Projections made by the State Demographer in 1996 served as "benchmark" projections for the Assessment Project. State Demographer projections extend from to the year 2020 and are made at the county level.

As shown in Table 3.1, the State Demographer prepared new projections in 1998. These more recent projections are somewhat higher than the 1996 projections. We decided not to change the base projections made for the Assessment Project. This decision was based on the fact that a range of projections of future populations was being established for planning purposes and the new projections fall within the low side of the range. We disaggregated the projections to municipal jurisdictions and unincorporated areas, based on the historical share of county population taken by these jurisdictions. They were used to provide a comparison with the locally prepared projections.

### 3.1.2 Local Projections

Population projections were compiled from local jurisdictions and were used to develop a series of projections for comparison with the benchmark projections. We found in our survey of local entities that the City of Colorado Springs has prepared two projections, a base case and a high projection. The base case is a "most likely" projection, with the probability of exceeding it estimated to be 50 percent. The "base case" projection series is used by Colorado Springs for short-term capital programming and budgeting. The high projection is used for long-term planning. The probability of exceeding the high projection is estimated to be 15 percent. We used these two projections, along with locally developed projections from other jurisdictions, and the State Demographer's projections where no local numbers were available, to develop the local base and the local high projections. The following rationale was used to develop the projections:

- Local Base Projections -- Local projections were used, where available, along with Colorado Springs base case projections. We used the State Demographer's

# TABLE 3.1
# COMPARISON OF STATE DEMOGRAPHERS' POPULATION PROJECTIONS MADE IN 1997 AND 1998 FOR COUNTIES IN SECWCD

| County | 1996 Projection | | | 1998 Projection | | |
|---|---|---|---|---|---|---|
| | 2000 | 2010 | 2020 | 2000 | 2010 | 2020 |
| Chaffee | 16,305 | 19,048 | 21,743 | 17,593 | 20,787 | 23,929 |
| Fremont | 42,118 | 45,764 | 49,060 | 43,895 | 49,124 | 54,352 |
| Pueblo | 134,774 | 147,056 | 159,531 | 139,899 | 159,156 | 179,750 |
| Crowley | 4,612 | 5,110 | 5,506 | 4,616 | 4,811 | 4,850 |
| Otero | 22,180 | 23,839 | 25,360 | 21,991 | 23,669 | 24,774 |
| Bent | 5,942 | 6,362 | 6,583 | 5,990 | 6,446 | 6,725 |
| Prowers | 14,202 | 14,978 | 15,187 | 14,279 | 15,374 | 16,405 |
| Kiowa | 1,747 | 1,827 | 1,853 | 1,802 | 1,866 | 1,937 |
| El Paso | 515,129 | 596,065 | 668,431 | 508,870 | 596,131 | 680,978 |
| **Total Population** | **759,009** | **862,059** | **955,274** | **758,935** | **877,364** | **993,700** |
| **Difference** | | | | **-74** | **15,305** | **38,426** |
| **Percent Difference** | | | | **0.0%** | **1.8%** | **4.0%** |

**Note: These projections are totals for the counties and in some cases include population in the county that is not in the District.**

projections for jurisdictions where locally developed projections were not available.

- Local High Projections -- Local projections were used, where available, along with Colorado Springs high projections. We used the State Demographer's projections for jurisdictions where locally developed projections were not available.

The local base and the local high projections were used in planning studies for the Assessment Project.

### 3.1.3 Reconciliation of Population Projections

As expected when the Assessment Project studies began, we found that the local base population projections, when aggregated, exceeded the State Demographer's numbers. As shown on Figure 3.2, the local projections prepared using the Colorado Springs base case projections for the SECWCD exceed the State Demographer's projections by 8 percent, 15 percent, and 20 percent in the years 2000, 2010, and 2020, respectively. The differences between the State Demographer's and the base case local projections are not too significant. The State Demographer's projections generally tend to be "middle-of-the-road" type projections. Therefore, comparison of the local base projections with the State Demographer's projections indicates that the local base projections are reasonable.

## 3.2 Population Growth by Region in the District

Final population projections for the SECWCD were developed through the year 2040. The projections include detail for the 23 entities and the balance of each county that is in the District. We have prepared two sets of population projections -- a base projection and a high projection, consistent with desires of the Storage Study Committee (SSC). As suggested by the SSC, we used projections obtained from the local water supply entities, where available.

Not all entities had both a base and a high projection. For these entities, we used the State Demographer's projections. The methodology for calculating the State Demographer's projections is described in Section 3.1.1. Additionally, with the exception of Colorado Springs, Pueblo, and LaJunta, none of the entities took their projections out to the year 2040. In these cases, we extrapolated to the year 2040 by applying the benchmark-projected decade growth rate for each respective county.

The methods for developing the population projections, using the local and the State Demographer's figures, are described below:

1. Where one set of local projections was provided and the State Demographer's projections were previously calculated, the State Demographer's projections were used for the base projections and local projections were used for the high projections. We took this approach because, except in only several cases, the local projections were higher than the State Demographer's projections.

2. Where local projections were provided and benchmark projections were not previously calculated, the local projections were used for both the base and the high projections.

3. Where no local projections were provided and the State Demographer's projections were previously calculated, the State Demographer's projections were used for both the base and high projections.

The resulting population projections by county and major water supply entity within the SECWCD are provided in Tables 3.1 (Base Projection) and 3.2 (High Projection).

As shown on Figure 3.3 and Tables 3.2 and 3.3, total SECWCD population is projected to increase from 620,000 persons in 1997 to 1,192,000 in 2040 under the base case and to 1,627,000 under the high scenario. Population growth by region is summarized below:

| | | **Projected Population in Thousands[1] (Base/High)** | | |
|---|---|---|---|---|
| **Location** | **1997** | **2000** | **2020** | **2040** |
| **Total SECWCD** | 620 | 668/672 | 974/1108 | 1192/1627 |
| Colorado Springs | 349 | 370/373 | 528/616 | 622/919 |
| Pueblo | 103 | 111/111 | 140/178 | 170/292 |
| Other Municipal Entities[2] | 155 | 173/173 | 287/294 | 378/394 |
| Other Population[3] | 13 | 14/15 | 19/20 | 22/22 |

[1] Population within SECWCD boundaries only.
[2] Population for the other 21 larger municipal entities.
[3] Population in smaller towns, water districts, and in portions of counties within the SECWCD.

The bulk of population growth will occur in the large metropolitan areas of Colorado Springs and Pueblo. The base projection population growth rate from the year 1997 to 2040 is 1.5 percent per year. The high projection population growth rate from the year 1997 to 2040 is nearly 2.3 percent per year.

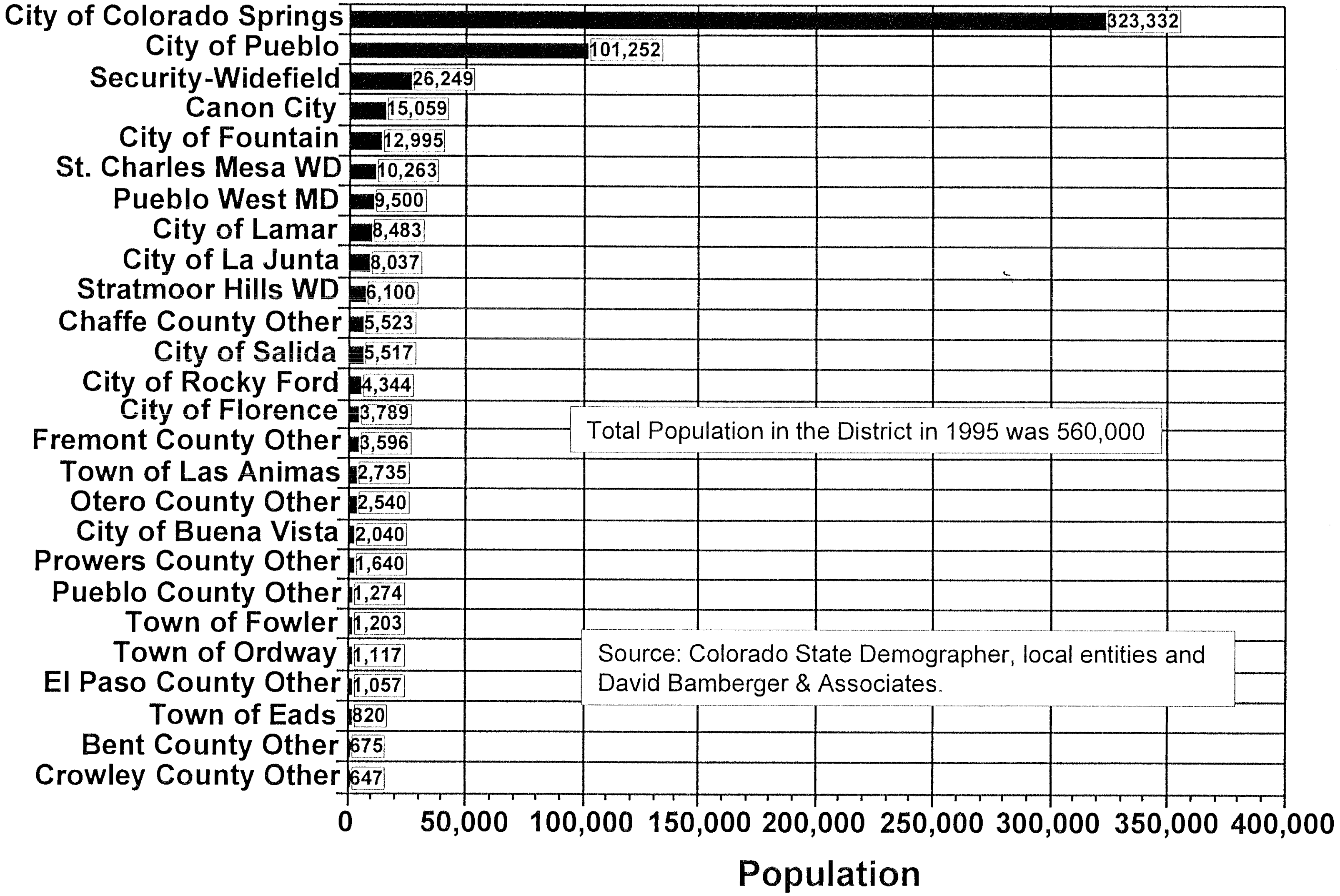
# TABLE 3.2
# BASE POPULATION PROJECTIONS
# SOUTHEASTERN COLORADO WATER CONSERVANCY DISTRICT, 2000 - 2040

| | ESTIMATE | BASE PROJECTION | | | | |
|---|---|---|---|---|---|---|
| ENTITY | 1997 | 2000 | 2010 | 2020 | 2030 | 2040 |
| **Chaffee County** | | | | | | |
| City of Buena Vista | 2,167 | 2,251 | 2,629 | 3,001 | 3,373 | 3,746 |
| City of Salida | 5,687 | 5,800 | 6,200 | 6,800 | 9,123 | 10,129 |
| Other Chaffee County Areas in District | 5,889 | 6,094 | 7,119 | 8,127 | 9,134 | 10,141 |
| Total Chaffee County in District | 13,743 | 14,145 | 15,948 | 17,928 | 21,630 | 24,016 |
| **Fremont County** | | | | | | |
| Canon City | 24,333 | 25,822 | 31,544 | 36,238 | 42,056 | 48,807 |
| City of Florence | 5,860 | 6,927 | 10,095 | 14,431 | 18,767 | 23,103 |
| Park Center WD | 3,928 | 4,000 | 4,360 | 4,665 | 4,992 | 5,291 |
| Penrose WD | 3,499 | 3,563 | 3,884 | 4,156 | 4,446 | 4,713 |
| Other Fremont County Areas in District | 828 | 830 | 837 | 862 | 869 | 899 |
| Total Fremont County in District | 38,448 | 41,142 | 50,720 | 60,352 | 71,130 | 82,813 |
| **Pueblo County** | | | | | | |
| City of Pueblo | 103,200 | 111,000 | 125,000 | 140,000 | 155,000 | 170,000 |
| Pueblo West MD | 11,238 | 16,227 | 32,857 | 49,487 | 59,276 | 59,276 |
| St. Charles Mesa WD | 10,263 | 10,743 | 11,943 | 13,143 | 14,343 | 15,543 |
| Other Pueblo County Areas in District | 1,304 | 1,328 | 1,449 | 1,572 | 1,694 | 1,817 |
| Total Pueblo County in District | 126,005 | 139,298 | 171,249 | 204,202 | 230,313 | 246,636 |
| **Crowley County** | | | | | | |
| Town of Ordway | 1,166 | 1,198 | 1,327 | 1,430 | 1,533 | 1,636 |
| Crowley County WA | 3,849 | 4,609 | 5,000 | 5,500 | 5,750 | 6,000 |
| Other Crowley County Areas in District | 596 | 680 | 1,100 | 1,164 | 1,224 | 1,289 |
| Total Crowley County in District | 5,611 | 6,487 | 7,427 | 8,094 | 8,507 | 8,925 |
| **Otero County** | | | | | | |
| Town of Fowler | 1,184 | 1,195 | 2,000 | 2,010 | 2,131 | 2,258 |
| City of La Junta | 8,040 | 8,449 | 9,567 | 10,832 | 11,482 | 12,171 |
| City of Rocky Ford | 4,400 | 4,800 | 5,800 | 6,800 | 7,800 | 8,800 |
| Other Otero County Areas in District | 2,635 | 2,675 | 2,875 | 3,058 | 3,242 | 3,425 |
| Total Otero County in District | 16,259 | 17,119 | 20,242 | 22,700 | 24,655 | 26,654 |
| **Bent County** | | | | | | |
| Town of Las Animas | 2,675 | 3,000 | 3,900 | 4,500 | 5,100 | 5,700 |
| Bents Fort WA | 1,520 | 1,520 | 1,520 | 1,520 | 1,520 | 1,520 |
| Other Bent County Areas in District | 702 | 712 | 762 | 789 | 815 | 842 |
| Total Bent County in District | 4,897 | 5,232 | 6,182 | 6,809 | 7,435 | 8,062 |
| **Prowers County** | | | | | | |
| City of Lamar | 8,440 | 8,567 | 8,696 | 8,827 | 8,961 | 9,096 |
| May Valley WA | 1,500 | 1,700 | 1,800 | 2,000 | 2,120 | 2,247 |
| Other Prowers County Areas in District | 1,040 | 1,168 | 1,806 | 1,832 | 1,857 | 1,882 |
| Total Prowers County in District | 10,980 | 11,435 | 12,302 | 12,659 | 12,938 | 13,225 |
| **Kiowa County** | | | | | | |
| Total Kiowa County in District | 829 | 835 | 873 | 885 | 898 | 910 |
| **El Paso County** | | | | | | |
| City of Colorado Springs | 348,807 | 370,115 | 447,671 | 528,072 | 553,400 | 622,300 |
| City of Fountain | 12,000 | 15,000 | 25,000 | 41,000 | 57,000 | 73,000 |
| Security WD | 16,000 | 19,000 | 22,000 | 25,000 | 25,000 | 25,000 |
| Widefield Homes WC | 20,000 | 21,400 | 28,400 | 35,400 | 42,400 | 49,400 |
| Stratmoor Hills WD | 6,100 | 6,300 | 9,300 | 9,300 | 9,800 | 9,800 |
| Other El Paso County Areas in District | 1,139 | 1,176 | 1,361 | 1,526 | 1,691 | 1,857 |
| Total El Paso County in District | 404,046 | 432,991 | 533,732 | 640,298 | 689,291 | 781,357 |
| | | | | | | |
| **Total SECWCD** | **620,817** | **668,685** | **818,675** | **973,927** | **1,066,796** | **1,192,598** |

# TABLE 3.3
# HIGH POPULATION PROJECTIONS
# SOUTHEASTERN COLORADO WATER CONSERVANCY DISTRICT, 2000 - 2040

| | ESTIMATE | HIGH PROJECTION | | | | |
|---|---|---|---|---|---|---|
| ENTITY | 1997 | 2000 | 2010 | 2020 | 2030 | 2040 |
| **Chaffee County** | | | | | | |
| City of Buena Vista | 2,167 | 2,251 | 2,629 | 3,001 | 3,373 | 3,746 |
| City of Salida | 5,687 | 6,087 | 7,111 | 8,117 | 10,877 | 12,073 |
| Other Chaffee County Areas in District | 5,889 | 6,094 | 7,119 | 8,127 | 9,134 | 10,141 |
| Total Chaffee County in District | 13,743 | 14,432 | 16,859 | 19,245 | 23,384 | 25,960 |
| **Fremont County** | | | | | | |
| Canon City | 24,333 | 25,975 | 31,663 | 38,597 | 47,049 | 57,353 |
| City of Florence | 5,860 | 6,927 | 10,095 | 14,431 | 18,767 | 23,103 |
| Park Center WD | 3,928 | 4,000 | 4,360 | 4,665 | 4,992 | 5,291 |
| Penrose WD | 3,499 | 3,563 | 3,884 | 4,156 | 4,446 | 4,713 |
| Other Fremont County Areas in District | 828 | 830 | 837 | 862 | 869 | 899 |
| Total Fremont County in District | 38,448 | 41,295 | 50,839 | 62,711 | 76,123 | 91,359 |
| **Pueblo County** | | | | | | |
| City of Pueblo | 103,200 | 111,000 | 139,000 | 178,000 | 228,000 | 292,000 |
| Pueblo West MD | 11,238 | 16,227 | 32,857 | 49,487 | 59,276 | 59,276 |
| St. Charles Mesa WD | 10,263 | 10,743 | 11,943 | 13,143 | 14,343 | 15,543 |
| Other Pueblo County Areas in District | 1,304 | 1,328 | 1,449 | 1,572 | 1,694 | 1,817 |
| Total Pueblo County in District | 126,005 | 139,298 | 185,249 | 242,202 | 303,313 | 368,636 |
| **Crowley County** | | | | | | |
| Town of Ordway | 1,166 | 1,198 | 1,327 | 1,430 | 1,533 | 1,636 |
| Crowley County WA | 3,849 | 4,609 | 5,000 | 5,500 | 5,750 | 6,000 |
| Other Crowley County Areas in District | 596 | 680 | 2,100 | 2,244 | 2,380 | 2,526 |
| Total Crowley County in District | 5,611 | 6,487 | 8,427 | 9,174 | 9,663 | 10,162 |
| **Otero County** | | | | | | |
| Town of Fowler | 1,184 | 1,195 | 2,000 | 2,010 | 2,131 | 2,258 |
| City of La Junta | 8,040 | 8,449 | 12,048 | 13,199 | 14,460 | 15,842 |
| City of Rocky Ford | 4,400 | 4,800 | 5,800 | 6,800 | 7,800 | 8,800 |
| Other Otero County Areas in District | 2,635 | 2,675 | 2,875 | 3,058 | 3,242 | 3,425 |
| Total Otero County in District | 16,259 | 17,119 | 22,723 | 25,067 | 27,633 | 30,325 |
| **Bent County** | | | | | | |
| Town of Las Animas | 2,675 | 3,000 | 3,900 | 4,500 | 5,100 | 5,700 |
| Bents Fort WA | 1,520 | 1,541 | 1,649 | 1,699 | 1,750 | 1,802 |
| Other Bent County Areas in District | 702 | 712 | 762 | 789 | 815 | 842 |
| Total Bent County in District | 4,897 | 5,253 | 6,311 | 6,988 | 7,665 | 8,344 |
| **Prowers County** | | | | | | |
| City of Lamar | 8,440 | 8,567 | 8,696 | 8,827 | 8,961 | 9,096 |
| May Valley WA | 1,500 | 1,700 | 1,800 | 2,000 | 2,120 | 2,247 |
| Other Prowers County Areas in District | 1,040 | 1,168 | 1,806 | 1,832 | 1,857 | 1,882 |
| Total Prowers County in District | 10,980 | 11,435 | 12,302 | 12,659 | 12,938 | 13,225 |
| **Kiowa County** | | | | | | |
| Total Kiowa County in District | 829 | 835 | 873 | 885 | 898 | 910 |
| **El Paso County** | | | | | | |
| City of Colorado Springs | 348,807 | 373,237 | 471,213 | 616,504 | 759,400 | 918,700 |
| City of Fountain | 12,000 | 15,000 | 25,000 | 41,000 | 57,000 | 73,000 |
| Security WD | 16,000 | 19,000 | 22,000 | 25,000 | 25,000 | 25,000 |
| Widefield Homes WC | 20,000 | 21,400 | 28,400 | 35,400 | 42,400 | 49,400 |
| Stratmoor Hills WD | 6,100 | 6,300 | 9,300 | 9,300 | 9,800 | 9,800 |
| Other El Paso County Areas in District | 1,139 | 1,176 | 1,361 | 1,526 | 1,691 | 1,857 |
| Total El Paso County in District | 404,046 | 436,113 | 557,274 | 728,730 | 895,291 | 1,077,757 |
| | | | | | | |
| **Total SECWCD** | **620,817** | **672,267** | **860,857** | **1,107,661** | **1,356,908** | **1,626,678** |

## Population by Entity
## Southeastern Colorado Water Conservancy District, 1995

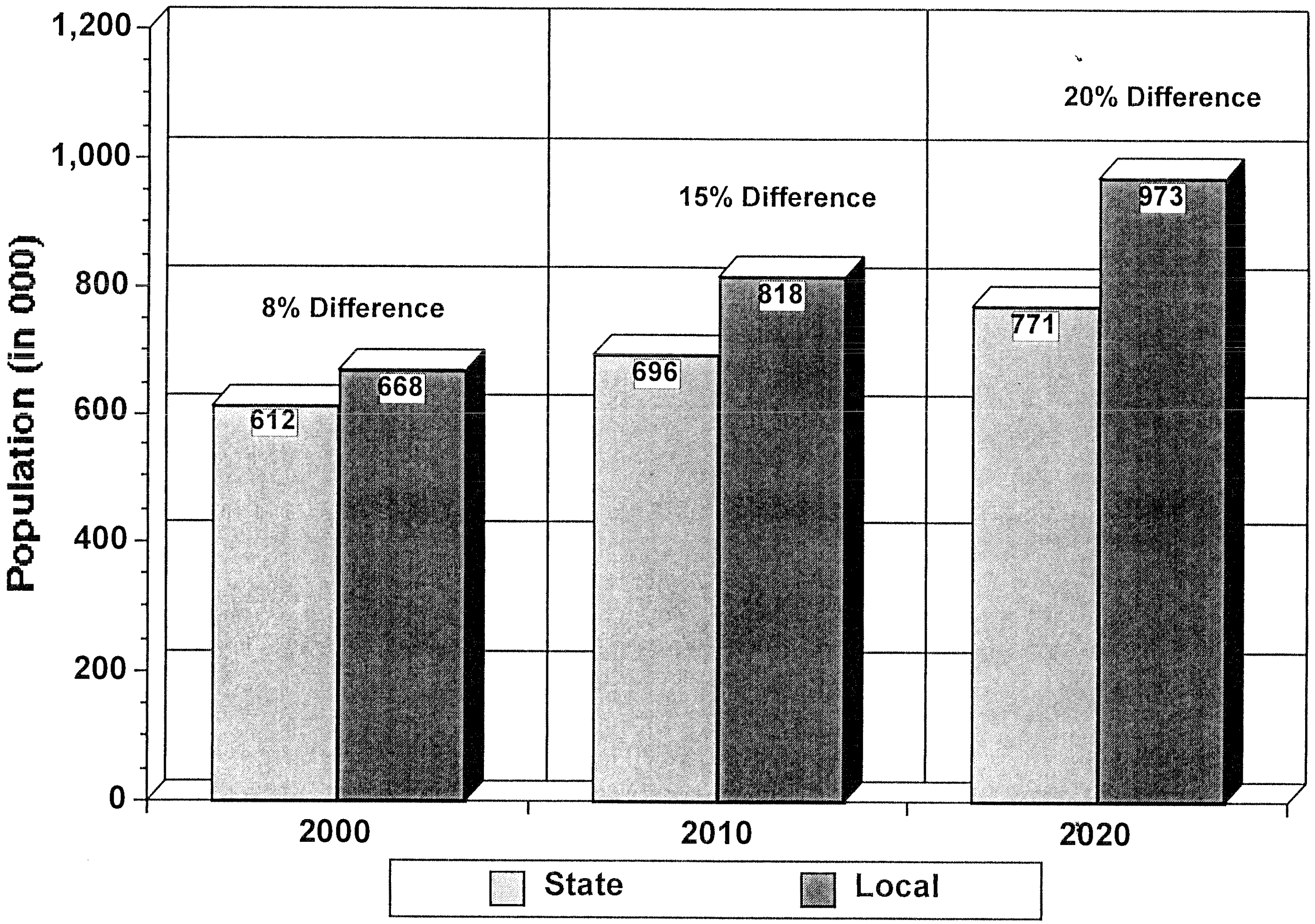


Total Population in the District in 1995 was 560,000

Source: Colorado State Demographer, local entities and David Bamberger & Associates.

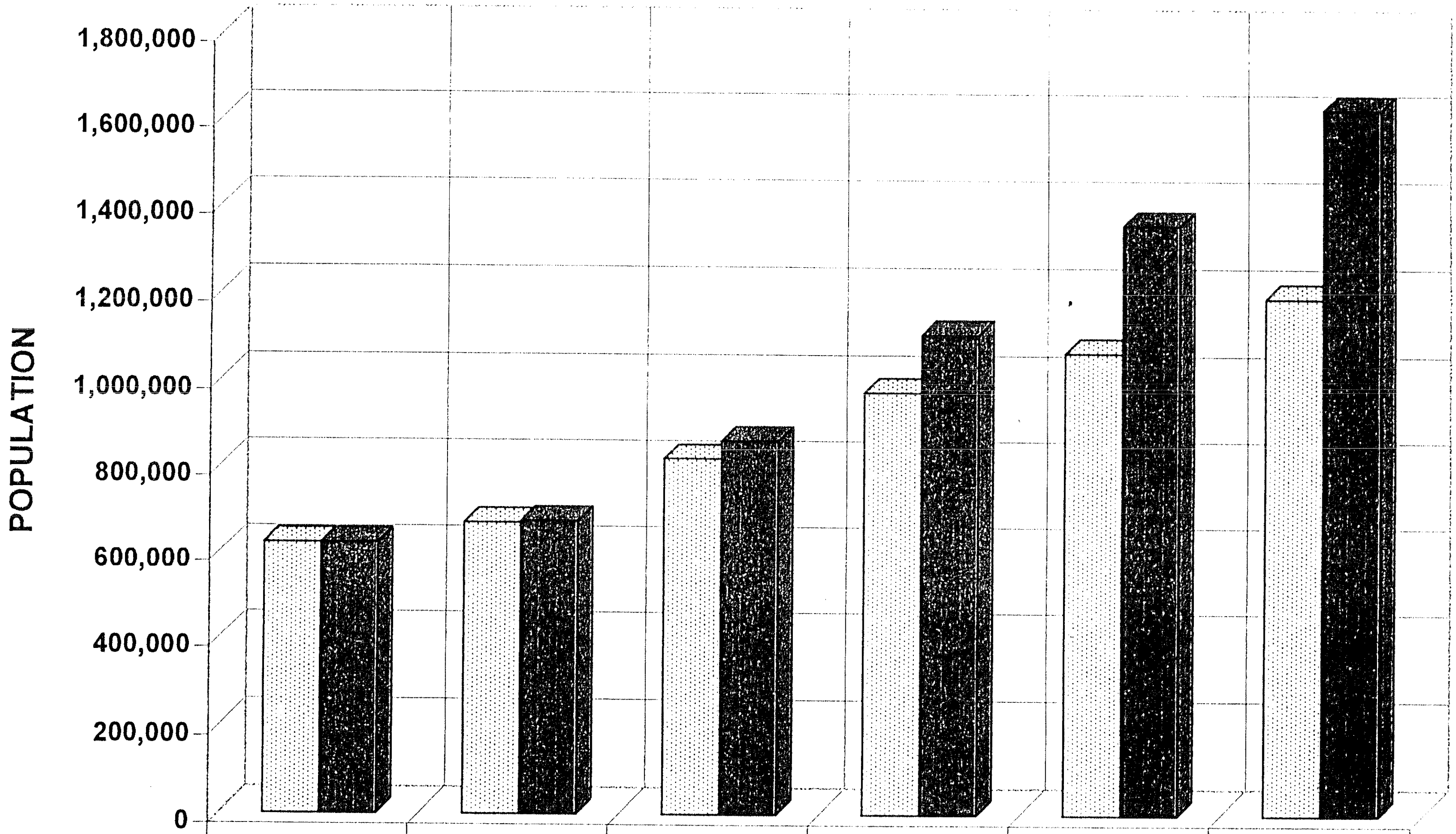
FIGURE 3.1

## Comparison of State Demographer's and Local Base Population Projections Southeastern Colorado Water Conservancy District



Sources: Local Projections are from the local entities where available and where not available are based onColorado State Demographer's projections. State Demographer's projections are from the State Demographer's Office.

FIGURE 3.2



Base and High Population Projections
Southeastern Colorado Water Conservancy District

| | 1997 | 2000 | 2010 | 2020 | 2030 | 2040 |
|---|---|---|---|---|---|---|
| ☐ BASE PROJECTION | 620,817 | 668,685 | 818,675 | 973,927 | 1,066,796 | 1,192,598 |
| ▨ HIGH PROJECTION | 620,817 | 672,267 | 860,857 | 1,107,661 | 1,356,908 | 1,626,678 |

sumdem_graphs.xls/POPULATION

FIGURE 3.3
POPULATION PROJECTIONS

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Section 4

# 4. AGRICULTURAL WATER USE IN THE DISTRICT

## 4.1 Historical Diversions

A long-term record of water diversions by agricultural users in the SECWCD is available. Data from the 1940 to 1985 period was assembled for the Arkansas River litigation (Boyle, 1990). More recent data (1986-1996) was obtained from the official records maintained by the Colorado Division of Water Resources. As shown in Appendix B, which contains the irrigation diversions by month for major canals and ditches above Las Animas, as well as a summary of all diversions, irrigation diversions have averaged approximately 709,000 acre-feet per year (af/yr) for the 1965-1995 period. Except for portions of the irrigated areas under the Keesee Canal and the Fort Lyon Canal, the canal systems downstream of Las Animas are not within the SECWCD. The Amity Canal Company, which diverts water from the Arkansas below Las Animas, does participate in the Winter Water Storage Program.

For the 1965-1995 period, the maximum diversion of 994,000 af occurred in 1995 and the minimum of 348,000 af occurred in 1977. On average, diversions are the highest in June and the lowest in January. On average for the 1965-1995 period, approximately 80 percent of the annual diversions occurred in the months of April through September. Average maximum and minimum annual diversions during the 1965-1995 period are summarized in Table 4.1 by canal or ditch system.

## 4.2 Ground Water Pumping for Irrigation

As shown in Table 4.2, ground water pumping by irrigation users in the SECWCD has averaged approximately 93,500 af/yr (1950-1985). Peak pumping in the period was approximately 142,000 af, with the greatest use for most canal and ditch systems occurring in 1976. Of the total average pumping of 93,500 af/yr, approximately 17,200 af/yr (18.4 percent) is for irrigated lands relying solely on wells, while the use of ground water to supplement surface supplies is approximately 76,100 af/yr (81.6 percent). Ground water pumping for irrigation is approximately 11.6 percent of the total irrigation diversion (sum of surface diversions and ground water pumping).

## TABLE 4.1
## AGRICULTURAL DIVERSIONS BY WATER USERS IN SECWCD (1965-1995)
## (PUEBLO TO LAS ANIMAS)

| Canal or Ditch | Annual Diversion (acre-feet) | | | |
|---|---|---|---|---|
| | Average | Maximum | Minimum | Average with Transfers(1) |
| Bessemer | 61,746 | 84,182 | 35,971 | 61,746 |
| Excelsior | 1,754 | 8,718 | 0 | 1,754 |
| Colorado | 71,773 | 112,407 | 21,812 | 8,500 |
| Rocky Ford Highline | 86,206 | 125,223 | 46,900 | 86,206 |
| Oxford | 25,453 | 37,879 | 9,892 | 25,453 |
| Otero | 6,852 | 13,982 | 936 | 6,852 |
| Catlin | 91,092 | 127,900 | 36,980 | 91,092 |
| Holbrook | 39,209 | 64,547 | 9,202 | 39,209 |
| Rocky Ford | 42,379 | 54,816 | 23,989 | 17,800 |
| Fort Lyon | 254,220 | 422,718 | 126,243 | 254,220 |
| Las Animas Consolidated | 28,701 | 36,866 | 17,655 | 4,600 |
| **TOTAL** | **709,385** | **993,825** | **347,857** | **597,432** |

(1) The diversions by the Colorado, Rocky Ford, and Las Animas Canal Systems were reduced to account for water right transfers to municipal and industrial purposes.

Total is based on summation of monthly data for all canals and ditches. Maximums and minimums in each ditch system are not additive.

# TABLE 4.2
# GROUND WATER PUMPED FOR IRRIGATION (PUEBLO TO LAS ANIMAS)

| Canal or Ditch System | Average Annual (acre-feet) | | Peak Annual (acre-feet) | | Average Annual with Transfers[1] (acre-feet) |
|---|---|---|---|---|---|
| | **1950-85** | **1970-79** | **Amount** | **Year** | **1950-85** |
| Bessemer | 8,589 | 10,660 | 14,735 | 1978 | 8,589 |
| Excelsior | 3,251 | 3,471 | 6,025 | 1963 | 3,251 |
| Colorado | 4,785 | 6,989 | 10,353 | 1978 | 570 |
| Highline | 5,025 | 5,892 | 7,373 | 1976 | 5,025 |
| Oxford | 6,440 | 7,237 | 9,331 | 1976 | 6,440 |
| Otero | 1,175 | 1,586 | 2,317 | 1974 | 1,175 |
| Catlin | 8,578 | 11,415 | 15,970 | 1978 | 8,578 |
| Holbrook | 3,510 | 4,287 | 6,332 | 1981 | 3,510 |
| Rocky Ford | 1,963 | 2,730 | 3,554 | 1976 | 820 |
| Fort Lyon | 26,348 | 39,702 | 60,786 | 1976 | 26,348 |
| Las Animas | 4,148 | 5,699 | 7,834 | 1976 | 660 |
| Other Ditches | 2,308 | 2,688 | 3,573 | 1976 | 2,308 |
| Sole Source Wells | 17,183 | 19,533 | 25,201 | 1978 | 17,183 |
| **TOTAL** | **93,303** | **121,889** | **---** | **---** | **84,457** |

(1) Well pumpage by the Colorado, Rocky Ford, and Las Animas Canal Systems was reduced to account for water right transfers to municipal and industrial purposes.

Pumping volumes taken from "Arkansas River Basin Study - Water Budget Documentation" by Boyle Engineering Corp., December 1990. Estimates prepared for 1940-1985 based on power consumption records and studies completed by the U.S. Geological Survey.

## 4.3 Irrigated Acreages

Irrigated acreages within the SECWCD service area were obtained from two sources: 1) the Arkansas River Basin Study (Boyle, 1990) for canals and ditches diverting water from the river below Pueblo; and 2) measurements made from orthophoto maps of irrigated lands upstream of Pueblo Reservoir and lands supplied with water from Fountain Creek. As shown in Table 4.3, irrigated lands along Fountain Creek were estimated by Helton & Williamsen to total 8,510 acres, based on aerial photographs made in 1974-76. The USBR estimated more land under irrigation (12,805 acres) in their 1972 status report. Helton & Williamsen also estimated irrigated lands in the Upper Arkansas Basin above Pueblo Reservoir, based on orthophoto maps made from 1974-87. As shown in Table 4.3, approximately 7,980 acres are estimated to be irrigated from the Arkansas River, and 17,480 acres are estimated to be irrigated from tributaries.

### TABLE 4.3
### IRRIGATED ACREAGES FOR LANDS IN THE SECWCD ABOVE PUEBLO RESERVOIR AND LANDS ALONG FOUNTAIN CREEK

| Location | Estimated Irrigated Area (acres) |
|---|---|
| Fountain Creek | 8,510(1) |
| Upper Arkansas | 7,981(2) |
| Upper Arkansas Tributaries | 17,478(3) |
| **Total** | **33,969** |

(1) Based on measurements from USGS orthophoto quad sheets made in 1974-1976 period. USBR identified 12,805 acres in 1972.
(2) Based on measurements from USGS orthophoto quad sheets made in 1974-1987 period. USBR identified 9,117 acres in 1972.
(3) Based on measurements from USGS orthophoto quad sheets made in 1974-1987 period. Amount includes 5,265 acres irrigated from Brush Hollow and Beaver Creeks, which were identified by the USBR. Other tributaries, such as Chalk Creek, Cottonwood Creek, and South Arkansas River, were not included by the USBR.
Note: All measurements were made in 1998 by Helton & Williamsen, P.C.

As shown in Table 4.4, approximately 224,000 acres of land were irrigated by the 14 larger ditch systems, the smaller ditches, and sole-source irrigation wells, along the Arkansas River from Pueblo to Las Animas within the boundaries of the SECWCD in 1985. By 1997, the acreage had been reduced to approximately 194,500 acres, because of transfers of water from the Colorado Canal and the Rocky Ford Ditch.

## TABLE 4.4
## IRRIGATED ACREAGES FOR CANAL SYSTEMS BELOW PUEBLO DAM AND WITHIN THE SECWCD(1)

| Year | Area in Acres | | | | | |
|---|---|---|---|---|---|---|
| | **1947** | **1953** | **1964** | **1970** | **1985** | **Current** |
| Bessemer | 20,791 | 19,779 | 20,172 | 19,150 | 17,713 | 17,713 |
| Excelsior | 1,835 | 1,715 | 1,751 | 1,660 | 1,509 | 0(6) |
| Colorado | 41,913 | 43,012 | 38,549 | 41,105 | 30,593 | 6,800 |
| Oxford Farmers | 5,118 | 5,087 | 5,049 | 5,094 | 4,855 | 4,855 |
| Highline | 21,195 | 20,967 | 20,713 | 20,877 | 19,490 | 19,490 |
| Highline & Otero(2) | 1,763 | 1,693 | 1,722 | 1,723 | 1,642 | 1,642 |
| Highline & Catlin(2) | 126 | 126 | 126 | 126 | 126 | 126 |
| Otero | 2,839 | 4,438 | 2,370 | 3,682 | 2,346 | 2,346 |
| Catlin & Otero(2) | 1,836 | 1,836 | 1,708 | 1,836 | 1,754 | 1,754 |
| Catlin(3) | 17,949 | 17,915 | 17,380 | 17,629 | 17,093 | 17,093 |
| Holbrook | 15,545 | 15,500 | 14,338 | 14,879 | 14,191 | 14,191 |
| Rocky Ford | 7,697 | 7,611 | 7,389 | 7,380 | 7,169 | 3,011 |
| Fort Lyon | 93,514 | 95,045 | 91,772 | 94,421 | 91,124 | 91,124 |
| Las Animas | 6,841 | 6,822 | 7,090 | 7,179 | 6,502 | 6,502 |
| Other Ditches(4) | 5,396 | 5,374 | 5,770 | 5,716 | 3,029 | 3,029 |
| Sole Source Wells(5) | 4,499 | 5,844 | 6,001 | 6,599 | 4,776 | 4,776 |
| **Total** | **248,857** | **252,764** | **241,900** | **249,056** | **223,912** | **194,452** |

(1) Values taken from "Irrigated Acreage - Arkansas River Basin" (May 10, 1991, Colorado Defense Exhibit 816, Kansas v. Colorado) prepared by the State Engineer's staff. The acreages were measured from aerial photographs taken in 1947, 1953, 1964, 1970, and 1985.

(2) The acres irrigated from the combined sources are not included in the values presented for the individual ditches.

(3) Does not include lawn, park, and garden irrigation within the Town of Rocky Ford.

(4) Other ditches include the Booth Orchard, Collier, Hamp-Bell, Riverside Dairy, West Pueblo, Las Animas Town, Jones, and Keesee.

(5) Sole source wells acreages include the irrigated land under the Brown-Mexican, Blunt, Zoeller, Baldwin Stubbs, and Klinkerman Ditches.

(6) Now irrigated by wells with ditch water used for recharge.

Note: Refer to Section 4.4 and Table 4.5 for discussion of water transfers and sales.

## 4.4 Historical Water Transfers from Irrigated Agriculture to Other Uses

During the 1950-1985 period, an average of 242,000 acres of land were irrigated in the area from Pueblo to Las Animas. In 1985, the irrigated area had dropped to 222,000 acres. Since that time, there has been further reduction in irrigated acreage due to acquisition of irrigated land by municipal and industrial entities and conversion of agricultural water rights to municipal and industrial use. This reduction is documented in Table 4.4. The reduction in irrigation to date, however, has not been too significant because of continuing irrigation of lands to establish native vegetation and lease back of water to irrigators. The following conversions of agricultural water to M&I users are completed or in progress:

- In 1982, Public Service Company (PSCo) changed the use of the water rights for the Las Animas Consolidated and Consolidated Extension Canal Companies to include industrial purposes. The shares acquired by PSCo have been leased back annually to farmers under the two systems so the irrigated acreage has not changed substantially to date. PSCo's interests represent about 81 percent of the water supply.

- In 1986, the water right for the Rocky Ford Canal was changed to include municipal uses. As of 1992, approximately two-thirds of the irrigated crop land involved in the change continued to be irrigated to initiate re-vegetation. When the re-vegetation is complete in the year 2000, approximately 4,100 acres will be retired.

- In the 1980s, the water rights for the Colorado Canal Company, Lake Meredith Reservoir Company, and Lake Henry Reservoir Company were changed to include municipal purposes. Through 1996, the irrigated acreage decreased to 6,800 acres.

The history of sales of water from irrigated agricultural use to M&I use is summarized in Table 4.5. The data contained in Table 4.5 came from a different source than the data in Table 4.4. Table 4.5 is provided for an overall perspective on water sales from the agricultural to the M&I sector. As described above, the major transfers include the Twin Lakes Canal and Reservoir water, Clear Creek Reservoir water, the Rocky Ford Ditch, the Las Animas Consolidated Canal, and the Colorado Canal.

# TABLE 4.5
# HISTORICAL SALES OF AGRICULTURAL WATER TO M&I AND OTHER USERS

| Ditch | Irrigated Area (acres) | Percent of Shares | Transfer Destination | Approximate Land Affected (acres) |
|---|---|---|---|---|
| Bessemer | 20,000 | 3.5 | St. Charles Mesa | 500 |
| Hamp Bell | 91 | 100 | Valco, Inc. | 91 |
| West Pueblo Ditch | 328 | 100 | Pueblo | 328 |
| Booth-Orchard | 1,400 | 100 | Pueblo | 1400 |
| Zoeller | 110 | 75 | St. Charles Mesa | 100 |
| Twin Lakes | 50,000 - 56,000 | 94.1 | Aurora, Pueblo, Colorado Springs, Crowley, Olney Springs, Pueblo West, and Sugar City | (1) |
| Colorado Canal Company(2) | 47,373 | 86 | Colorado Springs and Aurora | 40,000 |
| Busk-Ivanhoe | 24,100 | 96 | Pueblo and Aurora | (1) |
| Clear Creek(3) | 14,000 - 16,000 | 100 | Pueblo | 9,000 |
| Catlin Canal | 19,000 | 11 | CDOW | (4) |
| Rocky Ford | 8,200 | 58 | Aurora | 4,100 |
| Las Animas Consolidated | 6,950 | 84 | Public Service Company | (4) |
| Fort Bent | 8,000 | 11 | City of Lamar | 850 |
| | | | **Total** | **56,369** |

(1) Supplemental source of irrigation water.
(2) Includes Lake Meredith Company and Lake Henry Company.
(3) Includes Ewing, Wurtz, and Columbine transmountain ditches.
(4) All shares leased back to shareholders.

NOTE: Source is Gronning Engineering Company (February 1994).The data in this table came from a different source than the data in Table 4.4.

## 4.5 Use of Project Water

The allocations of Project Water to the irrigation ditches between Pueblo and Las Animas are shown in Table 4.6. The allocations averaged about 24,300 af annually and ranged from none in several years to 94,784 af in 1989. The actual diversions of this water were less than these amounts due to transit losses. Currently, there is no year-to-year carryover storage in the Fry-Ark Project for agricultural users. As a result, Project irrigation water is subject to reallocation.

## 4.6 The Winter Water Storage Program (WWSP)

The WWSP allows the users to store water during the winter months and to call for the stored water at times when the user needs the water. It allows the user to call for the water during the spring and late summer when the natural streamflows are low. Prior to the adoption of the WWSP, most of the ditches had diverted water for irrigation during the winter months.

The decree in Case No. 84CW179 sets forth the formula for distributing, among the WWSP participants, the winter water stored in Pueblo and John Martin Reservoirs, as well as water diverted by the Colorado Canal for storage in Lake Henry and Lake Meredith; by the Fort Lyon Storage Canal for storage in Adobe Creek, Horse Creek and Thurston Reservoirs; by the Holbrook Canal for storage in Holbrook and Dye Reservoirs; and by the Fort Lyon Canal for storage in the Great Plains Reservoirs.

Prior to execution of the decree in 1987, various storage seasons and distribution schemes were used. Table 4.7 summarizes the derivation of the winter water supply from the various sources for 1976-77 and 1979-97. The total winter water supply averaged 153,047 af annually and ranged from 85,011 af in 1990 to 216,886 af in 1987.

The Otero, Rocky Ford, and Excelsior Canals do not participate in the decreed WWSP; however, the Rocky Ford Canal did participate in 1976, and the Otero Canal did participate in 1976-77 and 1979-86.

## TABLE 4.6
## ANNUAL ALLOCATIONS OF PROJECT WATER BY SECWCD TO IRRIGATION DITCHES BELOW PUEBLO RESERVOIR IN ACRE-FEET

| Year | Bessemer | Excelsior | Colorado | Highline | Oxford Farmers | Otero | Catlin | Holbrook | Rocky Ford | Fort Lyon | Las Animas Consol. | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1970 | 0 | 0 | 2,512 | 0 | 0 | 0 | 1,212 | 0 | 0 | 0 | 0 | 3,724 |
| 1971 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1972 | 788 | 0 | 5,480 | 548 | 0 | 0 | 2,740 | 3,288 | 0 | 0 | 0 | 12,844 |
| 1973 | 1,792 | 0 | 3,448 | 750 | 550 | 0 | 2,774 | 3,831 | 0 | 0 | 0 | 13,145 |
| 1974 | 2,340 | 0 | 1,750 | 1,200 | 600 | 500 | 1,700 | 3,000 | 0 | 4,100 | 0 | 15,190 |
| 1975 | 2,750 | 130 | 2,750 | 2,250 | 600 | 0 | 2,750 | 3,845 | 0 | 6,200 | 0 | 21,275 |
| 1976 | 900 | 52 | 900 | 900 | 200 | 300 | 900 | 1,800 | 0 | 2,072 | 0 | 8,024 |
| 1977 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1978 | 2,310 | 145 | 3,000 | 1,500 | 500 | 400 | 2,820 | 2,850 | 0 | 6,450 | 0 | 19,975 |
| 1979 | 2,555 | 150 | 2,890 | 2,495 | 825 | 0 | 2,790 | 2,090 | 0 | 7,330 | 0 | 21,125 |
| 1980 | 3,485 | 391 | 11,580 | 3,500 | 840 | 700 | 2,306 | 10,000 | 0 | 15,778 | 0 | 48,580 |
| 1981 | 2,050 | 133 | 2,050 | 2,050 | 501 | 376 | 2,050 | 1,890 | 0 | 4,441 | 0 | 15,541 |
| 1982 | 3,000 | 0 | 10,200 | 5,000 | 750 | 1,130 | 4,000 | 5,000 | 0 | 17,500 | 0 | 46,580 |
| 1983 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1984 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1985 | 3,000 | 0 | 0 | 0 | 877 | 0 | 0 | 0 | 0 | 0 | 0 | 3,877 |
| 1986 | 5,700 | 0 | 164 | 2,500 | 1,150 | 1,000 | 5,000 | 0 | 0 | 0 | 0 | 15,514 |
| 1987 | 600 | 0 | 2,093 | 3,000 | 0 | 500 | 0 | 0 | 0 | 0 | 0 | 6,193 |
| 1988 | 6,500 | 0 | 3,140 | 8,500 | 1,200 | 1,500 | 12,000 | 10,000 | 0 | 28,000 | 0 | 70,840 |
| 1989 | 10,937 | 0 | 3,678 | 13,027 | 2,700 | 1,978 | 7,600 | 9,264 | 0 | 45,600 | 0 | 94,784 |
| 1990 | 3,040 | 0 | 1,162 | 3,600 | 960 | 791 | 2,986 | 2,560 | 0 | 15,040 | 0 | 30,139 |

| Year | Bessemer | Excelsior | Colorado | Highline | Oxford Farmers | Otero | Catlin | Holbrook | Rocky Ford | Fort Lyon | Las Animas Consol. | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1991 | 4,560 | 0 | 1,594 | 5,400 | 1,440 | 1,187 | 4,560 | 3,840 | 0 | 22,560 | 0 | 45,141 |
| 1992 | 2,347 | 0 | 821 | 2,780 | 741 | 611 | 1,387 | 1,977 | 0 | 11,613 | 0 | 22,277 |
| 1993 | 6,825 | 0 | 2,323 | 5,000 | 1,000 | 1,742 | 0 | 5,600 | 0 | 32,900 | 0 | 55,390 |
| 1994 | 4,156 | 0 | 1,357 | 4,693 | 1,241 | 1,055 | 2,500 | 3,397 | 0 | 18,660 | 0 | 37,059 |
| 1995 | 0 | 0 | 1,631 | 5,465 | 1,438 | 1,722 | 3,501 | 3,931 | 0 | 41,180 | 0 | 58,868 |
| 1996 | 9,000 | 0 | 1,698 | 5,000 | 2,000 | 2,500 | 11,000 | 12,000 | 0 | 30,000 | 0 | 73,198 |
| 1997 | 9,000 | 0 | 0 | 5,000 | 1,000 | 2,300 | 0 | 6,000 | 0 | 35,000 | 0 | 58,300 |
| 1998 | 20,000 | 0 | 0 | 15,000 | 3,000 | 1,500 | 10,000 | 10,000 | 0 | 30,000 | 0 | 89,500 |
| Average | 3,711 | 36 | 2,284 | 3,419 | 832 | 752 | 2,985 | 3,660 | 0 | 12,911 | 0 | 30,590 |

NOTE: Data obtained from the SECWCD.

The total winter water supply is distributed to the direct flow participants and the off-channel storage participants. The first 100,000 af are distributed 28.8 percent to the direct flow participants and 71.2 percent to the off-channel storage participants. That distribution is further divided:

Direct Flow Participants
28.8 Percent Share of First 100,000 Acre-feet

| | |
|---|---|
| Bessemer | 21.50 percent |
| Highline | 28.87 percent |
| Oxford Farmers | 6.96 percent |
| Catlin | 31.72 percent |
| Las Animas Consolidated | 9.57 percent |
| Riverside-West Pueblo | 1.38 percent |
| | 100.00 percent |

Off-Channel Storage Participants
71.2 Percent Share of First 100,000 Acre-feet

| | |
|---|---|
| Colorado, Lake Henry, and Lake Meredith | 15.01 percent |
| Holbrook | 11.97 percent |
| Fort Lyon | 53.60 percent |
| Amity | 19.42 percent |
| | 100.00 percent |

The next 2,750 af above the first 100,000 af are assigned to the Amity Mutual Irrigation Company (Amity), and the following 356 af are assigned to the Holbrook. Winter stored water greater than 103,106 af is distributed 25 percent to the direct flow participants and 75 percent to the off-channel storage participants. That distribution is further divided:

Direct Flow Participants
25 Percent Share of Stored Water over 103,106 Acre-feet

| | |
|---|---|
| Bessemer | 21.50 percent |
| Highline | 28.87 percent |
| Oxford Farmers | 6.96 percent |
| Catlin | 31.72 percent |
| Las Animas Consolidated | 9.57 percent |
| Riverside-West Pueblo | 1.38 percent |
| | 100.00 percent |

Off-Channel Storage Participants
75 Percent Share of Stored Water Over 103,106 Acre-feet

| | |
|---|---|
| Colorado, Lake Henry, and Lake Meredith | 17.07 percent |
| Holbrook | 14.05 percent |
| Fort Lyon | 50.88 percent |
| Amity | 18.00 percent |
| | 100.00 percent |

The participants may continue to irrigate during the winter; however, such diversions are charged against the user's assignment of stored water. Also, the participants may call for their stored water at any time, except that any water in storage in Pueblo Reservoir on May 1 of the succeeding year will be released to the Arkansas River at rates determined by the Division Engineer.

Table 4.8 shows the annual releases of WWSP water from Pueblo Reservoir to the participating direct flow ditches. These releases averaged about 31,800 af annually and ranged from none in 1987 to 47,389 af in 1993.

Because there is no carryover storage for agricultural users in the Project, stored winter water not used later for irrigation is subject to spill. Dedicated storage for the WWSP would enable much better management of water for irrigation. Comparison of WWSP storage in Pueblo Reservoir (Table 4.7; Pueblo Reservoir Column) against WWSP releases from Pueblo Reservoir (Table 4.8) indicates that storage exceeds releases in certain years, sometimes by a considerable amount. This is due to spills and evaporation, with the predominant factor being spills. For example, storage in Pueblo Reservoir exceeded releases by considerable amounts in the following years:

| Year | WWSP Storage(1) (af) | WWSP Releases(1) (2) (af) | Difference (af) |
|---|---|---|---|
| 1982 | 45,241 | 30,873 | 14,368 |
| 1983 | 75,628 | 27,879 | 47,749 |
| 1984 | 82,396 | 23,816 | 58,580 |
| 1985 | 49,912 | 34,132 | 15,780 |
| 1987 | 20,179 | 0 | 20,179 |
| 1990 | 33,453 | 26,126 | 7,327 |
| 1995 | 42,627 | 9,541 | 33,081 |

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(1) Pueblo Reservoir; Table 4.7
(2) See Table 4.8.

# TABLE 4.7
# DERIVATION OF WINTER WATER SUPPLY WINTER WATER STORAGE PROGRAM IN ACRE-FEET

| Year | Winter Storage Period | Winter Storage By: | | | | | | Winter Irrigation | Transit Loss LA to JMR | Total Winter Water Supply |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Pueblo Reservoir | Colorado Canal | Fort Lyon Storage | Holbrook Canal | Great Plains Reservoirs | John Martin Reservoir | | | |
| 1976 | Dec 1-Feb 29 | 32,179 | 888 | 53,670 | 7,659 | 10,272 | 0 | 2,342 | | 107,010 |
| 1977 | Nov 15-Mar 5 | 35,768 | 2,481 | 46,331 | 10,040 | 0 | 11,904 | 722 | | 107,246 |
| 1978 | No Program | | | | | | | | | |
| 1979 | Nov 15-Mar 15 | 37,809 | 5,408 | 41,400 | 0 | 0 | 10,152 | 25 | | 94,794 |
| 1980 | Dec 1-Mar 15 | 39,713 | 6,407 | 45,964 | 11,284 | 0 | 20,096 | 0 | | 123,464 |
| 1981 | Nov 15-Mar 15 | 49,755 | 10,868 | 48,439 | 6,228 | 0 | 24,090 | 25 | | 139,405 |
| 1982 | Nov 15-Mar 14 | 45,241 | 7,556 | 51,621 | 10,868 | 0 | 19,560 | 0 | | 134,846 |
| 1983 | Nov 15-Mar 14 | 75,628 | 9,672 | 69,595 | 7,456 | 0 | 26,626 | 0 | | 188,977 |
| 1984 | Nov 15-Mar 14 | 82,396 | 7,305 | 63,101 | 8,222 | 0 | 35,021 | 0 | | 196,045 |
| 1985 | Nov 15-Mar 15 | 49,912 | 0 | 58,161 | 844 | 40,761 | 29,612 | 1,266 | | 180,556 |
| 1986 | Nov 15-Mar 14 | 30,000 | 13,945 | 82,205 | 11,414 | 23,687 | 22,350 | 7,334 | | 190,935 |
| 1987 | Nov 15-Mar 15 | 20,179 | 8,760 | 86,426 | 8,443 | 48,131 | 35,586 | 9,361 | | 216,886 |
| 1988 | Nov 15-Mar 15 | 38,050 | 27,261 | 81,839 | 10,062 | 0 | 29,717 | 0 | | 186,929 |
| 1989 | Nov 15-Mar 15 | 40,991 | 15,724 | 55,322 | 9,556 | 0 | 26,479 | 0 | | 148,072 |
| 1990 | Nov 15-Mar 15 | 33,453 | 9,678 | 26,838 | 0 | 0 | 15,042 | 0 | | 85,011 |
| 1991 | Nov 15-Mar 15 | 43,340 | 14,903 | 53,370 | 5,754 | 0 | 26,333 | 97 | | 143,797 |
| 1992 | Nov 15-Mar 15 | 46,112 | 16,086 | 59,599 | 8,668 | 368 | 27,556 | 22 | 867 | 159,278 |
| 1993 | Nov 15-Mar 15 | 48,014 | 16,619 | 60,957 | 8,131 | 0 | 28,782 | 0 | 906 | 163,409 |
| 1994 | Nov 15-Mar 15 | 46,122 | 16,059 | 56,667 | 6,421 | 0 | 28,118 | 17 | 885 | 154,289 |
| 1995 | Nov 15-Mar 15 | 42,627 | 15,843 | 57,489 | 9,942 | 2,535 | 24,541 | 0 | 772 | 153,749 |
| 1996 | Nov 15-Mar 15 | 34,100 | 22,379 | 55,390 | 13,004 | 13,260 | 34,374 | 4,002 | 1,081 | 177,590 |
| 1997 | Nov 15-Mar 15 | 46,505 | 13,143 | 59,855 | 6,248 | 0 | 34,858 | 0 | 1,097 | 161,706 |
| **Average** | — | **43,709** | **11,475** | **57,821** | **7,631** | **6,620** | **24,324** | **1,201** | **935** | **153,047** |
| **Maximum** | — | **82,396** | **27,261** | **86,426** | **13,004** | **48,131** | **35,586** | **9,361** | **1,097** | **216,886** |
| **Minimum** | — | **20,179** | **0** | **26,838** | **0** | **0** | **0** | **0** | **772** | **85,011** |

NOTE: Values taken from annual summaries prepared by the Division Engineer.
The Winter Water Storage Program was decreed in Case No. 84CW179 on November 10, 1987.
The "Total Winter Water Supply" was distributed to the participants according to the agreement in effect for the particular year.

## TABLE 4.8
## WINTER WATER STORAGE PROGRAM RELEASES FROM PUEBLO RESERVOIR FOR IRRIGATION IN ACRE-FEET

| Year | Bessemer | Excelsior | Colorado | Highline | Oxford Farmers | Otero | Catlin | Holbrook | Rocky Ford | Fort Lyon | Las Animas Consol. | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1976 | 6,017 | Does not participate | 5,629 | 6,958 | 1,212 | 576 | 6,409 | 2,620 | Does not participate | 0 | 2,752 | 32,173 |
| 1977 | 5,396 | | 9,182 | 6,677 | 1,070 | 1,889 | 7,864 | 0 | | 0 | 2,171 | 34,249 |
| 1978(1) | no program | | | | | | | | | | | |
| 1979 | 4,331 | | 2,162 | 7,884 | 1,786 | 387 | 7,915 | 7,851 | | 0 | 1,970 | 34,286 |
| 1980 | 4,380 | | 8,315 | 7,908 | 1,743 | 379 | 7,836 | 2,882 | | 1,247 | 2,277 | 36,967 |
| 1981 | 6,117 | Does not participate | 8,649 | 7,084 | 2,001 | 672 | 8,579 | 8,058 | Does not participate | 2,216 | 2,672 | 46,048 |
| 1982 | 5,428 | | 0 | 11,408 | 1,260 | 862 | 11,915 | 0 | | 0 | 0 | 30,873 |
| 1983 | 4,962 | | 9,767 | 9,103 | 84 | 369 | 0 | 3,550 | | 0 | 44 | 27,879 |
| 1984 | 7,269 | | 10,005 | 3,237 | 93 | 742 | 0 | 2,470 | | 0 | 0 | 23,816 |
| 1985 | 0 | | 15,673 | 3,946 | 47 | 0 | 5,926 | 8,540 | | 0 | 0 | 34,132 |
| 1986 | 8,882 | Does not participate | 0 | 9,283 | 2,237 | 0 | 10,171 | 0 | Does not participate | 0 | 0 | 28,573 |
| 1987 | 0 | | 0 | 0 | 0 | 0 | 0 | 0 | | 0 | 0 | 0 |
| 1988 | 9,187 | | 0 | 13,347 | 1,332 | 0 | 6,755 | 2,465 | | 0 | 0 | 33,086 |
| 1989 | 8,450 | | 701 | 11,459 | 3,863 | 0 | 9,481 | 3,911 | | 0 | 0 | 37,865 |
| 1990 | 7,239 | | 988 | 4,540 | 712 | 0 | 9.592 | 3,055 | | 0 | 0 | 26,126 |
| 1991 | 8,162 | Does not participate | 924 | 12,789 | 3,668 | 0 | 8,281 | 7,193 | Does not participate | 0 | 0 | 41,017 |
| 1992 | 8,880 | | 1,614 | 9,987 | 1,843 | 0 | 11,296 | 5,836 | | 0 | 0 | 39,456 |
| 1993 | 8,656 | | 1,317 | 16,085 | 3,395 | 0 | 11,229 | 6,707 | | 0 | 0 | 47,389 |
| 1994 | 8,404 | | 452 | 8,552 | 3,520 | 0 | 13,624 | 6,106 | | 0 | 0 | 40,658 |
| 1995 | 411 | | 247 | 2,886 | 0 | 00 | 5,997 | 0 | | 0 | 0 | 9,541 |
| Average | 5,798 | Does not participate | 3,980 | 8,060 | 1,572 | 309 | 7,519 | 3,750 | Does not participate | 182 | 626 | 31,797 |

NOTE: Values taken from records obtained from the Bureau of Reclamation.
(1) There was no WWSP in 1978.

Φ

Section 5

# 5. WATER DEMAND FORECASTS

## 5.1 Municipal Water Use Patterns

As part of the data acquisition and surveys described in Section 2, information was obtained on current and projected future per capita water use for municipal water supply entities within the District. Current municipal water demand in the District is approximately 148,000 af per year (Figure 5.1) for a population of 620,200 persons. Based on information provided by the municipal entities, the average current per capita water use in the District is 213 gallons per capita per day (gpcd). Per capita water use, for the entities that reported such figures, ranges from 118 gpcd to 457 gpcd. The per capita water use factors estimated for the District are based on reported total water use divided by reported service area population. Therefore, per capita use includes indoor and outdoor residential use, commercial and industrial use, system losses, and other "unaccounted for" water.

Per capita water use has wide variation depending on a variety of factors, including outdoor water use, socio-economic conditions, commercial and industrial water use, and water provider policies. For example, high per capita water use in Salida (457 gpcd) is attributable to the lack of water meters and extensive water use for irrigation. Water use in the Penrose Water District (118 gpcd) is low because virtually all use is for domestic purposes and outdoor irrigation uses are relatively small.

## 5.2 Potential Impacts of Water Conservation

### 5.2.1 Background on Conservation

Increase in future water demand in the District is dependent upon population growth, types of uses, and effectiveness of conservation efforts within the District. Current and planned conservation measures were used to forecast possible reductions in future demands as a result of conservation over and above that currently provided.

The Energy Policy Act of 1992 and the Water Metering Act (Colorado House Bill 90-1106), are recently enacted measures related to water conservation. The Energy Policy Act has required low-flow showerheads, toilets, and faucets to be installed on all new homes built after 1994. The Water Metering Act mandates water providers in Colorado to use metered water delivery and billing on all new construction, and to phase in the metering of existing properties through the year 2009. These mandatory measures are expected to result in immediate, as well as long-term, water demand reductions for municipal entities in Colorado.

Since the passage of Colorado House Bill 91-1154, water providers that supply 2,000 acre-feet of water annually have been required to prepare a water conservation plan. (At 200 gallons per capita per day, annual supply of 2,000 af per year corresponds to a population base of approximately 9,000 persons.) Each entity is required to consider the feasibility of implementing up to nine identified conservation measures, and to develop a program for implementing the measures chosen. Entities were expected to submit a conservation plan to the Colorado Water Conservation Board (CWCB) before June 1996.

### 5.2.2 SECWCD (District) Water Conservation Plan

The District prepares a water conservation plan every 5 years, which is submitted to the USBR. The plan considers all aspects of Project water use in the District including agricultural, municipal, and industrial use. The 1997 Water Conservation Plan for the Fryingpan-Arkansas Project is currently in draft form. A plan also was prepared in 1992. The 1997 conservation objectives include: Allocation Policy and Process; USBR Seepage Reduction Study; communication enhancements, including the Water News newsletter, a project brochure, an educational video, and the Arkansas River Forum; potential designation of a water conservation coordinator; return flow sales enhancement; completion of the Water and Storage Needs Assessment Project; completion of the Pueblo Reservoir Dam Enlargement Study; and pursuit of Warren Act or Project-specific amendments to allow long-term storage of non-Project water in Project facilities and storage of Project water in non-Project space. The District also is seeking to decree the Cottonwood Creek/South Arkansas exchange.

Schedules and budgets for meeting these objectives are currently being refined. Some of the 1997 Conservation Plan programs are already functioning within the District. Some of the existing water management and conservation measures are inherent in State of Colorado water laws and the State's administration of water resources. The "Water Conservation Act of 1991" and the "Water Metering Act" are two examples of these measures. Fryingpan-Arkansas Project operating and allocation principles incorporate conservation as a fundamental priority. Other currently successful conservation efforts are the reuse of Project water and the Winter Water Storage Program.

### 5.2.3 Current and Planned Municipal Water Conservation Measures

Municipal entities currently delivering 2,000 af per year or more to customers in the District include Colorado Springs Utilities, Pueblo Board of Water Works, Canon City, Security Water District, Widefield Water and Sanitation District, La Junta, Salida, Lamar, and the Pueblo West Metropolitan District. Together, these nine entities account for nearly 90 percent of the current municipal water demand in the SECWCD. Five of these nine entities have submitted or soon will submit conservation plans to the CWCB. These entities are Colorado Springs Utilities, Canon City, La Junta, Security Water District, and Widefield Water and Sanitation District. Salida, Pueblo, and Pueblo West have conservation initiatives in place, but have not yet submitted plans to the CWCB.

By the year 2020, forecasts using the base population projections presented in Section 3 indicate that the City of Fountain, St. Charles Mesa Water District, the City of Rocky Ford, and the City of Florence will have water demands in excess of 2,000 af per year. Therefore, these entities will be required, over the next 10 to 20 years, to develop water conservation plans in compliance with the CWCB guidelines. In the year 2020, the 12 municipal water supply entities with water demands exceeding 2,000 af per year are expected to account for approximately 94 percent of the total municipal water demand.

Based on survey results documented in Chapter 2, the per capita water demand for larger municipal entities in the District, which have (or require) conservation plans, ranges from a low of 137 gpcd in Widefield to 333 gpcd in La Junta. In several smaller communities and water districts, the per capita demand exceeds 400 gpcd. The entities with high water usage generally include a significant component of irrigation.

As indicated in Table 5.1, there are nine types of measures considered in conservation planning under the CWCB program:

1. Water-efficient features and appliances.

2. Low-water-use landscaping and irrigation efficiency improvements.

3. Water-efficient industrial and commercial water-using processes.

4. Water reuse systems.

5. Distribution system leak detection and repair.

6. Water use efficiency measures:

    a. Public education,
    b. Customer water use audits, and
    c. Water-savings demonstrations.

7. Tiered rate structures.

8. Water efficiency ordinances.

# TABLE 5.1
# STATUS OF WATER CONSERVATION MEASURES IN SECWCD FOR MUNICIPAL ENTITIES SUPPLYING MORE THAN 2000 AF/YR

| | | | | Measures in 1991 Water Conservation Act | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | 1 | 2 | 3 | 4 | 5 | 6 - Efficiency Measures | | | 7 | 8 | 9 |
| Water Organization | Conservation Plan Accepted by CWCB | Per Capita Use | Metering | Water Efficient Fixtures and Appliances | Landscaping/Efficient Irrigation | Efficient Ind. & Comm. Water-Using Processes | Water Reuse Systems | Distribution System Leak Repair | Public Education | Customer Water Use Audits | Water-Saving Demonstrations | Tiered Water Rate Structures | Water Use Efficiency Ordinances | Efficiency Incentives (Rebates) |
| Colorado Springs | Y | 207 | E | P | E,P | | E | E | E, P | E, P | | P | P | P |
| Canon City | Y | 204 | E | P | E | P | | E | P | P | | | | |
| Security | Y | 218 | E | P | | | | P | P | P | P | P | P | |
| La Junta | Y | 333 | E | P | | E,P | P | E | E,P | P | E,P | | P | P |
| Widefield | Y | 137 | E | P | E | | | E | E | E | E | E | | |
| Pueblo | | 228 | E | E | E | | | E | | | | | | |
| Lamar | | 273 | E | | E | | E | | | | | E | | |
| Pueblo West | | 235 | E | Plan is under development | | | | | | | | P | | |

Y - Yes.

E - Existing measure expected to provide future water savings.

P - Proposed demand reduction measure being considered for implementation.

9. Water efficiency incentives (rebates).

Not all of these measures are applicable to a particular entity. Under the CWCB program, water providers can evaluate the available options and decide which measures are worthy of implementation in light of current water-use patterns and socio-economic realities.

The CWCB program does not specifically address metering of customers. However, metering is an important element of water conservation for two reasons:

1. Customers generally use less water when they are required to pay for water based on actual consumption rather than a set charge.

2. Metering enables the water provider to assess the amount of "unaccounted for" water in the system by comparing water production (at the treatment plant or wells) against metered sales of water.

If "unaccounted for" water is a larger percentage of total production than the industry standard, the water provider is alerted to the need for identifying the sources of "unaccounted for" water. These sources may include system leakage, water main flushing, firefighting, waste, etc.

As shown in Table 5.1, the most common currently used conservation measures include: low water-using landscaping and irrigation efficiency improvements; distribution system leak detection and repair; public education programs; and customer water-use audits.

### ***Colorado Springs Utilities***

Colorado Springs Water Resources Department was required by the USBR to write a Water Conservation Plan as a condition of its participation in the Southeast Water Conservancy District in the early 1980s. The Department continues to comply with that requirement and provide the USBR with periodic updates to that plan.

Colorado Springs has been a national leader in such proven conservation measures as metering (the City was fully metered in the 1940s); wastewater reuse (the City was a pioneer in using treated wastewater for irrigation of roadway medians, parks, cemeteries, campuses and golf courses with a program on line in 1961); its award winning Xeriscape Demonstration Garden, which opened in 1992; and an evapotranspiration lawn watering guide, based on information gathered from weather stations throughout the City, which began in 1991. These measures were implemented in the spirit of stewardship of the resource, and not as a result of legislative requirements.

The conservation program of Colorado Springs Utilities is significant to the region as a whole because this entity accounts for approximately 55 percent of the current municipal water demand in the District. Also, a recently completed conservation study conducted by Colorado Springs Utilities addressed a wide range of conservation measures, including those inherent in the CWCB guidelines.

Colorado Springs Utilities has a conservation program identified as a "base" program, which is being implemented. In addition, they have conducted a detailed study of water conservation to provide a broad foundation for increased future water savings (Montgomery Watson, *1995 Water Conservation Study*). A total of 20 additional water conservation measures were evaluated as part of the study. Five were eliminated due to unreasonably high costs or anticipated community opposition. Based largely on cost, the 15 remaining measures were organized into three levels of additional conservation (minimum, moderate, and maximum), which are referred to as programs. The programs reflect an increasing amount of community commitment and cost to achieve increasing levels of conservation. The three programs, and their estimated water savings, are summarized in Table 5.2 (adapted from Black & Veatch, 1996).

Since the 1992 Energy Policy Act requirements are fairly recent, there is not a large database of information available to accurately predict the water savings that will be achieved. For this reason, Colorado Springs Utilities has decided to continue to closely monitor actual water use within the service area. This will be accomplished through accounting of yearly production and through specifically designed pilot programs.

## TABLE 5.2
## COLORADO SPRINGS UTILITIES CONSERVATION PROGRAMS

| Existing Base | Minimum | Moderate | Maximum |
|---|---|---|---|
| Plumbing Code(1) | Plumbing Code(1) | Plumbing Code(1) | Plumbing Code(1) |
| Metering(1) | Metering(1) | Metering(1) | Metering(1) |
| Home Water Audit(1) | Home Water Audit(1) | Home Water Audit(1) | Home Water Audit(1) |
| Evapotranspiration Advisory Program(1) | Evapotranspiration Advisory Program(1) | Evapotranspiration Advisory Program(1) | Evapotranspiration Advisory Program(1) |
| Xeriscape Demonstration Garden(1) | Xeriscape Demonstration Garden(1) | Xeriscape Demonstration Garden(1) | Xeriscape Demonstration Garden(1) |
| Public Education(1) | Public Education(1) | Public Education(1) | Public Education(1) |
| Pressure Reduction Devices | Pressure Reduction Devices | Pressure Reduction Devices | Pressure Reduction Devices |
| Leak Detection | Leak Detection | Leak Detection | Leak Detection |
| System Monitoring | System Monitoring | System Monitoring | System Monitoring |
| Commercial Landscape Ordinances | Commercial Landscape Ordinances | Commercial Landscape Ordinances | Commercial Landscape Ordinances |
| | Large Landscape Irrigation Audit | Large Landscape Irrigation Audit | Large Landscape Irrigation Audit |
| | Rain Sensor | Rain Sensor | Rain Sensor |
| | | Miliary Executive Order | Military Executive Order |
| | | Small Commercial Audits | Small Commercial Audits |
| | | Interior Government Building Retrofit | Interior Government Building Retrofit |
| | | Residential Retrofit | Residential Retrofit |
| | | Incentives for Irrigation System Upgrade | Incentives for Irrigation System Upgrade |
| | | Zoo Pilot Program | Zoo Pilot Program |
| | | | Landscape Retrofit Program |
| | | | New Home Xeriscape Incentive |
| | | | Large Commercial Audits |

(1) Currently implemented program.
Source: Adapted from the Water Resources Plan for Colorado Springs Utilities (Black & Veatch, 1996).

Another program, which was identified but not fully evaluated, is a seasonal block rate structure. This measure specifically targets "discretionary" use of water, such as irrigation. Rate changes that target irrigation uses could significantly reduce peak water consumption with few structural changes. Colorado Springs Utilities plans to further evaluate this measure because it could reduce the size of "peaking" water distribution facilities and also send a clear message about the value of water to all customers. This measure could not be instituted without a public participation program and policy review.

The long-range water plan for Colorado Springs incorporates the "base" level of conservation into the planning process. This level of conservation in the Colorado Springs service area is expected to reduce per capita water demand, over time, as shown below:

| Year | Per Capita Use (gpcd) | | Percent Reduction |
|---|---|---|---|
| | Without Conservation⁽¹⁾ | With Conservation⁽¹⁾ | |
| 2000 | 213 | 205 | 3.8 |
| 2010 | 212 | 194 | 8.5 |
| 2020 | 207 | 182 | 12 |
| 2030 | 200 | 176 | 12 |
| 2040 | 198 | 174 | 12 |

(1) Data provided by the Colorado Springs Utilities.

Implementation of the base measures will provide the largest incremental reduction in water use with the service area. Other conservation features in the other three identified programs will be prudently used to adjust the actual realized savings in the base program. These additional programs are expected to reduce water use by another 3 to 6 percent.

Colorado Springs Utilities views water conservation as a sound management practice to provide a margin of safety against unavoidable delays in construction of major new facilities and to optimize the timing of major capital expenditures. Colorado Springs Utilities will carefully consider the effects of decreases in utility revenues resulting from demand management so that decisions regarding water rates can be balanced against operating costs and debt service requirements. CS Utilities does not plan to adjust water demand projections to reflect demand reductions beyond the base case until the effectiveness of additional programs can be assessed.

### ***Pueblo Board of Water Works***

Customers in the Board's service area are fully metered. This includes all city offices, Board of Water Works facilities, and all parks. The metering program includes a small meter check program where every year 500 meters are randomly checked for accuracy. Any meter that is not within American Water Works Association (AWWA) specifications is replaced. The large meter test program includes testing of all 3-inch and larger industrial meters every year. Meters that are found to be inaccurate are replaced.

The Board has a uniform water rate ($/1,000 gallons) for all water users. Large water customers and infrequent water customers are all charged the same rate for the water used. Most of the city's parks are connected to the City Parks and Recreation Departments "maxi-com system," which monitors weather conditions and regulates park watering. A central weather station monitors rainfall and soil moisture to turn sprinkler systems on or off as moisture and weather conditions indicate. Pueblo was the first city in the state to install this advanced sprinkler control system.

The Pueblo City Council has passed plumbing code ordinances that require installation of water-efficient fixtures.

The Board employs one full-time person that works exclusively on leak detection and cross-connection control. The Board's Transmission and Distribution Department is in the 30th year of a mains replacement and upgrade program, which has cut overall water loss in the distribution system to between 7 percent and 8 percent. This program began in 1968 and is scheduled to continue until the year 2003. After 2003, mains will be replaced as they show proof of failure. The AWWA rates any system that has a water loss below 10 percent as exceptional in terms of leakage/loss control.

### ***Canon City***

In January 1997, Canon City's water conservation plan was accepted by the CWCB. Currently, low water-use landscaping, efficient irrigation practices, and distribution system leak detection are included in the program. Efficiency in commercial/industrial water-use processes, public education, and customer water-use audits are being considered for implementation by Canon City. All water taps in Canon City are metered.

### ***Security Water District***

The Security Water District's conservation plan consists of the following proposed measures: water-efficient fixtures and appliances; distribution system leak repair; public education; customer water-use audits; water-saving demonstrations; a tiered-rate structure; and water-use efficiency ordinances. The plan was accepted by the CWCB in November 1996.

## *The City of La Junta*

La Junta's conservation plan was accepted by the CWCB in October 1996. Existing and proposed demand reduction measures include: water-efficient fixtures and appliances; leak detection and repair; efficient irrigation practices; efficient commercial/industrial water-use processes; public education; customer water-use audits; water-use efficiency ordinances; and rebates for implementing water-efficiency measures. The City is considering water reuse options.

## *Widefield Water and Sanitation District (WSD)*

The Widefield WSD has an in-place conservation program consisting of: low water-use landscaping and irrigation practices; distribution system leak repair; public education; customer water-use audits; water-saving demonstrations; and a tiered-rate structure. Widefield's per capita use is among the lowest in the District (137 gpcd). Widefield is considering implementation of measures to require use of water-efficient fixtures and appliances. The Widefield WSD's water conservation plan was accepted by the CWCB in July 1996.

## *Salida*

The City of Salida passed a resolution in June 1996 in accordance with HB 91-1154 (Water Conservation Act). In the resolution, the City Council committed to further consider requiring water-efficient fixtures and appliances; continuing encouraging customers to use Xeriscape landscaping and more efficient irrigation practices; continuing reuse of water for irrigating City lands; continuing its leak repair program; continuing public information programs on water use and conservation; implementing an "ascending block" rate structure; continuing in-place lawn watering restrictions; and continuing the ongoing meter retrofit program for old dwellings and businesses in the City. Meters are required to be installed when a sprinkler system is installed or when a customer's leak is repaired. Salida is currently working on a conservation plan for submittal to the CWCB.

## *Lamar*

The City of Lamar Water/Wastewater Department has adopted an aggressive program to conserve water. The implemented measures include:

- Replace all old, open-hose watering systems, used for Municipal Parks, ballfields, and other City recreational facilities, with sprinkler systems on timers.
- Restructured billing rates for water which will result in customers using less water.

- Downsized large residential and business meters where possible to reduce usage.
- The City uses ditch water to augment and recharge the well field.
- Non-potable water is used for irrigation of City recreational facilities.

***Pueblo West***

Pueblo West is in the process of developing its water conservation plan. A consultant has been hired to evaluate conservation options. A "progressive" water rate structure is being considered to replace a partial declining rate structure now in place. Under the progressive structure, water use greater than 5,000 gallons per month (or some other pre-set amount) would be billed at a higher rate per 1,000 gallons.

***St. Charles Mesa***

St. Charles Mesa Water District has conservation initiatives in place. However, a formal plan has not been submitted to the Colorado Water Conservation Board. Customers are fully metered. All meters are randomly checked for accuracy and those found to be inaccurate are replaced. The District has used an inclining block rate for a number of years. Distribution system leak repair and customers' water use audits are ongoing.

### 5.2.4 Potential Effects of Conservation

Forecasting the impact of current and future conservation measures on water demands is difficult. Relatively easy-to-implement measures, such as public education, rebates for new plumbing fixtures, and outdoor water use efficiency improvements, will typically result in an initial increment of savings at relatively low cost and a high degree of public acceptance.

Potentially greater reductions in water demand can typically be achieved by tiered rates, higher rates, water use restrictions, and water system modifications to control leakage and/or waste. These measures are more costly and difficult to "sell" to the public and commercial/industrial water users, because they have direct economic impacts.

The base measures implemented by CS Utilities (Table 5.2) will effect a reduction of approximately 12 percent in per capita demand by the year 2040, based on information supplied by CS Utilities. CS Utilities also estimates that its "minimum" conservation efforts may reduce water demand by 3,900 af/yr in the year 2040, approximately 3 percent. This reduction is over and above that expected to be achieved by the "base" measures already in place and reflected in estimates of future demand (i.e., metering, pressure reduction devices, enforcement of plumbing code, public education, etc.).

Typically, the full suite of conservation measures available to municipal water supply entities could be expected to reduce future water demands by 5 to 15 percent depending on current levels of conservation, socio-economic factors, and water-use patterns. Based on the forecasted reductions in per capita use in the Colorado Springs service area of 12 percent with their "base" conservation measures, a **10 percent reduction** in future per capita water demands has been assumed for municipal entities throughout the District. This assumes that existing conservation programs will be continued and will be effective and that municipal entities providing more than 2,000 af per year to customers will implement programs similar to those summarized in Tables 5.1 and 5.2. The effects of a 10 percent reduction in use on the municipal water demand forecasted for the year 2040 are presented in Section 5.4 of this report. (Note that the 10 percent reduction was applied to Colorado Springs even though the CS Utilities anticipates a greater percentage reduction to be achieved.)

## 5.3 Future Per Capita Water Use

Forecasts of water use at the municipal entity level are sometimes based on a detailed evaluation of water use patterns within the entity's water service area. This evaluation often includes indoor versus outdoor use, different ratios between residential, commercial, and industrial uses, single family versus multi-family dwelling unit usage, assessment of socio-economic factors affecting demand, and other considerations. When this data base has been assembled, a water-demand "model" then can be used to predict future per capita or per-sector demand (i.e., residential, commercial, industrial, etc.). This type of analysis is well beyond the scope of a regional study.

Many of the larger municipal water supply entities have prepared water demand forecasts using a variety of forecasting methods. Water demand forecasts prepared by the municipal entities are the basis of the water demand forecasts presented herein. Water demands for each of the larger municipal entities were estimated based on projections of future population and per capita water consumption figures provided by the municipal entities during the survey process. For Colorado Springs, future per capita water use is forecast by CS Utilities to decline by 12 percent during the planning period. For this study, a 10 percent decline was assumed. The methods used are summarized below:

1. Identify current and projected future per capita water needs for municipal entities that participated in the surveys or that have prepared water resources planning reports.
2. Use the per capita water demand figures and projected populations for the municipal entities to estimate future water demands (see Table 5.3).
3. For entities that did not report per capita water usage, apply the water use patterns of adjacent entities with similar demographic characteristics that did report.

4. Prepare the projections without consideration of possible additional conservation measures identified by the reporting municipal entities. (Colorado Springs, for example, may implement other conservation measures that would reduce water use even more than shown by their planning figures, which currently indicate a 12 percent reduction in per capita water use during the planning period.)

5. Apply factors to reflect implementation of conservation measures during the planning horizon (see Table 5.3). It was assumed that conservation measures would reduce future demands by 10 percent.

## 5.4 Range of Municipal/Industrial Water Demands to the Year 2040

Water demand forecasts were prepared for the years 2000, 2020, and 2040 for the following cases:

- Base case population with current levels of water conservation.
- High growth case population with current levels of water conservation.
- Base case population with conservation to effect a 10 percent reduction in per capita use.
- High growth case population with conservation to effect a 10 percent reduction in per capita use.

As shown in Table 5.4, municipal water use in the District by the year 2040 is expected to increase from 148,000 af per year to between 271,000 and 372,000 af per year with present levels of conservation, and between 244,000 and 335,000 af per year with additional conservation. The forecasts with conservation are shown graphically on Figure 5.2. Detailed breakdowns of water demands within the District are provided in Tables 5.5 and 5.6.

Incremental increases in municipal water demands from 1997 to 2040 are forecast to be 224,000 af with current water use and conservation practices and 187,000 af with additional conservation.

## 5.5 Agricultural Water Use

As indicated in Table 5.7 and Figure 5.18, the majority of agricultural water use in the District is supplied by direct flow from the Arkansas River. In a "dry" year, supplemental sources, such as Fry-Ark Project and ground water supplies, play a more important role in supplying water for agricultural use. In a dry year, direct flow represents only 65 percent of the agricultural use, with storage and transmountain sources plus ground water supplying 35 percent of the water.

In an average year, surface water sources account for most of the agricultural use (747,572 af; 91 percent), with well pumping making up the remainder (77,361 af; 9 percent). During the months of July-September, the supplemental sources provide up to 45 percent of the agricultural supply primarily from water stored in reservoirs or alluvial aquifers. Continued maintenance of these supplemental sources in terms of their timing and availability is critical to the health of the agricultural economy within the District and the Arkansas Basin as a whole.

## 5.6 Total Water Demands in the District

With agricultural water use included, total average water demand in the District is expected to increase to between 1.09 million acre-feet per year and 1.22 million acre-feet per year by the year 2040, as summarized in Table 5.8.

## TABLE 5.3
## PER CAPITA WATER USE (GALLONS PER CAPITA PER DAY)

| ENTITY | HISTORIC AVERAGE | 2000 |  | 2010 |  | 2020 |  | 2030 |  | 2040 |  |
|---|---|---|---|---|---|---|---|---|---|---|---|
|  |  | WITH CONSERV. | WITHOUT CONSERV. | WITH CONSERV. | WITHOUT CONSERV. | WITH CONSERV. | WITHOUT CONSERV. | WITH CONSERV. | WITHOUT CONSERV. | WITH CONSERV. | WITHOUT CONSERV. |
| **Chaffee County** |  |  |  |  |  |  |  |  |  |  |  |
| City of Buena Vista | 300 | 297 | 300 | 288 | 300 | 282 | 300 | 276 | 300 | 270 | 300 |
| City of Salida | 457 | 381 | 385 | 373 | 389 | 358 | 381 | 351 | 381 | 343 | 381 |
| Other Chaffee County Areas in District | 379 | 339 | 343 | 331 | 345 | 320 | 341 | 313 | 341 | 306 | 341 |
|  |  |  |  |  |  |  |  |  |  |  |  |
| **Fremont County** |  |  |  |  |  |  |  |  |  |  |  |
| Canon City | 204 | 202 | 204 | 202 | 210 | 221 | 235 | 216 | 235 | 211 | 235 |
| City of Florence | 260 | 257 | 260 | 250 | 260 | 244 | 260 | 239 | 260 | 234 | 260 |
| Park Center WD | 194 | 192 | 194 | 188 | 196 | 192 | 204 | 188 | 204 | 184 | 204 |
| Penrose WD | 118 | 117 | 118 | 113 | 118 | 111 | 118 | 109 | 118 | 106 | 118 |
| Other Fremont County Areas in District | 194 | 192 | 194 | 188 | 196 | 192 | 204 | 188 | 204 | 184 | 204 |
|  |  |  |  |  |  |  |  |  |  |  |  |
| **Pueblo County** |  |  |  |  |  |  |  |  |  |  |  |
| City of Pueblo | 228 | 226 | 228 | 219 | 228 | 214 | 228 | 210 | 228 | 205 | 228 |
| Pueblo West MD | 208 | 142 | 143 | 137 | 143 | 134 | 143 | 132 | 143 | 129 | 143 |
| St. Charles Mesa WD | 167 | 248 | 250 | 240 | 250 | 235 | 250 | 230 | 250 | 225 | 250 |
| Other Pueblo County Areas in District | 201 | 205 | 207 | 199 | 207 | 195 | 207 | 190 | 207 | 186 | 207 |
|  |  |  |  |  |  |  |  |  |  |  |  |
| **Crowley County** |  |  |  |  |  |  |  |  |  |  |  |
| Town of Ordway | 137 | 137 | 138 | 141 | 147 | 142 | 152 | 139 | 152 | 140 | 156 |
| Crowley County WA | 149 | 149 | 151 | 161 | 168 | 167 | 178 | 164 | 178 | 168 | 187 |
| Other Crowley County Areas in District | 125 | 124 | 125 | 120 | 125 | 118 | 125 | 115 | 125 | 113 | 125 |
|  |  |  |  |  |  |  |  |  |  |  |  |
| **Otero County** |  |  |  |  |  |  |  |  |  |  |  |
| Town of Fowler | 280 | 281 | 284 | 165 | 172 | 161 | 171 | 157 | 171 | 154 | 171 |
| City of La Junta | 333 | 330 | 333 | 320 | 333 | 313 | 333 | 306 | 333 | 300 | 333 |
| City of Rocky Ford | 283 | 280 | 283 | 271 | 283 | 266 | 283 | 260 | 283 | 254 | 283 |
| Other Otero County Areas in District | 299 | 297 | 300 | 252 | 263 | 246 | 262 | 241 | 262 | 236 | 262 |
|  |  |  |  |  |  |  |  |  |  |  |  |
| **Bent County** |  |  |  |  |  |  |  |  |  |  |  |
| Town of Las Animas | 179 | 236 | 238 | 228 | 238 | 224 | 238 | 219 | 238 | 214 | 238 |
| Bents Fort WA | 179 | 236 | 238 | 228 | 238 | 224 | 238 | 238 | 238 | 214 | 238 |
| Other Bent County Areas in District | 179 | 236 | 238 | 228 | 238 | 224 | 238 | 219 | 238 | 214 | 238 |
|  |  |  |  |  |  |  |  |  |  |  |  |
| **Prowers County** |  |  |  |  |  |  |  |  |  |  |  |
| City of Lamar | 293 | 290 | 293 | 281 | 293 | 275 | 293 | 270 | 293 | 264 | 293 |
| May Valley WA | 293 | 290 | 293 | 281 | 293 | 275 | 293 | 270 | 293 | 264 | 293 |
| Other Prowers County Areas in District | 293 | 290 | 293 | 281 | 293 | 275 | 293 | 270 | 293 | 264 | 293 |
|  |  |  |  |  |  |  |  |  |  |  |  |
| **Kiowa County** |  |  |  |  |  |  |  |  |  |  |  |
| Total Kiowa County in District | 224 | 237 | 239 | 220 | 230 | 216 | 230 | 211 | 230 | 207 | 230 |
| **El Paso County** |  |  |  |  |  |  |  |  |  |  |  |
| City of Colorado Springs | 207 | 211 | 213 | 204 | 212 | 194 | 207 | 184 | 200 | 179 | 198 |
| City of Fountain | 131 | 130 | 131 | 120 | 125 | 118 | 126 | 116 | 126 | 113 | 126 |
| Security WD | 218 | 227 | 229 | 220 | 229 | 215 | 229 | 211 | 229 | 206 | 229 |
| Widefield Homes WC | 137 | 137 | 138 | 132 | 138 | 131 | 139 | 128 | 139 | 125 | 139 |
| Stratmoor Hills WD | 128 | 128 | 129 | 134 | 140 | 132 | 140 | 129 | 140 | 126 | 140 |
| Other El Paso County Areas in District | 164 | 166 | 168 | 162 | 169 | 158 | 168 | 153 | 167 | 150 | 166 |
|  |  |  |  |  |  |  |  |  |  |  |  |
| **Average SECWCD** | 213 | 207 | 216 | 190 | 212 | 196 | 208 | 188 | 204 | 182 | 203 |

▨ **Projection based on local forecast of population and water use.**

## TABLE 5.4

## SUMMARY OF POPULATION AND M&I WATER DEMAND PROJECTIONS
## SOUTHEAST COLORADO WATER CONSERVANCY DISTRICT

| | 1997 | 2000 | 2010 | 2020 | 2030 | 2040 |
|---|---|---|---|---|---|---|
| Base Population Projection | 620,817 | 668,685 | 818,675 | 973,927 | 1,066,796 | 1,192,598 |
| Increase in Population | | 47,868 | 149,991 | 155,252 | 92,869 | 125,802 |
| % Annual Rate of Growth | | 2.5% | 2.0% | 1.8% | 0.9% | 1.1% |
| | | | | | | |
| High Population Projection | 620,817 | 672,267 | 860,857 | 1,107,661 | 1,356,908 | 1,626,678 |
| Increase in Population | | 51,450 | 188,590 | 246,804 | 249,247 | 269,770 |
| % Annual Rate of Growth | | 2.7% | 2.5% | 2.6% | 2.1% | 1.8% |
| | | | | | | |
| Per Capita Water Demand (Gallons per Day) | 213 | 216 | 212 | 208 | 204 | 203 |
| Per Capita Water Demand (Gallons per Day) -- With Conservation | 213 | 214 | 204 | 196 | 187 | 182 |
| % Demand Reduction due to Conservation | 0.0% | 1.0% | 4.0% | 6.0% | 8.0% | 10.0% |
| | | | | | | |
| Base Water Demand Projection (in Acre Feet) | 148,114 | 161,549 | 194,625 | 227,204 | 243,468 | 270,522 |
| Cumulative Increase in Demand | | 13,435 | 46,511 | 79,090 | 95,354 | 122,408 |
| % Increase in Demand over 1997 | | 9.1% | 31.4% | 53.4% | 64.4% | 82.6% |
| | | | | | | |
| High Water Demand Projection (in Acre Feet) | 148,114 | 162,459 | 205,316 | 259,651 | 311,647 | 372,237 |
| Cumulative Increase in Demand | | 14,345 | 57,202 | 111,537 | 163,533 | 224,123 |
| % Increase in Demand over 1997 | | 9.7% | 38.6% | 75.3% | 110.4% | 151.3% |
| | | | | | | |
| Base Water Demand Projection (in Acre Feet) -- With Conservation | 148,114 | 159,934 | 186,840 | 213,572 | 223,991 | 243,470 |
| Cumulative Increase in Demand | | 11,820 | 38,726 | 65,458 | 75,877 | 95,356 |
| % Increase in Demand over 1997 | | 8.0% | 26.1% | 44.2% | 51.2% | 64.4% |
| | | | | | | |
| High Water Demand Projection (in Acre Feet) -- With Conservation | 148,114 | 160,834 | 197,103 | 244,072 | 286,715 | 335,013 |
| Cumulative Increase in Demand | | 12,720 | 48,989 | 95,958 | 138,601 | 186,899 |
| % Increase in Demand over 1997 | | 8.6% | 33.1% | 64.8% | 93.6% | 126.2% |

**Source: David Bamberger & Associates, GEI Consultants, Inc. and local entities.**

## TABLE 5.5
## BASE ANNUAL M&I WATER DEMAND PROJECTIONS IN ACRE FEET
## SOUTHEASTERN COLORADO WATER CONSERVANCY DISTRICT, 2000 - 2040

| ENTITY | 1997 | 2000 | | 2010 | | 2020 | | 2030 | | 2040 | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | WITH CONSERV. | WITHOUT CONSERV | WITH CONSERV. | WITHOUT CONSERV. | WITH CONSERV. | WITHOUT CONSERV | WITH CONSERV. | WITHOUT CONSERV. | WITH CONSERV. | WITHOUT CONSERV |
| **haffee County** | | | | | | | | | | | |
| ity of Buena Vista | 728 | 749 | 756 | 848 | 883 | 948 | 1,008 | 1,043 | 1,133 | 1,133 | 1,259 |
| ity of Salida | 2,911 | 2,476 | 2,501 | 2,594 | 2,702 | 2,728 | 2,902 | 3,582 | 3,893 | 3,891 | 4,323 |
| ther Chaffee County Areas in District | 2,497 | 2,315 | 2,338 | 2,637 | 2,747 | 2,914 | 3,100 | 3,205 | 3,484 | 3,481 | 3,868 |
| tal Chaffee County in District | 6,136 | 5,540 | 5,596 | 6,079 | 6,332 | 6,590 | 7,010 | 7,830 | 8,511 | 8,505 | 9,449 |
| **emont County** | | | | | | | | | | | |
| non City | 5,560 | 5,842 | 5,901 | 7,123 | 7,420 | 8,967 | 9,539 | 10,180 | 11,066 | 11,558 | 12,842 |
| ty of Florence | 1,707 | 1,997 | 2,017 | 2,822 | 2,940 | 3,951 | 4,203 | 5,028 | 5,466 | 6,056 | 6,728 |
| rk Center WD | 854 | 861 | 869 | 919 | 957 | 1,004 | 1,068 | 1,051 | 1,142 | 1,090 | 1,211 |
| nrose WD | 462 | 466 | 471 | 493 | 513 | 516 | 549 | 541 | 588 | 561 | 623 |
| her Fremont County Areas in District | 180 | 179 | 180 | 176 | 184 | 185 | 197 | 183 | 199 | 185 | 206 |
| tal Fremont County in District | 8,763 | 9,344 | 9,439 | 11,534 | 12,014 | 14,623 | 15,556 | 16,984 | 18,460 | 19,449 | 21,610 |
| **eblo County** | | | | | | | | | | | |
| ty of Pueblo | 26,357 | 28,065 | 28,349 | 30,647 | 31,924 | 33,610 | 35,755 | 36,419 | 39,586 | 39,075 | 43,417 |
| eblo West MD | 2,618 | 2,573 | 2,599 | 5,053 | 5,263 | 7,451 | 7,927 | 8,735 | 9,495 | 8,545 | 9,495 |
| . Charles Mesa WD | 1,920 | 2,978 | 3,008 | 3,211 | 3,344 | 3,460 | 3,681 | 3,695 | 4,017 | 3,917 | 4,353 |
| her Pueblo County Areas in District | 294 | 305 | 308 | 323 | 336 | 343 | 364 | 361 | 393 | 379 | 421 |
| tal Pueblo County in District | 31,188 | 33,922 | 34,264 | 39,233 | 40,868 | 44,863 | 47,727 | 49,211 | 53,490 | 51,917 | 57,686 |
| **owley County** | | | | | | | | | | | |
| wn of Ordway | 179 | 183 | 185 | 209 | 218 | 228 | 243 | 239 | 260 | 257 | 286 |
| owley County WA | 642 | 772 | 780 | 903 | 941 | 1,031 | 1,097 | 1,055 | 1,146 | 1,131 | 1,257 |
| her Crowley County Areas in District | 83 | 94 | 95 | 148 | 154 | 153 | 163 | 158 | 171 | 162 | 180 |
| tal Crowley County in District | 905 | 1,049 | 1,060 | 1,260 | 1,313 | 1,412 | 1,502 | 1,452 | 1,578 | 1,551 | 1,723 |
| **ero County** | | | | | | | | | | | |
| wn of Fowler | 371 | 376 | 380 | 370 | 385 | 362 | 385 | 376 | 408 | 389 | 433 |
| y of La Junta | 2,999 | 3,120 | 3,152 | 3,426 | 3,569 | 3,798 | 4,040 | 3,940 | 4,283 | 4,086 | 4,540 |
| y of Rocky Ford | 1,392 | 1,504 | 1,519 | 1,762 | 1,835 | 2,023 | 2,152 | 2,271 | 2,468 | 2,506 | 2,785 |
| her Otero County Areas in District | 881 | 889 | 898 | 812 | 845 | 844 | 898 | 876 | 952 | 905 | 1,006 |
| tal Otero County in District | 5,644 | 5,890 | 5,949 | 6,369 | 6,635 | 7,027 | 7,475 | 7,462 | 8,111 | 7,887 | 8,763 |
| **nt County** | | | | | | | | | | | |
| wn of Las Animas | 536 | 792 | 800 | 998 | 1,040 | 1,128 | 1,200 | 1,251 | 1,360 | 1,368 | 1,520 |
| nts Fort WA | 305 | 401 | 405 | 389 | 405 | 381 | 405 | 373 | 405 | 365 | 405 |
| her Bent County Areas in District | 141 | 188 | 190 | 195 | 203 | 198 | 210 | 200 | 217 | 202 | 224 |
| tal Bent County in District | 982 | 1,381 | 1,395 | 1,582 | 1,648 | 1,706 | 1,815 | 1,824 | 1,982 | 1,934 | 2,149 |
| **owers County** | | | | | | | | | | | |
| y of Lamar | 2,770 | 2,784 | 2,812 | 2,740 | 2,854 | 2,723 | 2,897 | 2,706 | 2,941 | 2,687 | 2,985 |
| y Valley WA | 492 | 552 | 558 | 567 | 591 | 617 | 656 | 640 | 696 | 664 | 737 |
| her Prowers County Areas in District | 341 | 380 | 383 | 569 | 593 | 565 | 601 | 561 | 609 | 556 | 618 |
| tal Prowers County in District | 3,604 | 3,716 | 3,753 | 3,876 | 4,038 | 3,906 | 4,155 | 3,906 | 4,246 | 3,906 | 4,340 |
| **owa County** | | | | | | | | | | | |
| tal Kiowa County in District | 208 | 221 | 224 | 216 | 225 | 214 | 228 | 212 | 231 | 211 | 234 |
| **Paso County** | | | | | | | | | | | |
| y of Colorado Springs | 80,878 | 87,472 | 88,356 | 102,051 | 106,304 | 114,942 | 122,278 | 114,031 | 123,947 | 124,449 | 138,277 |
| y of Fountain | 1,761 | 2,179 | 2,201 | 3,360 | 3,500 | 5,439 | 5,787 | 7,401 | 8,045 | 9,273 | 10,303 |
| curity WD | 3,907 | 4,825 | 4,874 | 5,418 | 5,643 | 6,028 | 6,413 | 5,900 | 6,413 | 5,772 | 6,413 |
| defield Homes WC | 3,069 | 3,275 | 3,308 | 4,214 | 4,390 | 5,181 | 5,512 | 6,074 | 6,602 | 6,922 | 7,692 |
| atmoor Hills WD | 861 | 901 | 910 | 1,400 | 1,458 | 1,371 | 1,458 | 1,414 | 1,537 | 1,383 | 1,537 |
| er El Paso County Areas in District | 209 | 219 | 221 | 247 | 257 | 270 | 287 | 291 | 316 | 312 | 346 |
| tal El Paso County in District | 90,685 | 98,872 | 99,870 | 116,691 | 121,553 | 133,231 | 141,735 | 135,110 | 146,859 | 148,111 | 164,567 |
| | | | | | | | | | | | |
| **tal SECWCD** | **148,114** | **159,934** | **161,549** | **186,840** | **194,625** | **213,572** | **227,204** | **223,991** | **243,468** | **243,470** | **270,522** |

TABLE 5.6
HIGH ANNUAL M&I WATER DEMAND PROJECTIONS IN ACRE FEET
SOUTHEASTERN COLORADO WATER CONSERVANCY DISTRICT, 2000 - 2040

| ENTITY | 1997 | 2000 |  | 2010 |  | 2020 |  | 2030 |  | 2040 |  |
|---|---|---|---|---|---|---|---|---|---|---|---|
|  |  | WITH CONSERV. | WITHOUT CONSERV. | WITH CONSERV. | WITHOUT CONSERV. | WITH CONSERV. | WITHOUT CONSERV. | WITH CONSERV. | WITHOUT CONSERV. | WITH CONSERV. | WITHOUT CONSERV. |
| **Chaffee County** |  |  |  |  |  |  |  |  |  |  |  |
| City of Buena Vista | 728 | 749 | 756 | 848 | 883 | 948 | 1,008 | 1,043 | 1,133 | 1,133 | 1,259 |
| City of Salida | 2,911 | 2,599 | 2,625 | 2,975 | 3,099 | 3,256 | 3,464 | 4,271 | 4,642 | 4,637 | 5,152 |
| Other Chaffee County Areas in District | 2,497 | 2,315 | 2,338 | 2,637 | 2,747 | 2,914 | 3,100 | 3,205 | 3,484 | 3,481 | 3,868 |
| Total Chaffee County in District | 6,136 | 5,662 | 5,719 | 6,460 | 6,729 | 7,118 | 7,572 | 8,519 | 9,259 | 9,251 | 10,279 |
| **Fremont County** |  |  |  |  |  |  |  |  |  |  |  |
| Canon City | 5,560 | 5,876 | 5,935 | 7,150 | 7,448 | 9,550 | 10,160 | 11,389 | 12,380 | 13,582 | 15,091 |
| City of Florence | 1,707 | 1,997 | 2,017 | 2,822 | 2,940 | 3,951 | 4,203 | 5,028 | 5,466 | 6,056 | 6,728 |
| Park Center WD | 854 | 861 | 869 | 919 | 957 | 1,004 | 1,068 | 1,051 | 1,142 | 1,090 | 1,211 |
| Penrose WD | 462 | 466 | 471 | 493 | 513 | 516 | 549 | 541 | 588 | 561 | 623 |
| Other Fremont County Areas in District | 180 | 179 | 180 | 176 | 184 | 185 | 197 | 183 | 199 | 185 | 206 |
| Total Fremont County in District | 8,763 | 9,379 | 9,473 | 11,561 | 12,042 | 15,207 | 16,177 | 18,192 | 19,774 | 21,473 | 23,859 |
| **Pueblo County** |  |  |  |  |  |  |  |  |  |  |  |
| City of Pueblo | 26,357 | 28,065 | 28,349 | 34,080 | 35,500 | 42,732 | 45,460 | 53,571 | 58,230 | 67,117 | 74,575 |
| Pueblo West MD | 2,618 | 2,573 | 2,599 | 5,053 | 5,263 | 7,451 | 7,927 | 8,735 | 9,495 | 8,545 | 9,495 |
| St. Charles Mesa WD | 1,920 | 2,978 | 3,008 | 3,211 | 3,344 | 3,460 | 3,681 | 3,695 | 4,017 | 3,917 | 4,353 |
| Other Pueblo County Areas in District | 294 | 305 | 308 | 323 | 336 | 343 | 364 | 361 | 393 | 379 | 421 |
| Total Pueblo County in District | 31,188 | 33,922 | 34,264 | 42,665 | 44,443 | 53,986 | 57,432 | 66,363 | 72,134 | 79,959 | 88,843 |
| **Crowley County** |  |  |  |  |  |  |  |  |  |  |  |
| Town of Ordway | 179 | 183 | 185 | 209 | 218 | 228 | 243 | 239 | 260 | 257 | 286 |
| Crowley County WA | 642 | 772 | 780 | 903 | 941 | 1,031 | 1,097 | 1,055 | 1,146 | 1,131 | 1,257 |
| Other Crowley County Areas in District | 83 | 94 | 95 | 282 | 294 | 295 | 314 | 307 | 333 | 318 | 354 |
| Total Crowley County in District | 905 | 1,049 | 1,060 | 1,395 | 1,453 | 1,554 | 1,653 | 1,601 | 1,740 | 1,707 | 1,896 |
| **Otero County** |  |  |  |  |  |  |  |  |  |  |  |
| Town of Fowler | 371 | 376 | 380 | 370 | 385 | 362 | 385 | 376 | 408 | 389 | 433 |
| City of La Junta | 2,999 | 3,120 | 3,152 | 4,314 | 4,494 | 4,628 | 4,923 | 4,962 | 5,394 | 5,318 | 5,909 |
| City of Rocky Ford | 1,392 | 1,504 | 1,519 | 1,762 | 1,835 | 2,023 | 2,152 | 2,271 | 2,468 | 2,506 | 2,785 |
| Other Otero County Areas in District | 881 | 889 | 898 | 812 | 845 | 844 | 898 | 876 | 952 | 905 | 1,006 |
| Total Otero County in District | 5,644 | 5,890 | 5,949 | 7,258 | 7,560 | 7,857 | 8,358 | 8,484 | 9,222 | 9,119 | 10,132 |
| **Bent County** |  |  |  |  |  |  |  |  |  |  |  |
| Town of Las Animas | 536 | 792 | 800 | 998 | 1,040 | 1,128 | 1,200 | 1,251 | 1,360 | 1,368 | 1,520 |
| Bents Fort WA | 305 | 407 | 411 | 422 | 440 | 426 | 453 | 429 | 467 | 432 | 480 |
| Other Bent County Areas in District | 141 | 188 | 190 | 195 | 203 | 198 | 210 | 200 | 217 | 202 | 224 |
| Total Bent County in District | 982 | 1,386 | 1,400 | 1,615 | 1,682 | 1,751 | 1,863 | 1,880 | 2,043 | 2,002 | 2,224 |
| **Prowers County** |  |  |  |  |  |  |  |  |  |  |  |
| City of Lamar | 2,770 | 2,784 | 2,812 | 2,740 | 2,854 | 2,723 | 2,897 | 2,706 | 2,941 | 2,687 | 2,985 |
| May Valley WA | 492 | 552 | 558 | 567 | 591 | 617 | 656 | 640 | 696 | 664 | 737 |
| Other Prowers County Areas in District | 341 | 380 | 383 | 569 | 593 | 565 | 601 | 561 | 609 | 556 | 618 |
| Total Prowers County in District | 3,604 | 3,716 | 3,753 | 3,876 | 4,038 | 3,906 | 4,155 | 3,906 | 4,246 | 3,906 | 4,340 |
| **Kiowa County** |  |  |  |  |  |  |  |  |  |  |  |
| Total Kiowa County in District | 208 | 221 | 224 | 216 | 225 | 214 | 228 | 212 | 231 | 211 | 234 |
| **El Paso County** |  |  |  |  |  |  |  |  |  |  |  |
| City of Colorado Springs | 80,878 | 88,210 | 89,101 | 107,418 | 111,894 | 134,190 | 142,755 | 156,478 | 170,085 | 183,724 | 204,138 |
| City of Fountain | 1,761 | 2,179 | 2,201 | 3,360 | 3,500 | 5,439 | 5,787 | 7,401 | 8,045 | 9,273 | 10,303 |
| Security WD | 3,907 | 4,825 | 4,874 | 5,418 | 5,643 | 6,028 | 6,413 | 5,900 | 6,413 | 5,772 | 6,413 |
| Widefield Homes WC | 3,069 | 3,275 | 3,308 | 4,214 | 4,390 | 5,181 | 5,512 | 6,074 | 6,602 | 6,922 | 7,692 |
| Stratmoor Hills WD | 861 | 901 | 910 | 1,400 | 1,458 | 1,371 | 1,458 | 1,414 | 1,537 | 1,383 | 1,537 |
| Other El Paso County Areas in District | 209 | 219 | 221 | 247 | 257 | 270 | 287 | 291 | 316 | 312 | 346 |
| Total El Paso County in District | 90,685 | 99,609 | 100,616 | 122,058 | 127,143 | 152,480 | 162,212 | 177,557 | 192,997 | 207,386 | 230,428 |
|  |  |  |  |  |  |  |  |  |  |  |  |
| **Total SECWCD** | **148,114** | **160,834** | **162,459** | **197,103** | **205,316** | **244,072** | **259,651** | **286,715** | **311,647** | **335,013** | **372,237** |

# TABLE 5.7
# SUMMARY OF AGRICULTURAL WATER USE IN SECWCD
## (1986-1995)

| Source of Supply | Average Year (af) | Average Year (%) | "Wet" Year (1995) (af) | "Wet" Year (1995) (%) | "Dry" Year (1991) (af) | "Dry" Year (1991) (%) |
|---|---|---|---|---|---|---|
| | | | | | | |
| **Direct Flow** | **594,053** | **71.4%** | **856,119** | **85.8%** | **455,719** | **64.8%** |
| | | | | | | |
| **Fry- Ark Project** | 32,268 | | 5,562 | | 40,697 | |
| **Winter Water** | 31,010 | | 9,540 | | 40,546 | |
| **Other Transmountain** (1) | 22,443 | | 13,530 | | 16,894 | |
| **Other Storage** | 73,981 | | 57,016 | | 53,633 | |
| Subtotal | **159,702** | **19.2%** | **85,648** | **8.6%** | **151,770** | **21.6%** |
| | | | | | | |
| **Well Pumping** | **78,820** | **9.5%** | **55,507** | **5.6%** | **95,398** | **13.6%** |
| | | | | | | |
| **Total** | **832,575** | **100.0%** | **997,274** | **100.0%** | **702,887** | **100.0%** |

Note: Data are from a variety of sources, including the Colorado SEO, USGS, others.

(1) This water is leased from M&I users and is likely not to be available in the future.

### TABLE 5.8
### TOTAL AVERAGE WATER DEMAND IN SECWCD IN YEAR 2040
### (acre-feet)

| | Current Conservation(1) | | Additional Conservation(1) | |
|---|---|---|---|---|
| | Base | High | Base | High |
| Municipal(2) | 270,500 | 372,200 | 243,500 | 335,000 |
| Industrial(3) | 10,000 | 10,000 | 10,000 | 10,000 |
| Agricultural(4) | 832,600 | 832,600 | 832,600 | 832,600 |
| TOTAL | 1,113,100 | 1,214,800 | 1,086,100 | 1,177,600 |

(1) Conservation in municipal sector only.
(2) Includes commercial and industrial uses within municipal water systems.
(3) Public Service Company of Colorado. Forecasted water use at Comanche Generating Station in Pueblo.
(4) Sum of average annual diversions for 1986-95 by all ditches and canals including direct flow, Winter Water Storage, Project water, other storage water, non-Project transmountain water, and well pumping.

Figures 5.3 and 5.4 show District-wide water demands for the base and high population projections with conservation, resulting in an eventual 10 percent reduction in per capita water demands over current levels, and with agricultural water diversions included.

## 5.7 Monthly Variation in Municipal Water Demand

Water demands were estimated on a monthly basis for the base and high forecasts (with conservation) for groupings of municipal water supply entities corresponding to the geographic regions delineated in Allocation Principles for the Fryingpan-Arkansas Project:

- Entities West of Pueblo
- Pueblo West
- Pueblo
- Fountain Valley Authority
- Entities East of Pueblo

As shown on Figure 5.5, the monthly variations[1] in historical water demand for municipal entities in the District are fairly similar. Summertime usage as a percentage of total usage is highest for Pueblo and lowest for the entities west of Pueblo, indicating relative differences due to climate factors.

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[1] The curves shown on Figure 5.5 are based on water use in Canon City for entities west of Pueblo, water use in Pueblo, water use in Colorado Springs for the FVA, and water use in Lamar for entities east of Pueblo.

The monthly variations in demand depicted on Figure 5.5 were applied to the aggregated water demands for each entity within each of the four geographic regions. This was completed for base and high projections for the years 2000, 2010, 2020, 2030, and 2040, assuming conservation measures will achieve the reductions described previously. Results are presented in Table 5.9 and graphically on Figures 5.6 through 5.10, for the high demand projection, and Figures 5.11 through 5.15 for the base demand projection. Total municipal water demand for the year 2040 high forecast is presented on Figure 5.16.

## 5.8 Monthly Variation in Agricultural Water Use

Monthly variations in water use within the agricultural sector for the 1986-95 period are indicated on Figure 5.17. Demands are highest in the April through September period. The peak demand period for irrigation water coincides with the peak demand period in the municipal sector. Variations in agricultural water demand can be significant from year to year, depending on climatological factors. During the 10-year period 1986-95, agricultural water use varied from a minimum of 588,500 af (1992) to a maximum of 934,600 af (1995).

## 5.9 Monthly Variation in Total Water Demand

The monthly variation in year 2040 water demand for the and municipal sector and historic water use in the agricultural sector is presented on Figure 5.19 for the high population forecast.

# TABLE 5.9
# SUMMARY OF MONYHLY WATER DEMANDS
# BASE CASE AND HIGH FORECAST
(WITH CONSERVATION)

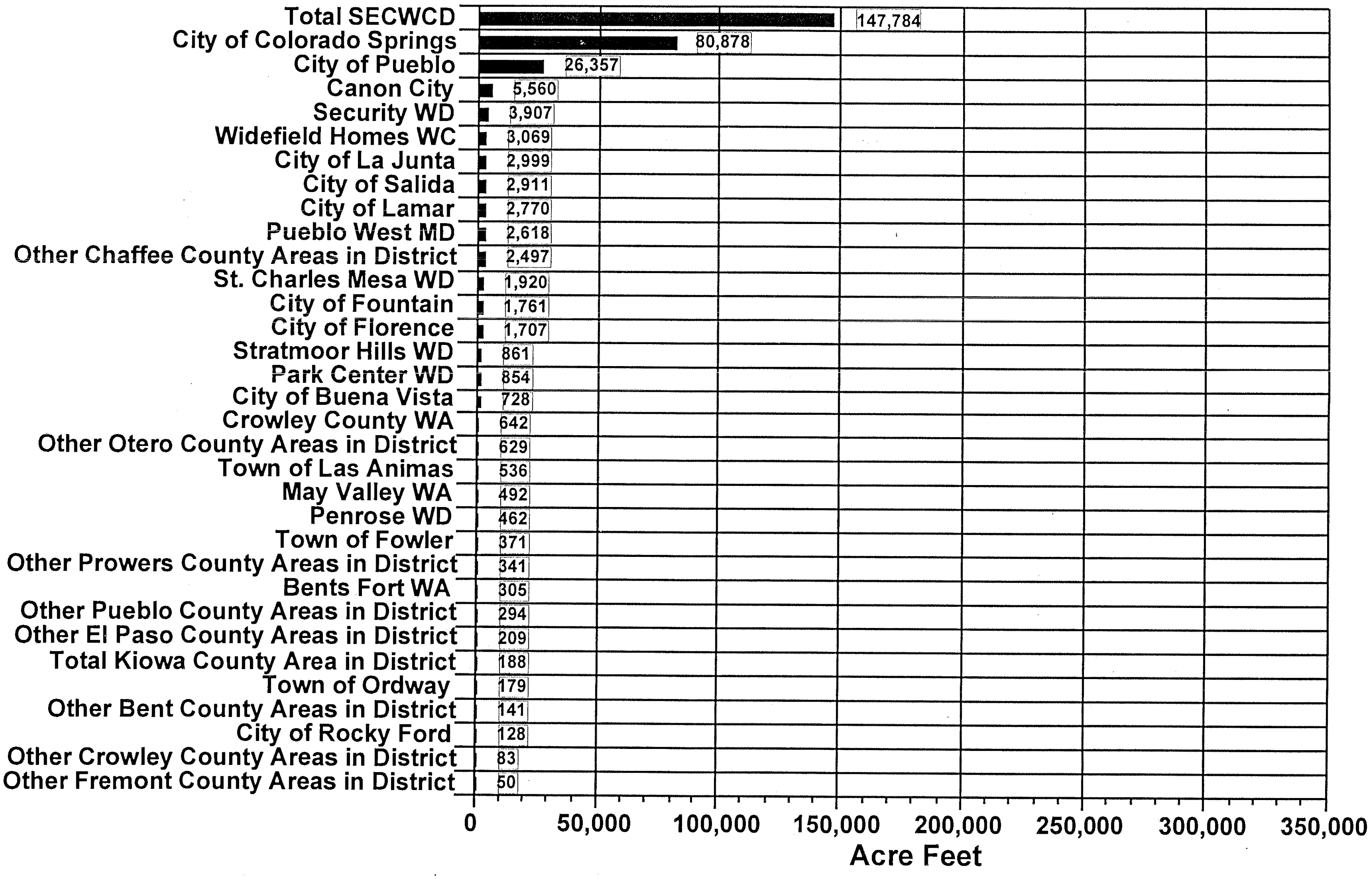
## BASE CASE FORECAST

| Year: | 1997 | 2000 | 2010 | 2020 | 2030 | 2040 |
|---|---|---|---|---|---|---|
| **West of Pueblo** | | | | | | |
| Nov | 819 | 819 | 969 | 1,167 | 1,365 | 1,537 |
| Dec | 819 | 819 | 969 | 1,167 | 1,365 | 1,537 |
| Jan | 745 | 744 | 881 | 1,061 | 1,241 | 1,398 |
| Feb | 670 | 670 | 793 | 955 | 1,117 | 1,258 |
| Mar | 819 | 819 | 969 | 1,167 | 1,365 | 1,537 |
| Apr | 1,192 | 1,191 | 1,409 | 1,697 | 1,985 | 2,236 |
| May | 1,490 | 1,488 | 1,761 | 2,121 | 2,481 | 2,795 |
| Jun | 1,862 | 1,860 | 2,202 | 2,652 | 3,102 | 3,494 |
| Jul | 2,086 | 2,084 | 2,466 | 2,970 | 3,474 | 3,914 |
| Aug | 1,713 | 1,712 | 2,025 | 2,439 | 2,854 | 3,215 |
| Sep | 1,490 | 1,488 | 1,761 | 2,121 | 2,481 | 2,795 |
| Oct | 1,192 | 1,191 | 1,409 | 1,697 | 1,985 | 2,236 |
| Subtotal | 14,899 | 14,884 | 17,613 | 21,213 | 24,813 | 27,954 |
| **Pueblo** | | | | | | |
| Nov | 1,212 | 1,291 | 1,410 | 1,546 | 1,675 | 1,797 |
| Dec | 1,107 | 1,179 | 1,287 | 1,412 | 1,530 | 1,641 |
| Jan | 1,028 | 1,095 | 1,195 | 1,311 | 1,420 | 1,524 |
| Feb | 949 | 1,010 | 1,103 | 1,210 | 1,311 | 1,407 |
| Mar | 1,397 | 1,487 | 1,624 | 1,781 | 1,930 | 2,071 |
| Apr | 2,240 | 2,386 | 2,605 | 2,857 | 3,096 | 3,321 |
| May | 2,794 | 2,975 | 3,249 | 3,563 | 3,860 | 4,142 |
| Jun | 3,584 | 3,817 | 4,168 | 4,571 | 4,953 | 5,314 |
| Jul | 4,112 | 4,378 | 4,781 | 5,243 | 5,681 | 6,096 |
| Aug | 3,268 | 3,480 | 3,800 | 4,168 | 4,516 | 4,845 |
| Sep | 2,609 | 2,778 | 3,034 | 3,327 | 3,605 | 3,868 |
| Oct | 2,056 | 2,189 | 2,390 | 2,622 | 2,841 | 3,048 |
| Subtotal | 26,357 | 28,065 | 30,647 | 33,610 | 36,419 | 39,075 |
| **Pueblo West** | | | | | | |
| Nov | 120 | 118 | 232 | 343 | 402 | 393 |
| Dec | 110 | 108 | 212 | 313 | 367 | 359 |
| Jan | 102 | 100 | 197 | 291 | 341 | 333 |
| Feb | 94 | 93 | 182 | 268 | 314 | 308 |
| Mar | 139 | 136 | 268 | 395 | 463 | 453 |
| Apr | 223 | 219 | 429 | 633 | 742 | 726 |
| May | 278 | 273 | 536 | 790 | 926 | 906 |
| Jun | 356 | 350 | 687 | 1,013 | 1,188 | 1,162 |
| Jul | 408 | 401 | 788 | 1,162 | 1,363 | 1,333 |
| Aug | 325 | 319 | 627 | 924 | 1,083 | 1,060 |
| Sep | 259 | 255 | 500 | 738 | 865 | 846 |
| Oct | 204 | 201 | 394 | 581 | 681 | 667 |
| Subtotal | 2,618 | 2,573 | 5,053 | 7,451 | 8,735 | 8,545 |
| **Fountain Valley** | | | | | | |
| Nov | 5,078 | 5,537 | 6,535 | 7,461 | 7,566 | 8,294 |
| Dec | 4,897 | 5,339 | 6,301 | 7,194 | 7,296 | 7,998 |
| Jan | 4,806 | 5,240 | 6,185 | 7,061 | 7,161 | 7,850 |
| Feb | 4,534 | 4,944 | 5,835 | 6,662 | 6,755 | 7,406 |
| Mar | 5,078 | 5,537 | 6,535 | 7,461 | 7,566 | 8,294 |
| Apr | 7,073 | 7,712 | 9,102 | 10,392 | 10,539 | 11,553 |
| May | 8,343 | 9,096 | 10,736 | 12,257 | 12,430 | 13,626 |
| Jun | 11,336 | 12,359 | 14,586 | 16,654 | 16,889 | 18,514 |
| Jul | 12,968 | 14,139 | 16,687 | 19,052 | 19,321 | 21,180 |
| Aug | 10,247 | 11,172 | 13,186 | 15,055 | 15,267 | 16,737 |
| Sep | 9,431 | 10,283 | 12,136 | 13,856 | 14,051 | 15,404 |
| Oct | 6,892 | 7,514 | 8,869 | 10,126 | 10,268 | 11,256 |
| Subtotal | 90,685 | 98,872 | 116,691 | 133,231 | 135,110 | 148,111 |
| **East of Pueblo** | | | | | | |
| Nov | 664 | 761 | 825 | 885 | 927 | 969 |
| Dec | 624 | 715 | 774 | 831 | 870 | 910 |
| Jan | 651 | 746 | 808 | 867 | 908 | 950 |
| Feb | 583 | 668 | 724 | 777 | 813 | 851 |
| Mar | 759 | 870 | 943 | 1,012 | 1,059 | 1,108 |
| Apr | 1,030 | 1,181 | 1,280 | 1,373 | 1,437 | 1,504 |
| May | 1,261 | 1,445 | 1,566 | 1,680 | 1,759 | 1,840 |
| Jun | 1,654 | 1,896 | 2,054 | 2,204 | 2,307 | 2,414 |
| Jul | 1,993 | 2,284 | 2,475 | 2,656 | 2,780 | 2,908 |
| Aug | 1,857 | 2,129 | 2,307 | 2,475 | 2,591 | 2,711 |
| Sep | 1,423 | 1,632 | 1,768 | 1,897 | 1,986 | 2,077 |
| Oct | 1,057 | 1,212 | 1,313 | 1,409 | 1,475 | 1,543 |
| Subtotal | 13,555 | 15,540 | 16,837 | 18,067 | 18,913 | 19,785 |
| **Total** | 148,114 | 159,934 | 186,840 | 213,572 | 223,991 | 243,470 |

## HIGH FORECAST

| Year: | 1997 | 2000 | 2010 | 2020 | 2030 | 2040 |
|---|---|---|---|---|---|---|
| **West of Pueblo** | | | | | | |
| Nov | 819 | 827 | 991 | 1,228 | 1,469 | 1,690 |
| Dec | 819 | 827 | 991 | 1,228 | 1,469 | 1,690 |
| Jan | 745 | 752 | 901 | 1,116 | 1,336 | 1,536 |
| Feb | 670 | 677 | 811 | 1,005 | 1,202 | 1,383 |
| Mar | 819 | 827 | 991 | 1,228 | 1,469 | 1,690 |
| Apr | 1,192 | 1,203 | 1,442 | 1,786 | 2,137 | 2,458 |
| May | 1,490 | 1,504 | 1,802 | 2,232 | 2,671 | 3,072 |
| Jun | 1,862 | 1,880 | 2,253 | 2,791 | 3,339 | 3,841 |
| Jul | 2,086 | 2,106 | 2,523 | 3,125 | 3,740 | 4,301 |
| Aug | 1,713 | 1,730 | 2,072 | 2,567 | 3,072 | 3,533 |
| Sep | 1,490 | 1,504 | 1,802 | 2,232 | 2,671 | 3,072 |
| Oct | 1,192 | 1,203 | 1,442 | 1,786 | 2,137 | 2,458 |
| Subtotal | 14,899 | 15,041 | 18,021 | 22,325 | 26,711 | 30,724 |
| **Pueblo** | | | | | | |
| Nov | 1,212 | 1,291 | 1,568 | 1,966 | 2,464 | 3,087 |
| Dec | 1,107 | 1,179 | 1,431 | 1,795 | 2,250 | 2,819 |
| Jan | 1,028 | 1,095 | 1,329 | 1,667 | 2,089 | 2,618 |
| Feb | 949 | 1,010 | 1,227 | 1,538 | 1,929 | 2,416 |
| Mar | 1,397 | 1,487 | 1,806 | 2,265 | 2,839 | 3,557 |
| Apr | 2,240 | 2,386 | 2,897 | 3,632 | 4,554 | 5,705 |
| May | 2,794 | 2,975 | 3,612 | 4,530 | 5,679 | 7,114 |
| Jun | 3,584 | 3,817 | 4,635 | 5,812 | 7,286 | 9,128 |
| Jul | 4,112 | 4,378 | 5,316 | 6,666 | 8,357 | 10,470 |
| Aug | 3,268 | 3,480 | 4,226 | 5,299 | 6,643 | 8,323 |
| Sep | 2,609 | 2,778 | 3,374 | 4,231 | 5,304 | 6,645 |
| Oct | 2,056 | 2,189 | 2,658 | 3,333 | 4,179 | 5,235 |
| Subtotal | 26,357 | 28,065 | 34,080 | 42,732 | 53,571 | 67,117 |
| **Pueblo West** | | | | | | |
| Nov | 120 | 118 | 232 | 343 | 402 | 393 |
| Dec | 110 | 108 | 212 | 313 | 367 | 359 |
| Jan | 102 | 100 | 197 | 291 | 341 | 333 |
| Feb | 94 | 93 | 182 | 268 | 314 | 308 |
| Mar | 139 | 136 | 268 | 395 | 463 | 453 |
| Apr | 223 | 219 | 429 | 633 | 742 | 726 |
| May | 278 | 273 | 536 | 790 | 926 | 906 |
| Jun | 356 | 350 | 687 | 1,013 | 1,188 | 1,162 |
| Jul | 408 | 401 | 788 | 1,162 | 1,363 | 1,333 |
| Aug | 325 | 319 | 627 | 924 | 1,083 | 1,060 |
| Sep | 259 | 255 | 500 | 738 | 865 | 846 |
| Oct | 204 | 201 | 394 | 581 | 681 | 667 |
| Subtotal | 2,618 | 2,573 | 5,053 | 7,451 | 8,735 | 8,545 |
| **Fountain Valley** | | | | | | |
| Nov | 5,078 | 5,578 | 6,835 | 8,539 | 9,943 | 11,614 |
| Dec | 4,897 | 5,379 | 6,591 | 8,234 | 9,588 | 11,199 |
| Jan | 4,806 | 5,279 | 6,469 | 8,081 | 9,411 | 10,991 |
| Feb | 4,534 | 4,980 | 6,103 | 7,624 | 8,878 | 10,369 |
| Mar | 5,078 | 5,578 | 6,835 | 8,539 | 9,943 | 11,614 |
| Apr | 7,073 | 7,770 | 9,521 | 11,893 | 13,849 | 16,176 |
| May | 8,343 | 9,164 | 11,229 | 14,028 | 16,335 | 19,079 |
| Jun | 11,336 | 12,451 | 15,257 | 19,060 | 22,195 | 25,923 |
| Jul | 12,968 | 14,244 | 17,454 | 21,805 | 25,391 | 29,656 |
| Aug | 10,247 | 11,256 | 13,793 | 17,230 | 20,064 | 23,435 |
| Sep | 9,431 | 10,359 | 12,694 | 15,858 | 18,466 | 21,568 |
| Oct | 6,892 | 7,570 | 9,276 | 11,588 | 13,494 | 15,761 |
| Subtotal | 90,685 | 99,609 | 122,058 | 152,480 | 177,557 | 207,386 |
| **East of Pueblo** | | | | | | |
| Nov | 664 | 762 | 877 | 935 | 987 | 1,041 |
| Dec | 624 | 715 | 823 | 878 | 926 | 977 |
| Jan | 651 | 746 | 859 | 916 | 967 | 1,020 |
| Feb | 583 | 668 | 769 | 821 | 866 | 913 |
| Mar | 759 | 871 | 1,002 | 1,069 | 1,128 | 1,190 |
| Apr | 1,030 | 1,181 | 1,360 | 1,450 | 1,531 | 1,614 |
| May | 1,261 | 1,446 | 1,664 | 1,775 | 1,873 | 1,975 |
| Jun | 1,654 | 1,897 | 2,183 | 2,328 | 2,457 | 2,591 |
| Jul | 1,993 | 2,285 | 2,630 | 2,805 | 2,961 | 3,122 |
| Aug | 1,857 | 2,130 | 2,451 | 2,614 | 2,759 | 2,910 |
| Sep | 1,423 | 1,632 | 1,879 | 2,004 | 2,115 | 2,230 |
| Oct | 1,057 | 1,213 | 1,396 | 1,489 | 1,571 | 1,657 |
| Subtotal | 13,555 | 15,545 | 17,892 | 19,084 | 20,141 | 21,241 |
| **Total** | 148,114 | 160,834 | 197,103 | 244,072 | 286,715 | 335,013 |

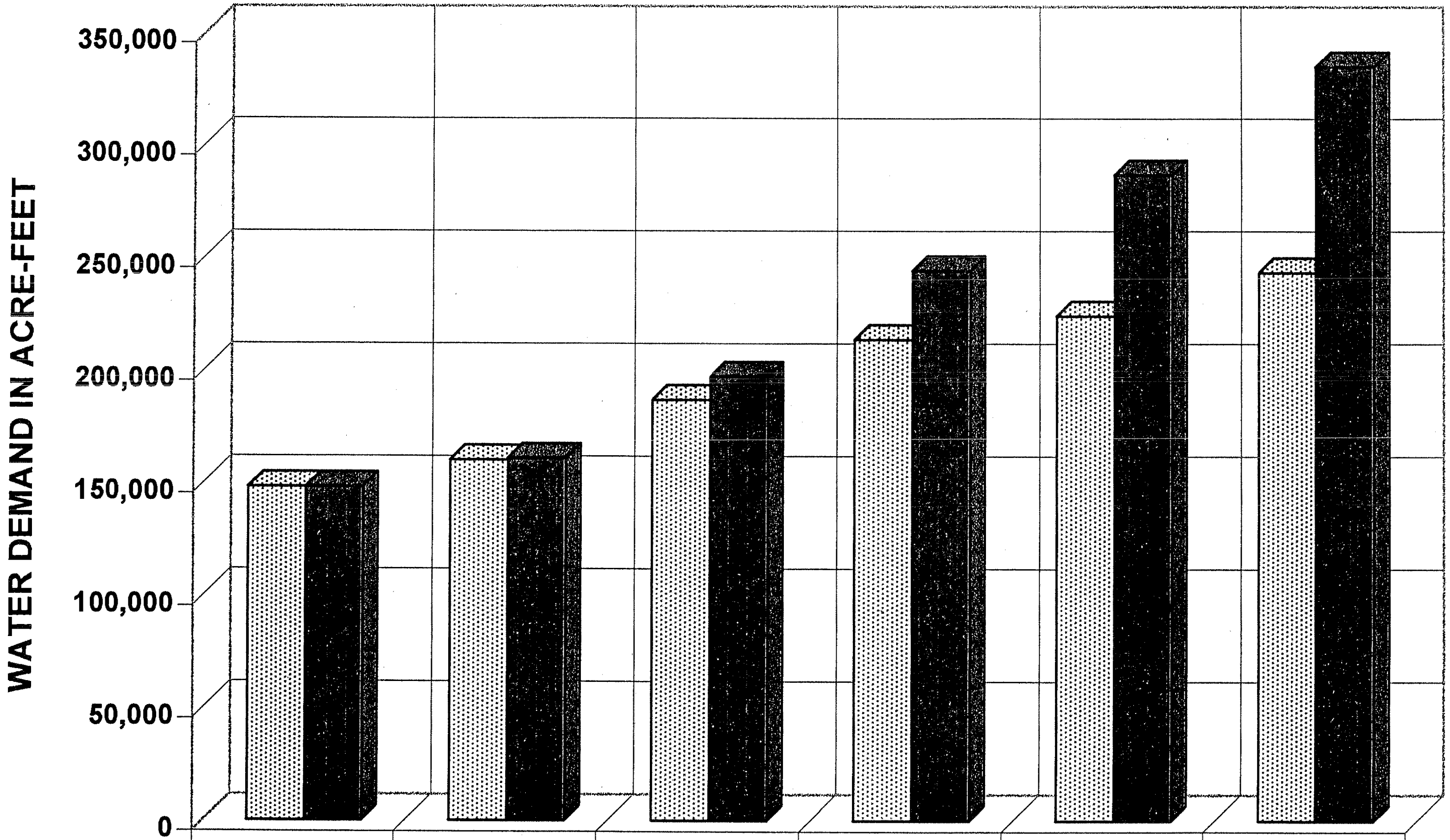
# Year 1997 Current Water Demand by Entity
# Southeastern Colorado Water Conservancy District



Sources: David Bamberger & Associates and GEI Consultants, Inc.
Note: Projections are based on data from local entities

FIGURE 5.1

Base and High Water Demand Forecasts
(With Conservation)



| | 1997 | 2000 | 2010 | 2020 | 2030 | 2040 |
|---|---|---|---|---|---|---|
| ▨ BASE FORECAST (AF) | 148,114 | 159,934 | 186,840 | 213,572 | 223,991 | 243,470 |
| ■ HIGH FORECAST (AF) | 148,114 | 160,834 | 197,103 | 244,072 | 286,715 | 335,013 |

sumdem_graphs.xls/WATER DEMANDS

**FIGURE 5.2**
**WATER DEMAND FORECASTS**

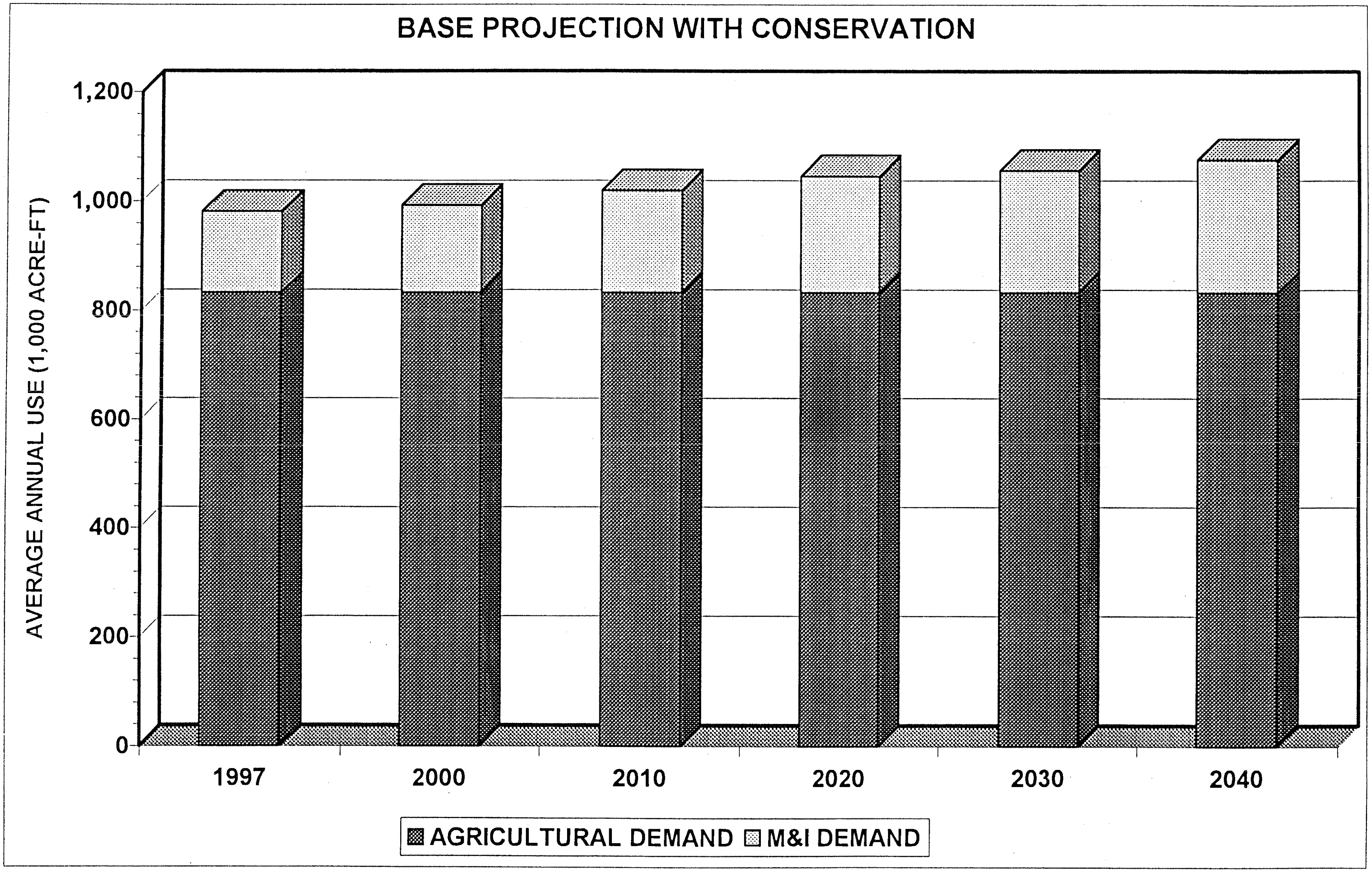


FIGURE 5.3
SUMMARY OF FORECAST TOTAL WATER USE
IN SECWCD

Base Chart 1
12/7/98

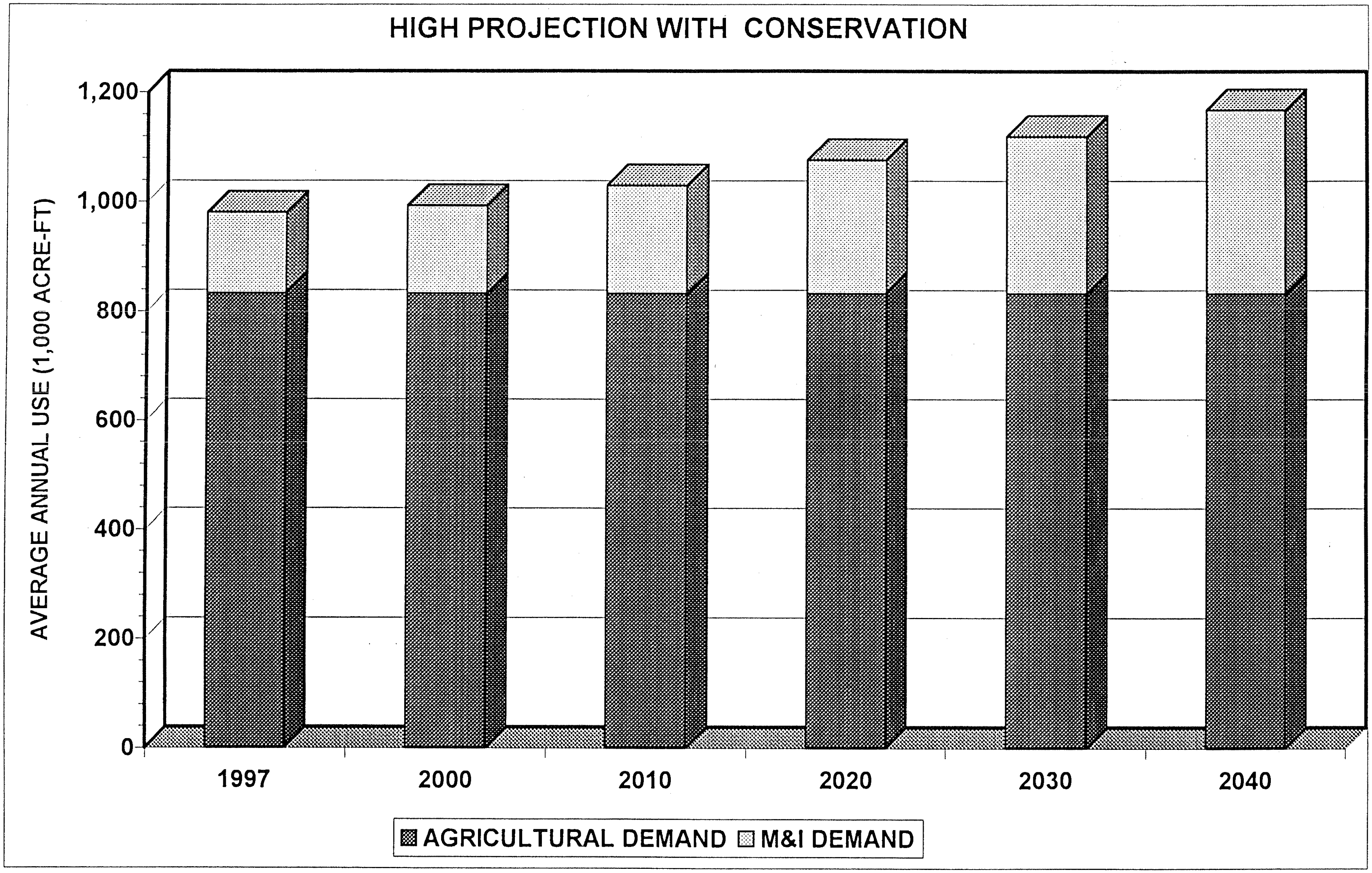
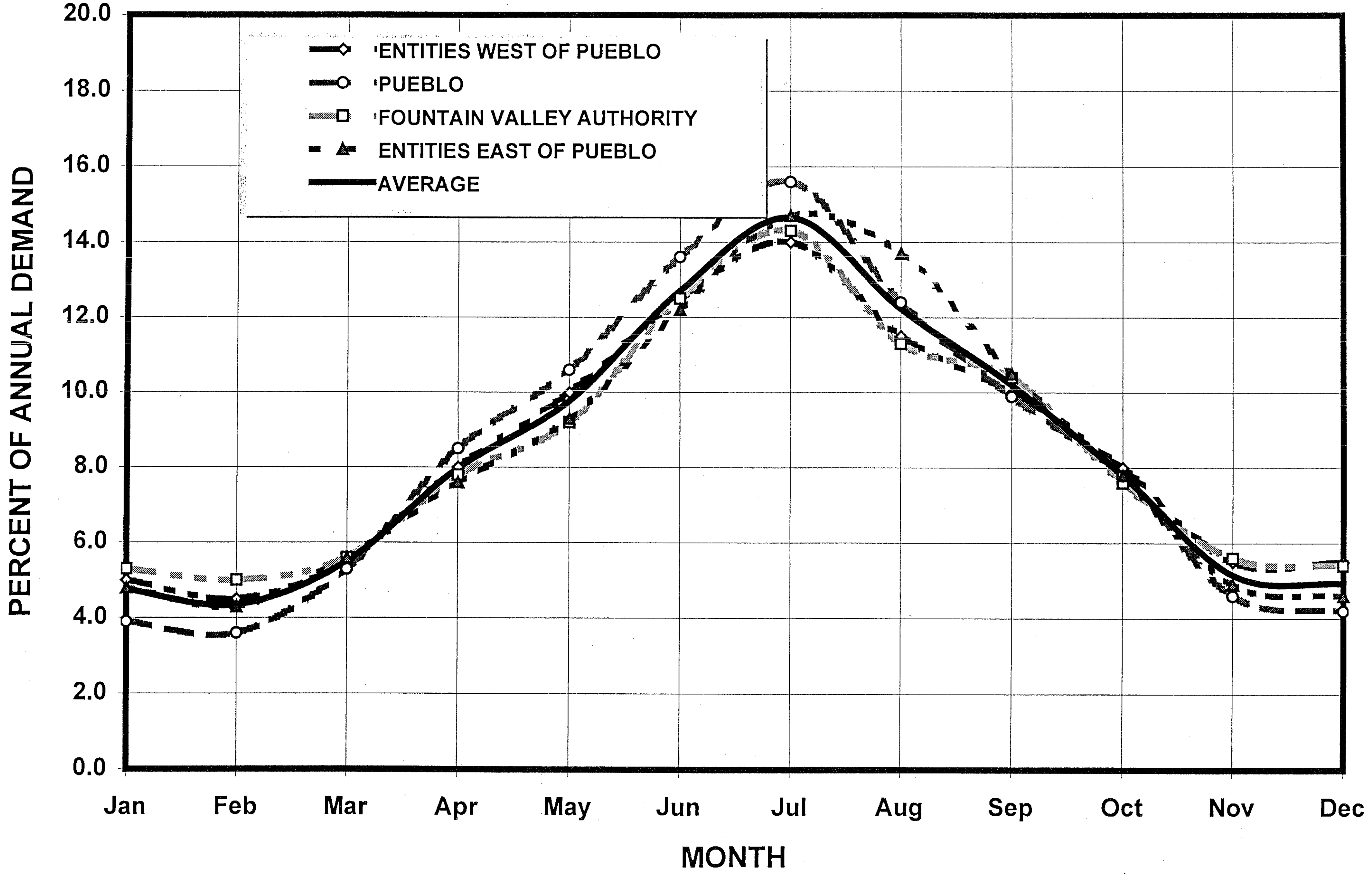


**FIGURE 5.4**
**SUMMARY OF FORECAST TOTAL WATER USE IN SECWCD**

High Chart 1
12/7/98

# FIGURE 5.5
# MONTHLY VARIATION IN WATER DEMAND



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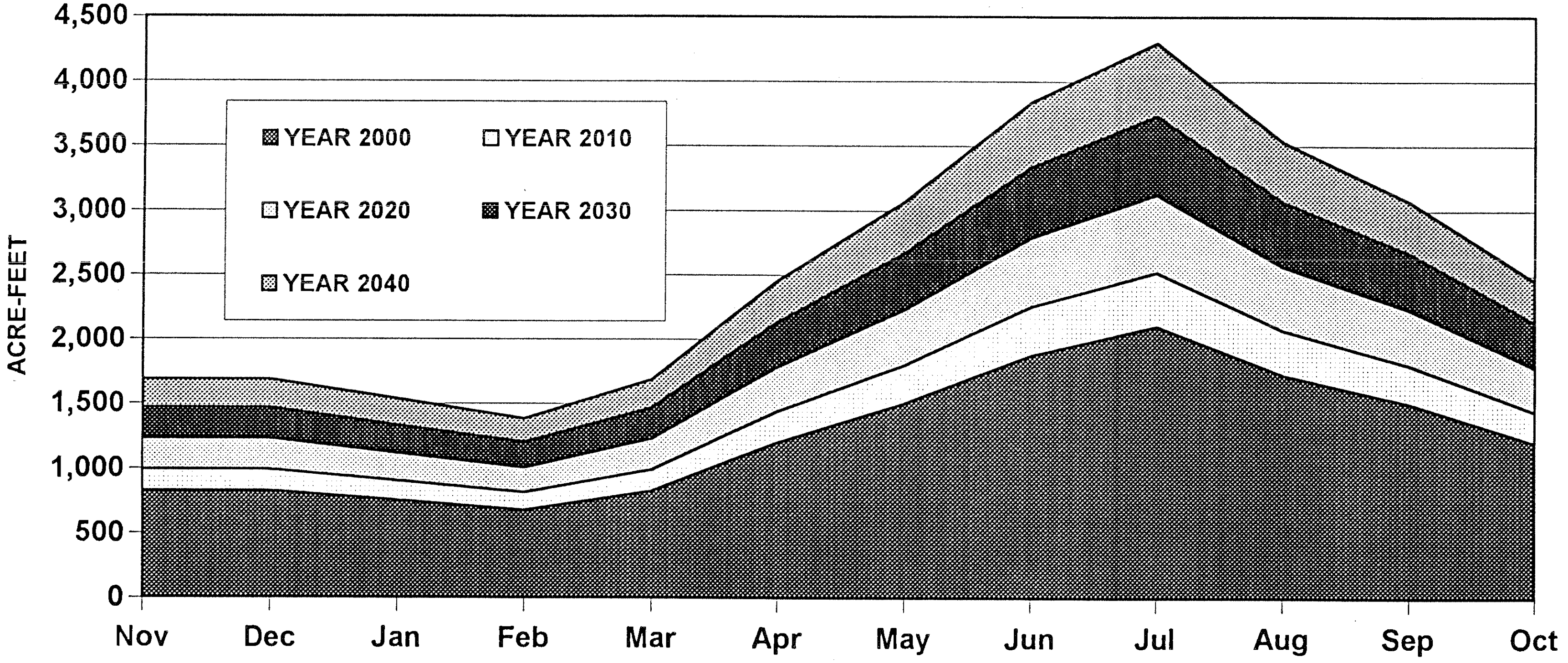
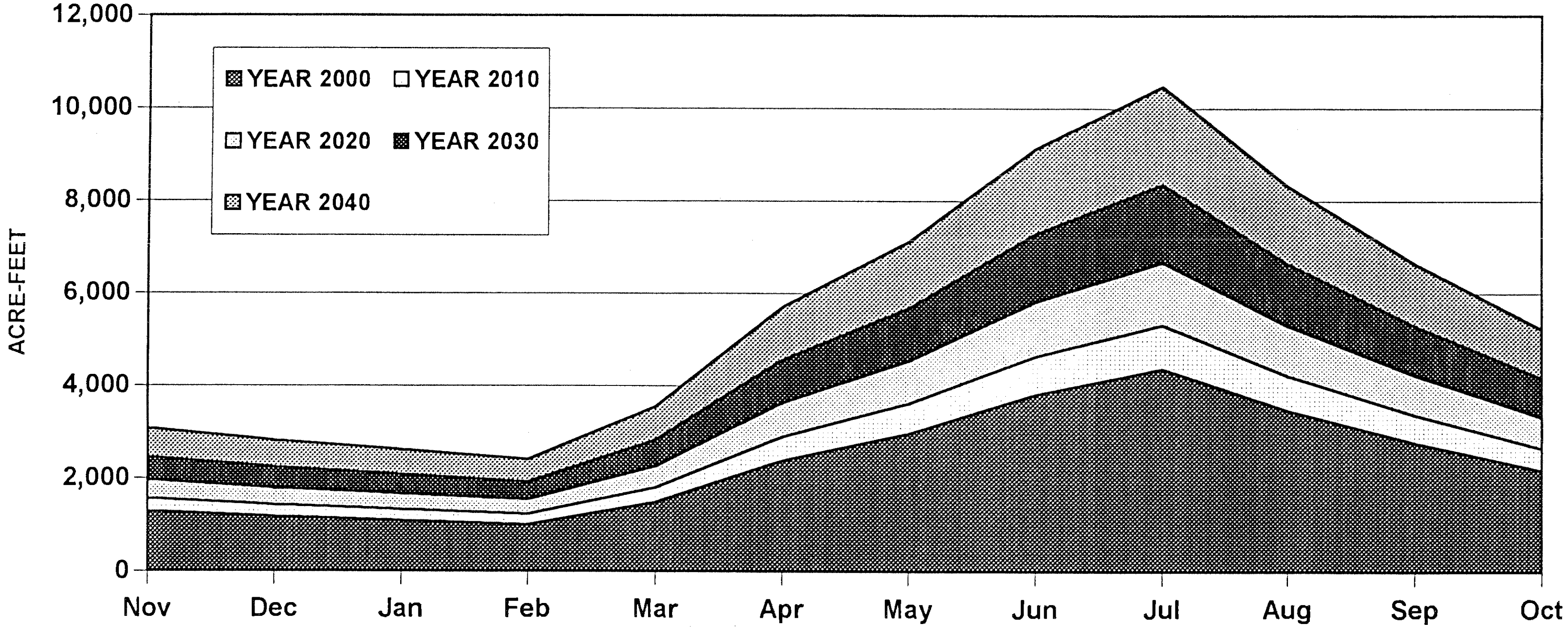
11/23/98

Demvar1.xls / DEMAND VARIATION

# FIGURE 5.6
# MONTHLY WATER DEMANDS
## WEST OF PUEBLO
## (HIGH FORECAST)



## FIGURE 5.7
## MONTHLY WATER DEMANDS
## PUEBLO
(HIGH FORECAST)



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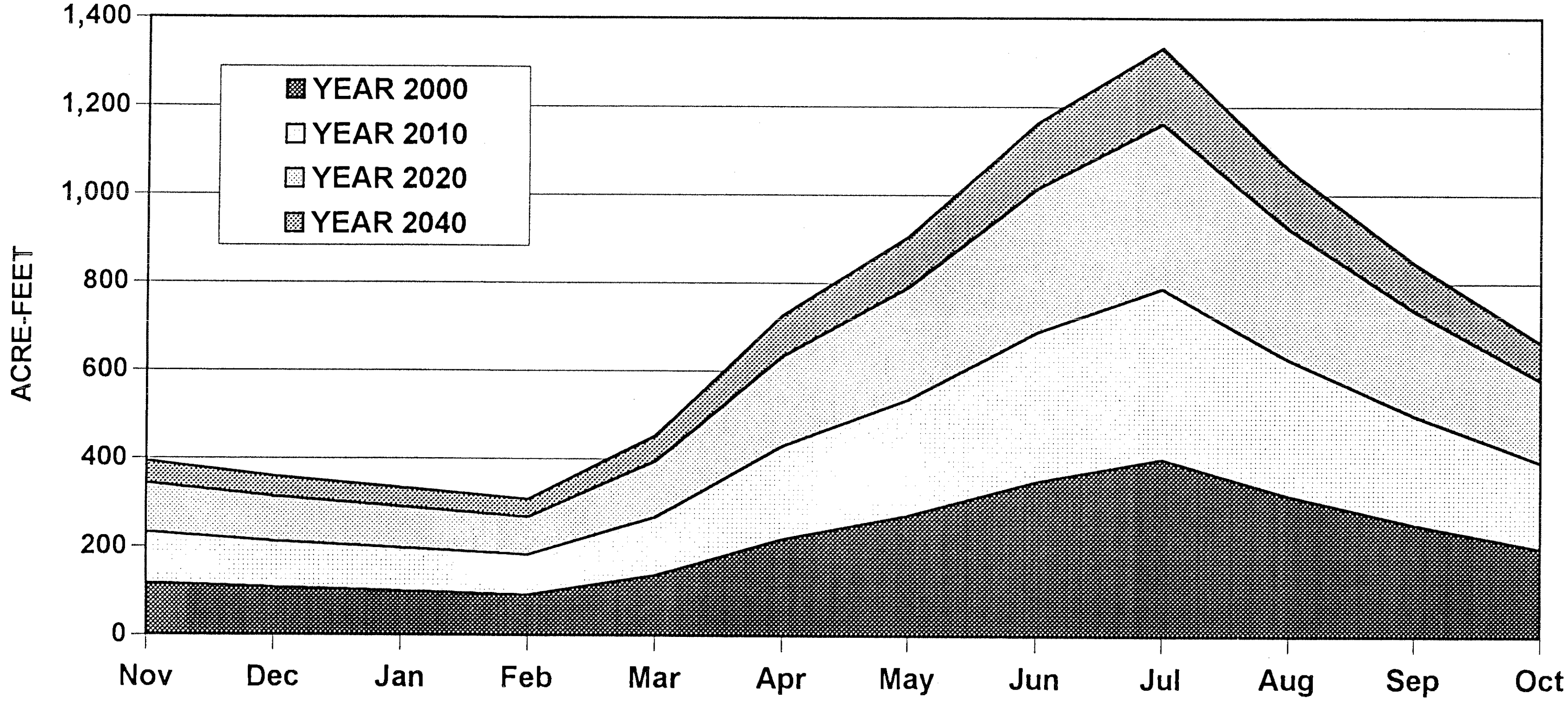
Sum_DemHa.xls/
PUEBLO

# FIGURE 5.8
# MONTHLY WATER DEMANDS
# PUEBLO WEST
## (HIGH FORECAST)



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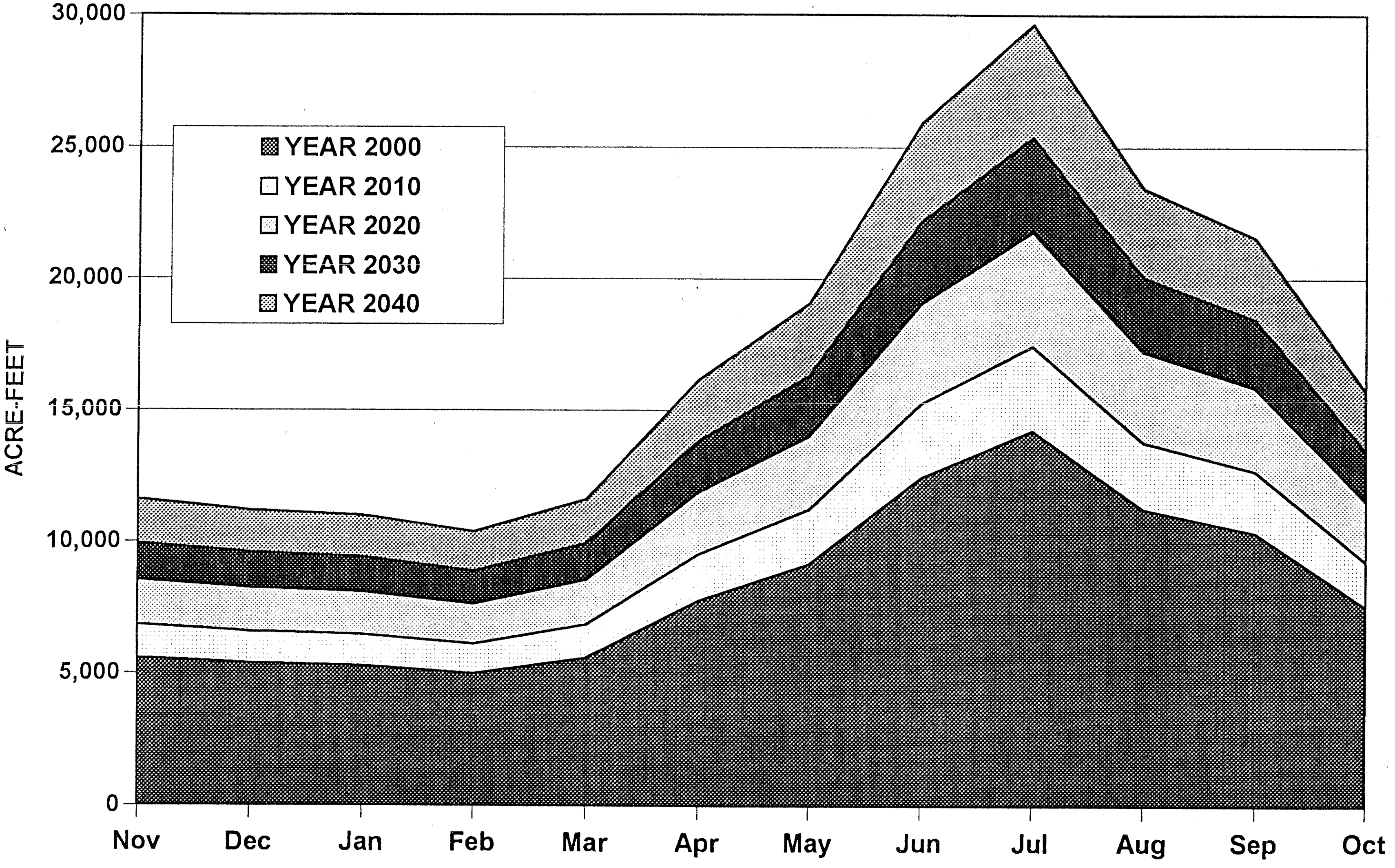
Sum_DemHa.xls/
PUEBLO WEST

FIGURE 5.9
MONTHLY WATER DEMANDS
FVA
(HIGH FORECAST)



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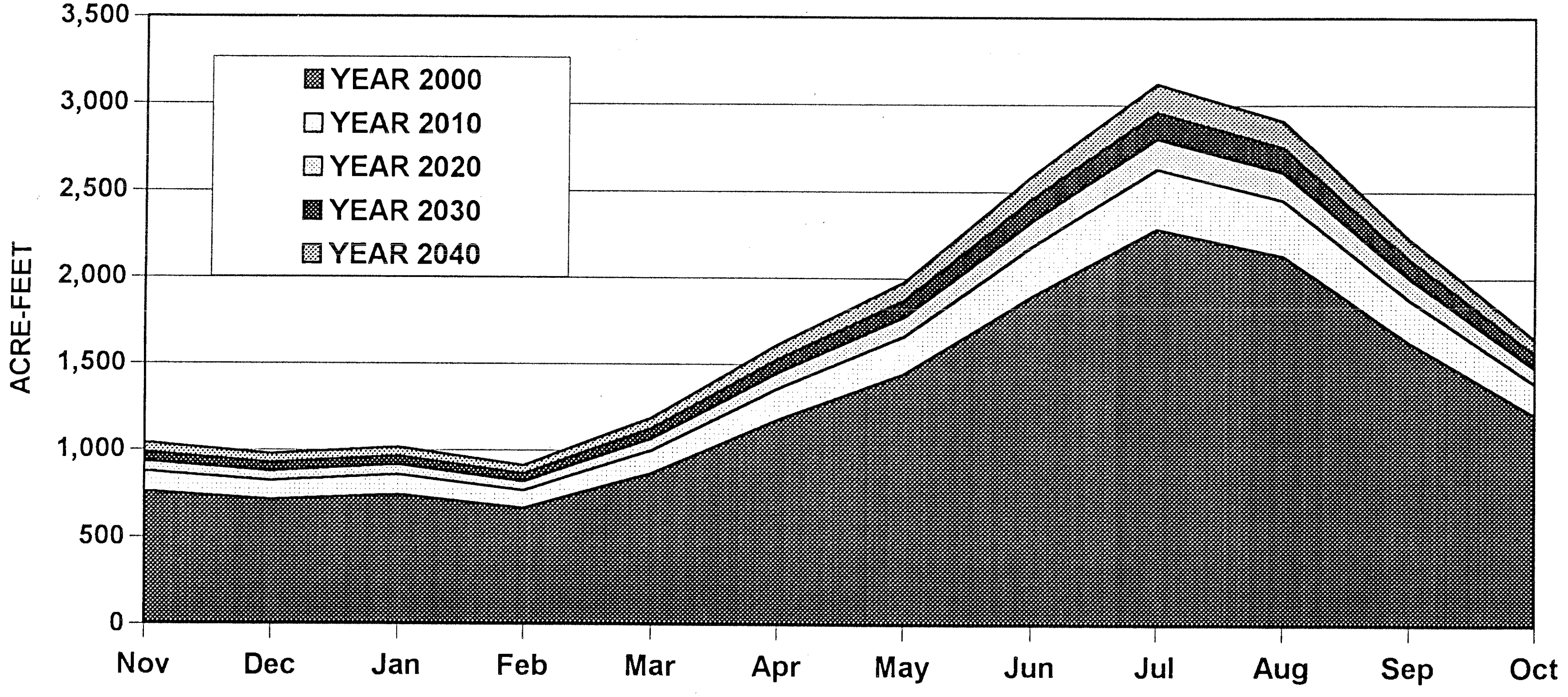
Sum_DemHa.xls/
FVA

## FIGURE 5.10
## MONTHLY WATER DEMANDS
## EAST OF PUEBLO
## (HIGH FORECAST)



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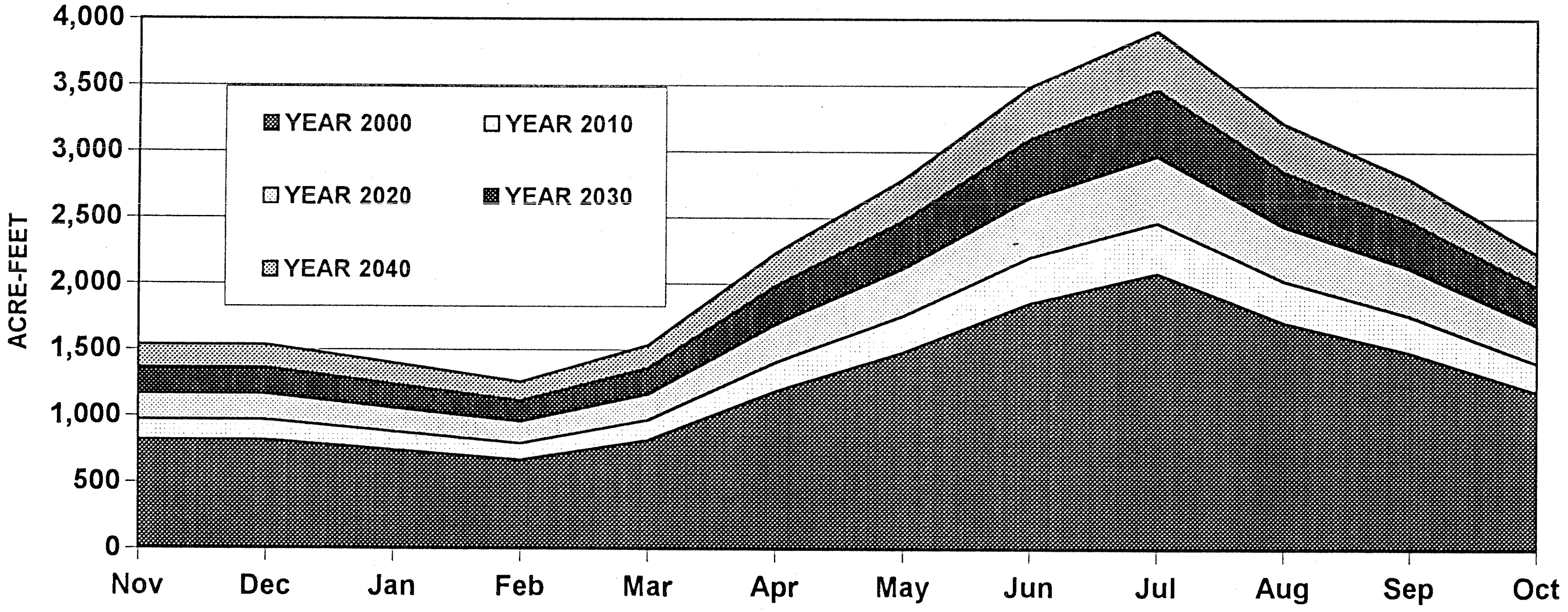
Sum_DemHa.xls/
EAST OF PUEBLO

# FIGURE 5.11
# MONTHLY WATER DEMANDS
# WEST OF PUEBLO
(BASE FORECAST)



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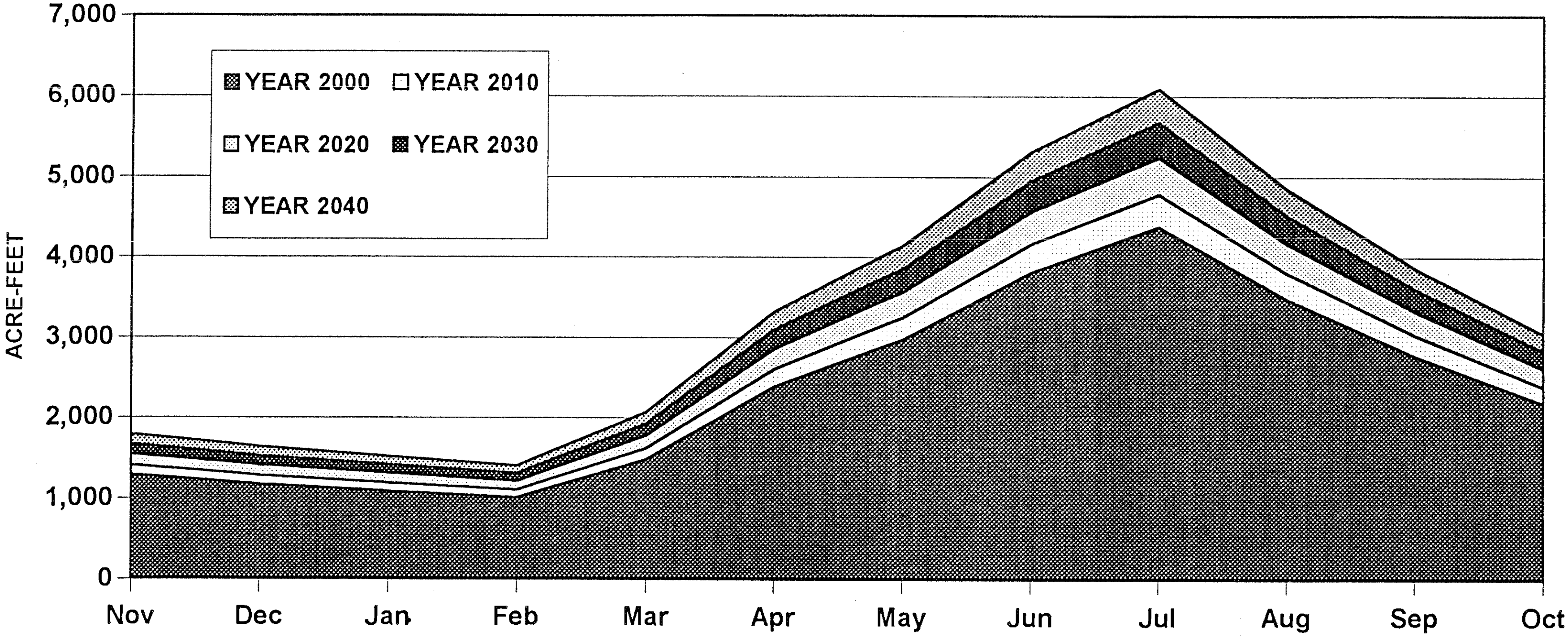
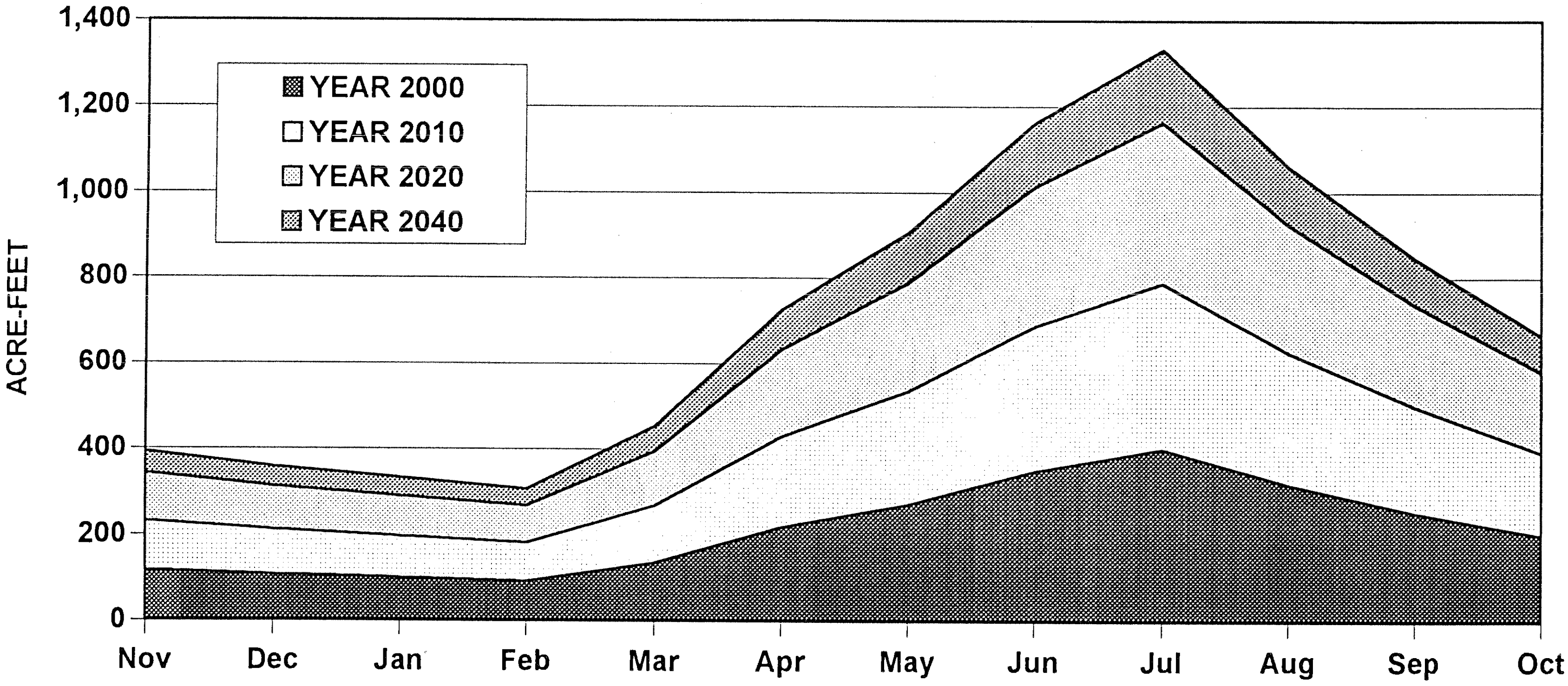
Sum_DemBG.xls/
WEST OF PUEBLO

# FIGURE 5.12
# MONTHLY WATER DEMANDS
# PUEBLO
(BASE FORECAST)



## FIGURE 5.13
## MONTHLY WATER DEMANDS
## PUEBLO WEST
(BASE FORECAST)



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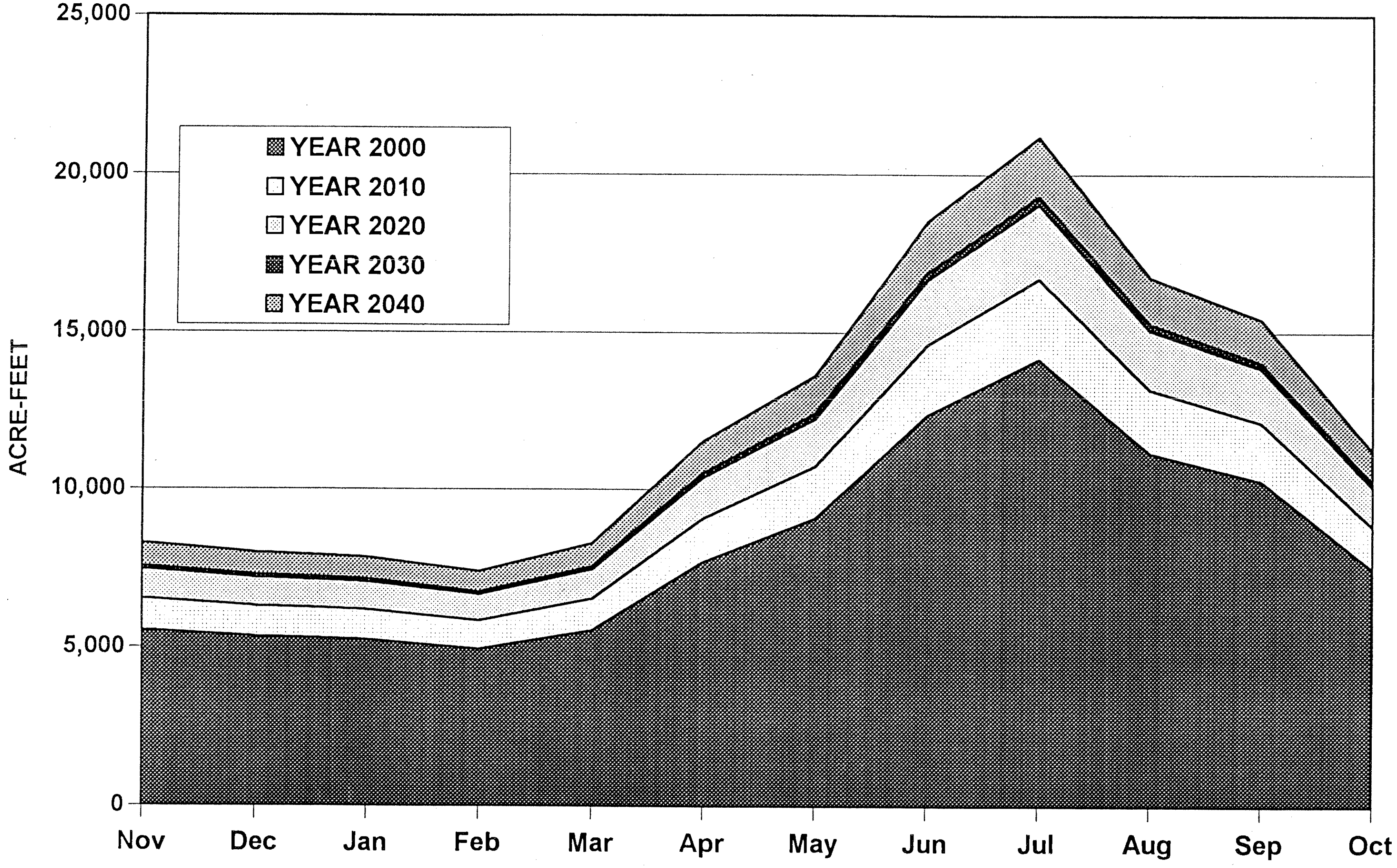
Sum_DemBG.xls/
PUEBLO WEST

## FIGURE 5.14
## MONTHLY WATER DEMANDS
## FVA
(BASE FORECAST)



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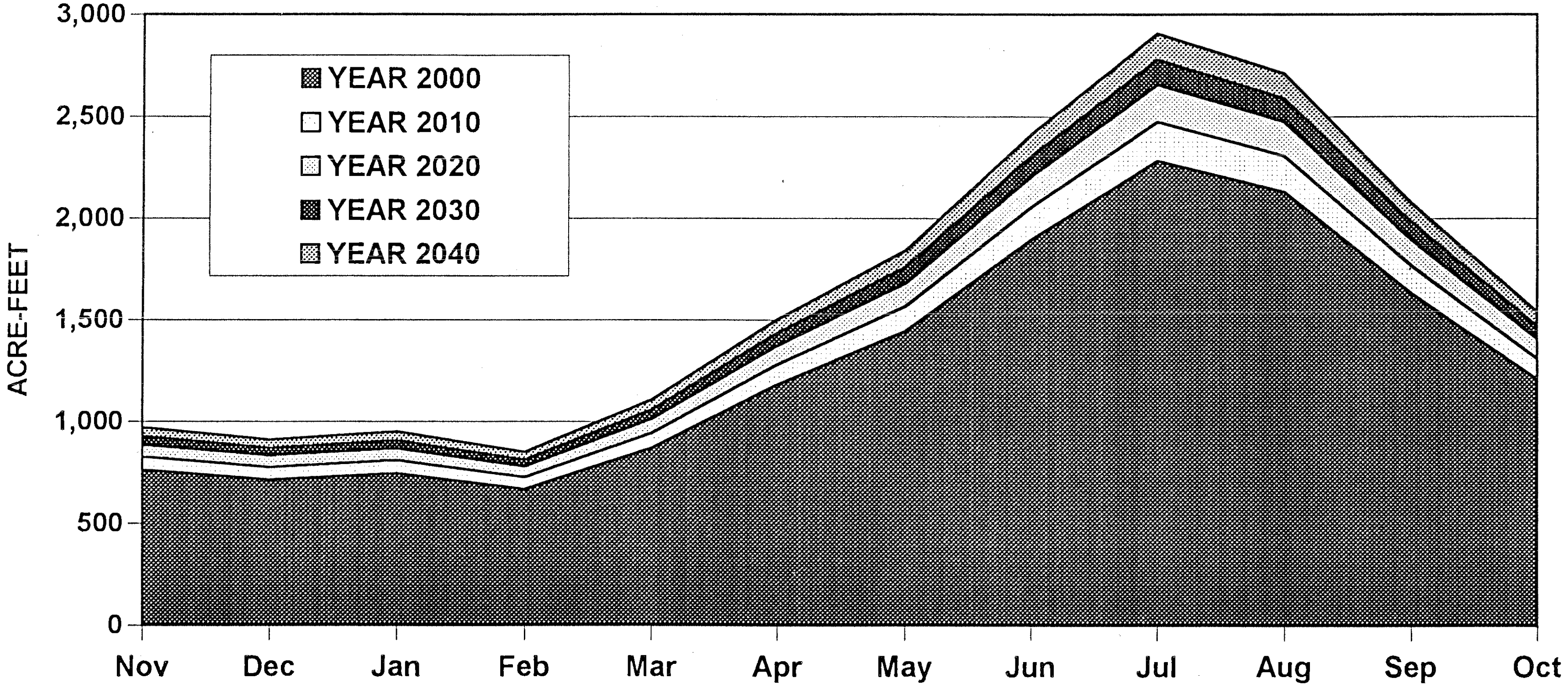
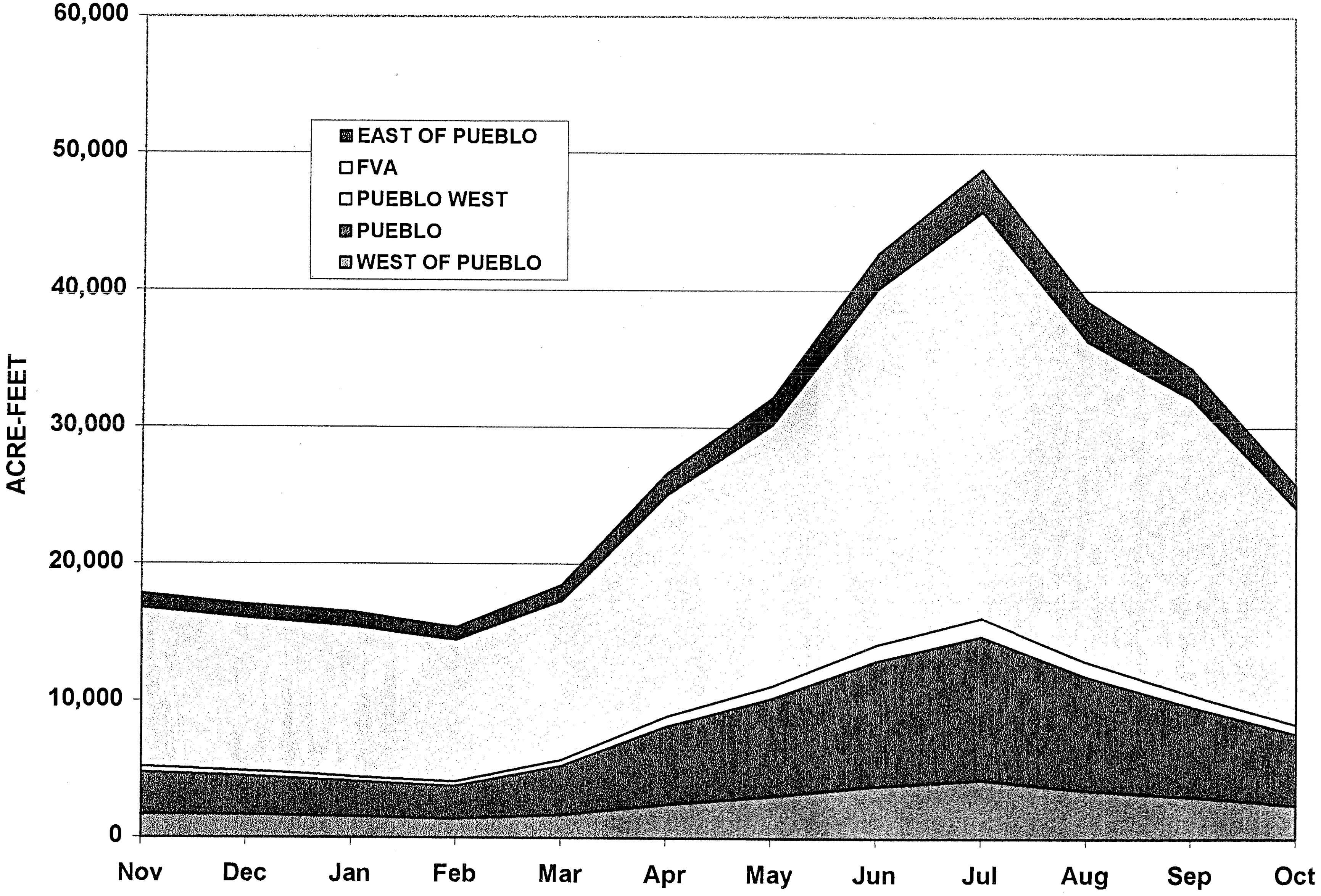
Sum_DemBG.xls/
FVA

# FIGURE 5.15
# MONTHLY WATER DEMANDS
# EAST OF PUEBLO
# (BASE FORECAST)

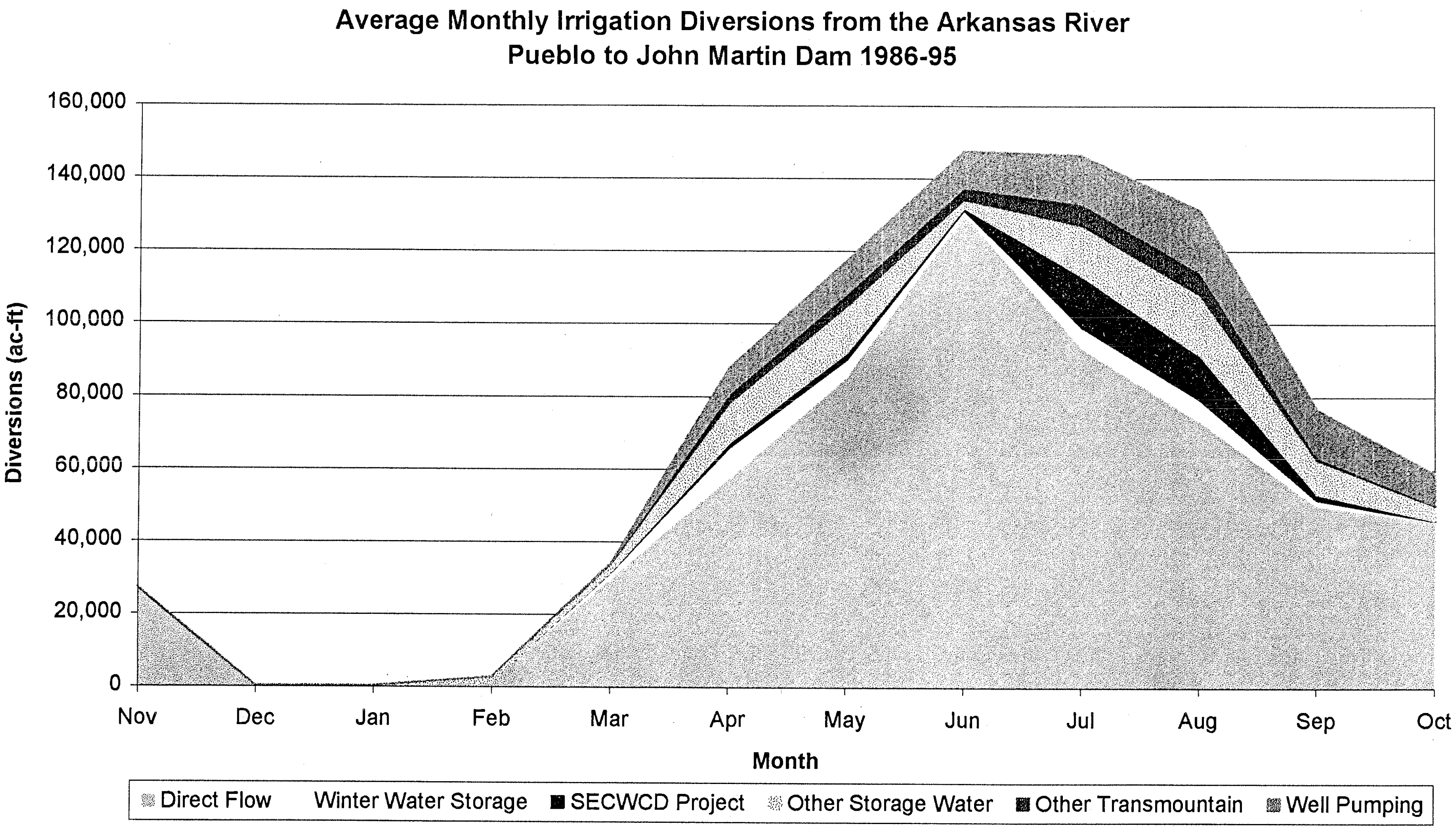


# FIGURE 5.16
# SUMMARY OF MUNICIPAL WATER DEMAND
## YEAR 2040 - HIGH FORECAST



GEI CONSULTANTS, INC.
12/8/98

Sum_DemHa.xls/
TOTAL MUNICIPAL - 2040



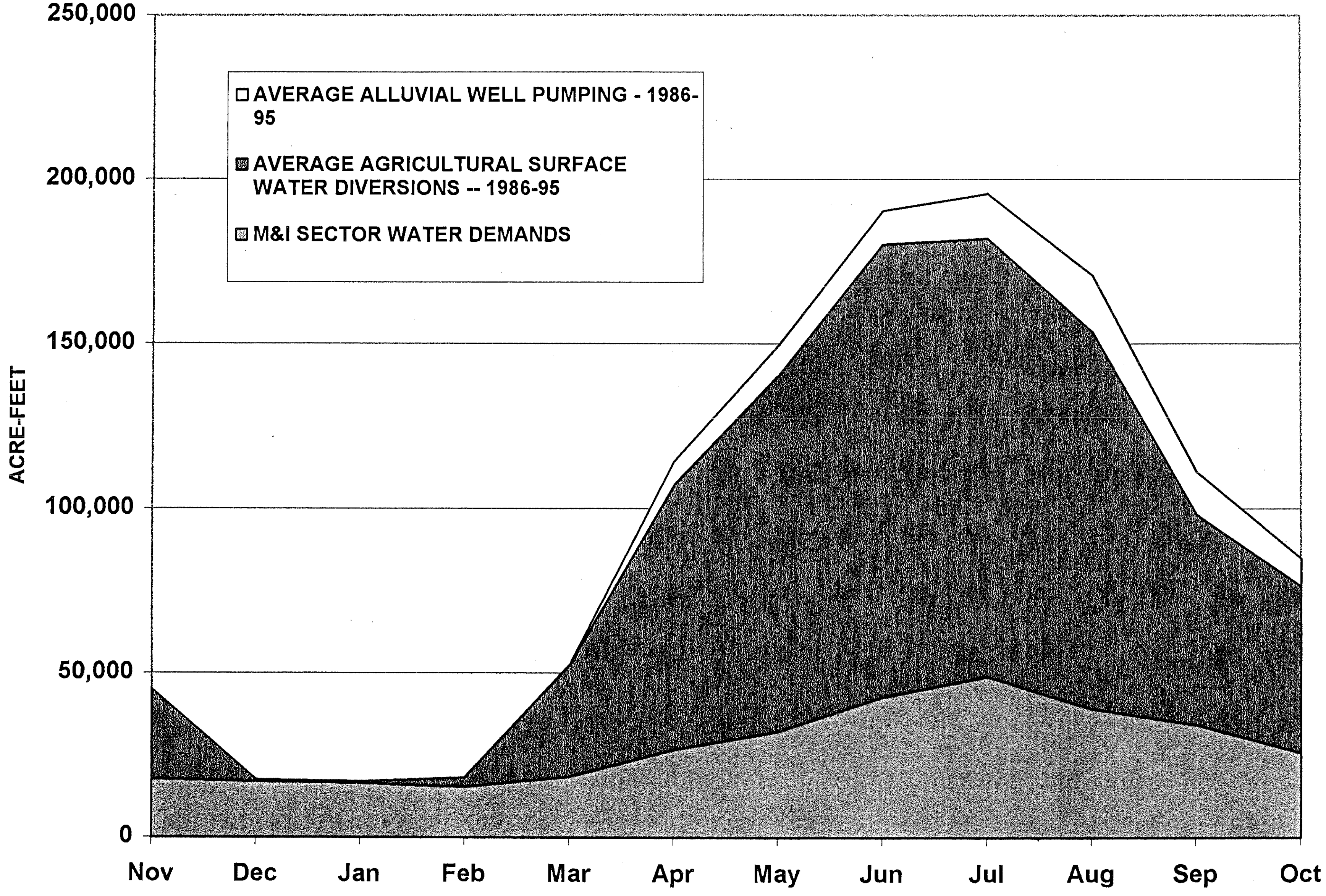
Note: Includes the Bessemer, Excelsior, Colorado, Highline, Oxford, Otero, Catlin, Fort Lyon, Rocky Ford, Holbrook, Las Animas Consolidated and Keesee Canals. Winter water includes only the water stored in Pueblo Reservoir for the direct flow ditches and in John Martin Reservoir for the Las Animas Consolidated and Fort Lyon Canals. Data was compiled from the State Engineer's records.

Divsum1.xls/All Ditches Chart

**FIGURE 5-17**

**AGRICULTURAL WATER USE**

# FIGURE 5.18
# TOTAL WATER DEMAND IN SECWCD
## YEAR 2040 - HIGH FORECAST



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12/8/98

Sum_DemHa.xls/
TOTAL DEMAND - 2040

Φ

Section 6

# 6. ASSESSMENT OF WATER SUPPLY AND STORAGE NEEDS

This chapter describes the findings of Tasks 7, 8, and 9 of the Future Water Storage Needs Assessment Project. These tasks deal with supply and demand comparison (Task 7), the need for additional water supplies (Task 8), and storage requirements (Task 9), which are defined in the contractual scope of services for the Assessment Project. Projections of future population in the District service area and associated future municipal and industrial (M&I) water demands are documented in Sections 3 and 5 of this report. Agricultural water use in the District is documented in Section 4.

A guiding assumption for the Assessment Project is that, except for currently adjudicated transfers of agricultural water supply to M&I use, agricultural water use in the District will remain at its present levels throughout the planning horizon, which extends to the year 2040. Water users in the district recognize that additional agricultural to M&I transfers may occur; however, sponsoring entities of the Assessment Project concur on the importance of articulating planning guidelines that foster maintaining the viability of the region's irrigated agricultural economy.

## 6.1 Potential Water Supply Deficits

As part of the Assessment Project, many of the individual municipal water supply entities within the District provided information on current and future populations and water use. As described in Section 5, these projections were supplemented with regional population and water use data and translated into a set of M&I water demand projections for the entire District. The Assessment Project recognizes the significant role that water conservation will play in achieving long-range water supply objectives. Therefore, the planning of potential water supply alternatives includes an assumption that conservation efforts, primarily in the M&I sector, will be successful and that, by the year 2040, municipal water demands in the District will be 10 percent less than they would have been without effective water conservation programs being implemented in the M&I sector.

Over the long term, the conservation of agricultural water will continue to evolve and expand, allowing production to hold constant or increase on a "per acre-foot" basis. Currently, water in the District is used and extensively re-used. "Efficiency" measures, such as ditch lining, while attractive on face value, will not provide significant benefits because of the high current levels of re-use and reliance on well pumping for irrigation supplies. Seepage from ditch systems recharges the alluvial aquifer and provides accretions to the surface water system. Recent studies completed by the Bureau of Reclamation (USBR) for the Catlin Canal system indicate that canal lining and other types of agricultural water conservation appear cost prohibitive at the present time (USBR, 1997). The planning process assumes that agricultural water use will hold constant at present levels.

The total average annual yield of surface water resources in the Arkansas Basin is approximately 780,000 acre-feet, as shown below:

| | **Average Annual Flow (Acre-Feet)** |
|---|---|
| Native Supplies at Pueblo Reservoir (1928-90) | 519,000 |
| Fountain Creek at Pueblo (1922-96) | 59,000 |
| St. Charles River at Vineland (1979-96) | 30,000 |
| Huerfano River near Boone (1922-96) | 28,000 |
| Apishapa River near Fowler (1922-96) | 20,000 |
| Transmountain Imports (1986-95) | 121,000 |
| Total | 777,000 |

During the 1986-95 period, average surface water diversion by agricultural users in the District was approximately 748,000 af. Well pumping averages approximately 84,500 af/yr within the District, of which 17,200 af/yr is sole source pumping and 67,300 af/yr is supplemental water. Agricultural pumping has averaged approximately 77,400 af. The sole source and supplemental pumping amounts translate to a surface diversion requirement of 29,000 af to offset well pumping, using a factor of 0.30 for supplemental well pumping and 0.50 for sole source well pumping.

As described in Section 5, municipal water use is anticipated to increase from 148,000 af per year at present to between 244,000 af and 335,000 af per year for the year 2040 base and high projections, respectively. These projections assume that conservation measures in the M&I sector will be successful and effect an overall reduction in water demand of 10 percent by the year 2040. With agricultural use of 748,000 af, replacement water needs for well pumping of 29,000 af the above-noted municipal demands and an allowance of 10,000 af for separate industrial use, the total average annual water need is forecast to increase from 935,000 af to between 1,031,000 and 1,122,000 af per year in the year 2040. In above average years, with extensive re-use of water by agricultural entities, water resources probably will be adequate to meet identified needs within the District. During dry years, however, the availability of both native and imported water supplies is reduced and the demands for water for irrigation are considerably higher than the average. Some of the potential shortfall during dry years is overcome by the re-use of municipal and agricultural return flows by lower basin irrigators.

Currently, the Arkansas Basin is over appropriated. In the absence of additional transmountain water imports, no "new" reliable water supplies will be developed within the Basin. Fulfillment of the future needs of water supply entities within the District is related to re-regulation of existing supplies. Storage is essential for providing re-regulation of supplies. It may be difficult to import significant volumes of additional West Slope water because of the potential environmental and regulatory constraints. Additional storage in the Basin would, however, facilitate better management of available water resources on both a seasonal and longer-term (carry-over) basis.

### 6.1.1 Deficits in the M&I Sector - High Demand Forecast

As described in Section 5, M&I users in the District are projecting a 126 percent increase in water demands by the year 2040 for the high demand forecast (148,000 to 335,000 af). Surveys reported in Section 2 indicate that most of the larger water supply entities have acquired or are acquiring the water rights to meet the additional demands in their service areas. A comparison of water supplies with current demands for the municipal entities is provided in Tables 6.1 through 6.5 for the high demand forecast. Much of the additional M&I demand will occur in Colorado Springs, Pueblo, and communities served by the Fountain Valley Authority. A portion of the additional demand in these service areas and other M&I water supply entities will be met by Fry-Ark Project supplies. Approximately 26 percent of Fry-Ark water is currently used by M&I entities. The District's Allocation Principles and Policies (Section 7) provide for 51 percent of the Project yield for municipal purposes and 49 percent for agricultural purposes.

Review of the Tables 6.1 through 6.5 indicates that, for the high water demand scenario, significant water supply deficits are forecast to occur in the municipal sector in the absence of additional water supply development. For planning, we have assumed that to the extent possible under the District's Allocation Principles and Policies, Fry-Ark Project water would be allocated and used by the municipal entities to meet increasing water demands over the 40-year planning horizon. Table 6.5 (year 2040 high demand) indicates that water supply deficit of nearly 81,800 af could develop within the District by the year 2040. As summarized below, the deficits are forecast to occur in the municipal entities served by the Fountain Valley Authority and for several entities West of Pueblo.

| **Region Year:** | **Forecast Deficit (Acre-Feet) High Forecast** | | | | |
|---|---|---|---|---|---|
| | **Current** | **2010** | **2020** | **2030** | **2040** |
| Entities West of Pueblo | 0 | 0 | 0 | 393 | 2,063 |
| Pueblo West | 0 | 0 | 0 | 0 | 0 |
| Pueblo | 0 | 0 | 0 | 0 | 0 |
| Fountain Valley | 0 | 503 | 24,789 | 50,402 | 79,696 |
| Entities East of Pueblo | 0 | 0 | 0 | 0 | 0 |
| Total (High): | 0 | 503 | 24,789 | 50,795 | 81,759 |

(1) Apparent needs in year 2000 based on reported water supplies. Deficits assumed to be met by Fry-Ark Project water by year 2010.

The majority of the future water deficit will occur in the Fountain Valley area. An additional 24,800 af of water will be needed by the year 2020, increasing to 81,800 af by the year 2040. Approximately 88 percent of this additional water demand is forecast to occur in Colorado Springs; however, all the FVA entities will require some additional water by the year 2020. An additional 2,100 af of water will be required by the entities west of Pueblo by the year 2040. This additional water need is forecast to develop in Chaffee County, the City of Salida, and in the City of Florence.

Both Pueblo West and Pueblo appear to have abundant water supplies to meet their long-range needs. The East of Pueblo entities also appear to have adequate water to meet their needs through the year 2040.

Graphical depictions of water supply, water demand in the year 2040, and potential deficits are provided for the high forecast on Figures 6.1 through 6.4

## TABLE 6.1
## WATER SUPPLY VS. WATER DEMAND
## CURRENT CONDITIONS

| Municipal Entity | Reported Non-Project Firm Yield | Fry-Ark Project Allocation (1) | Allocated But Available for Other Uses | Total Available Supply | Current Demand | Surplus/ (Deficit) | Range of Potential Fry-Ark Reuse (2) | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | Low | High |
| **Entities West of Pueblo** | | | | | | | | |
| Buena Vista | 2,809 | 29 | | 2,838 | 728 | 2,110 | 17 | 44 |
| Salida | 2,240 | 195 | | 2,435 | 2,400 | 35 | 117 | 293 |
| Chaffee County | 2,428 | 69 | | 2,497 | 2,497 | 0 | 41 | 104 |
| Canon City | 23,891 | 90 | | 23,981 | 5,560 | 18,421 | 54 | 135 |
| Park Center | 1,131 | 40 | | 1,171 | 854 | 317 | 24 | 60 |
| Florence | 4,835 | 9 | | 4,844 | 1,707 | 3,137 | 5 | 14 |
| Penrose | 1,000 | 0 | | 1,000 | 462 | 538 | 0 | 0 |
| Fremont County | 166 | 14 | | 180 | 180 | 0 | 8 | 21 |
| Subtotal | 38,500 | 446 | 0 | 38,946 | 14,388 | 24,558 | 268 | 669 |
| **Pueblo West** | 13,656 | 0 | 0 | 13,656 | 2,618 | 11,038 | 0 | 0 |
| **Pueblo Board of Water Works** | 74,032 | 0 | 8,040 | 74,032 | 26,357 | 47,675 | 0 | 0 |
| **Fountain Valley Authority (3)** | | | | | | | | |
| Colorado Springs Utilities | 97,000 | 1,200 | | 98,200 | 80,878 | 17,322 | 720 | 1,800 |
| Fountain | 3,300 | 1,600 | | 4,900 | 1,761 | 3,139 | 960 | 2,400 |
| Security | 3,336 | 1,640 | | 4,976 | 2,319 | 2,657 | 984 | 2,460 |
| Widefield | 2,975 | 1,500 | | 4,475 | 3,069 | 1,406 | 900 | 2,250 |
| Stratmoor Hills | 770 | 601 | | 1,371 | 861 | 510 | 361 | 902 |
| El Paso County | 209 | 0 | | 209 | 209 | 0 | 0 | 0 |
| Subtotal | 107,590 | 6,541 | 13,559 | 114,131 | 89,097 | 25,034 | 3,925 | 9,812 |
| **Entities East of Pueblo** | | | | | | | | |
| St. Charles Mesa | 1,884 | 270 | | 2,154 | 1,920 | 234 | 162 | 405 |
| Pueblo County | 262 | 32 | | 294 | 294 | 0 | 19 | 48 |
| Crowley County | 644 | 777 | | 1,421 | 903 | 518 | 466 | 1,166 |
| Fowler | 471 | 49 | | 520 | 371 | 149 | 29 | 74 |
| Rocky Ford | 2,385 | 30 | | 2,415 | 1,392 | 1,023 | 18 | 45 |
| LaJunta (4) | 0 | 1,050 | | 2,999 | 2,999 | 0 | 630 | 1,575 |
| Bents Fort WA | 116 | 0 | | 116 | 123 | **(7)** | 0 | 0 |
| Otero County | 856 | 25 | | 881 | 881 | 0 | 15 | 38 |
| Las Animas (4) | 0 | 215 | | 538 | 538 | 0 | 129 | 323 |
| Bent County | 141 | 0 | | 141 | 141 | 0 | 0 | 0 |
| Lamar (5) | 1,100 | 2,100 | | 3,200 | 2,770 | 430 | 1,260 | 3,150 |
| May Valley WA | 686 | 0 | | 686 | 492 | 194 | 0 | 0 |
| Prowers and Kiowa Counties | 525 | 24 | | 549 | 549 | 0 | 14 | 36 |
| Subtotal | 9,070 | 4,572 | 5,071 | 15,914 | 13,373 | 2,541 | 2,743 | 6,858 |
| Total | 242,848 | 11,559 | 26,670 | 256,679 | 145,833 | | 6,935 | 17,339 |

(1) Based on average annual allocation for period 1993-1997 or need for augmentation based on demand.
(2) Assumes that reuse of Fry-Ark Project ranges from 0.6 to 1.5 times the first use.
Where used for augmentation of wells, reuse potential is shown as zero.
(3) The average FVA allocation of Fry-Ark water was 10,313 af during 1993-1997.
Delivered amounts to FVA entities in averaged 6,541af in the same period.
(4) Water supplied by alluvial wells to be fully augmented using Fry-Ark Project water.
(5) Water supplied by alluvial wells to be fully augmented using Ft. Bent Ditch and Fry-Ark Project water.
Transit losses will reduce actual yield of Fry-Ark Project water depending on the time of year and river conditions.

TABLE 6.2

# WATER SUPPLY VS. DEMAND
# YEAR 2010 HIGH FORECAST

| Municipal Entity | Reported Non-Project Firm Yield | Fry-Ark Project Allocation (1) | Allocated But Available for Other Uses | Total Available Supply | Year 2010 Demand | Surplus/ (Deficit) | Range of Potential Fry-Ark Reuse (2) | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | Low | High |
| **Entities West of Pueblo** | | | | | | | | |
| Buena Vista | 2,809 | 29 | | 2,838 | 848 | 1,990 | 17 | 44 |
| Salida | 2,240 | 735 | | 2,975 | 2,975 | 0 | 441 | 1,103 |
| Chaffee County | 2,428 | 209 | | 2,637 | 2,637 | 0 | 125 | 314 |
| Canon City | 23,891 | 90 | | 23,981 | 7,150 | 16,831 | 54 | 135 |
| Park Center | 1,131 | 40 | | 1,171 | 919 | 252 | 24 | 60 |
| Florence | 4,835 | 9 | | 4,844 | 2,822 | 2,022 | 5 | 14 |
| Penrose | 1,000 | 393 | | 1,393 | 493 | 900 | 236 | 590 |
| Fremont County | 166 | 14 | | 180 | 180 | 0 | 8 | 21 |
| Subtotal | 38,500 | 1,519 | 0 | 40,019 | 18,024 | 21,995 | 911 | 2,279 |
| | | | | | | | | |
| **Pueblo West** | 13,656 | 0 | 0 | 13,656 | 5,053 | 8,603 | 0 | 0 |
| | | | | | | | | |
| **Pueblo Board of Water Works** | 74,032 | 0 | 8,040 | 74,032 | 34,080 | 39,952 | 0 | 0 |
| | | | | | | | | |
| **Fountain Valley Authority** | | | | | | | | |
| Colorado Springs Utilities | 97,000 | 10,418 | | 107,418 | 107,418 | 0 | 6,251 | 15,627 |
| Fountain | 3,300 | 1,600 | | 4,900 | 3,360 | 1,540 | 960 | 2,400 |
| Security | 3,336 | 1,646 | | 4,982 | 5,418 | **(436)** | 988 | 2,469 |
| Widefield | 2,975 | 1,500 | | 4,475 | 4,214 | 261 | 900 | 2,250 |
| Stratmoor Hills | 770 | 601 | | 1,371 | 1,400 | **(29)** | 361 | 902 |
| El Paso County | 209 | 0 | | 209 | 247 | **(38)** | 0 | 0 |
| Subtotal | 107,590 | 15,765 | 4,335 | 123,355 | 122,057 | **1,298** | 9,459 | 23,648 |
| | | | | | | | | |
| **Entities East of Pueblo** | | | | | | | | |
| St. Charles Mesa | 1,884 | 1,327 | | 3,211 | 3,211 | 0 | 796 | 1,991 |
| Pueblo County | 262 | 61 | | 323 | 323 | 0 | 37 | 92 |
| Crowley County | 644 | 777 | | 1,421 | 1,395 | 26 | 466 | 1,166 |
| Fowler | 471 | 215 | | 686 | 370 | 316 | 129 | 323 |
| Rocky Ford | 2,385 | 30 | | 2,415 | 1,762 | 653 | 18 | 45 |
| LaJunta (3) | 0 | 1,508 | | 4,314 | 4,314 | 0 | 905 | 2,262 |
| Bents Fort WA | 116 | 306 | | 422 | 422 | 0 | 184 | 459 |
| Otero County | 856 | 0 | | 856 | 812 | 44 | 0 | 0 |
| Las Animas (3) | 0 | 399 | | 998 | 998 | 0 | 239 | 599 |
| Bent County | 141 | 54 | | 195 | 195 | 0 | 32 | 81 |
| Lamar (4) | 1,100 | 2,100 | | 3,200 | 2,740 | 460 | 1,260 | 3,150 |
| May Valley WA | 686 | 0 | | 686 | 567 | 119 | 0 | 0 |
| Prowers and Kiowa Counties | 525 | 260 | | 785 | 785 | 0 | 156 | 390 |
| Subtotal | 9,070 | 7,037 | 2,606 | 19,512 | 17,894 | 1,618 | 4,222 | 10,556 |
| | | | | | | | | |
| Total | 242,848 | 24,321 | 14,981 | 270,574 | 197,108 | | 14,593 | 36,482 |
| | | | | | **Deficit** | **(503)** | | |

(1) Based on needs for additional water with assumed use of Fry-Ark water to minimize deficits up to the allocation limitations for Entities west of Pueblo (3,200 af), Pueblo (8,040 af), FVA (20,100 af), and Entities East of Pueblo (9,643 af).

(2) Assumes that reuse of Fry-Ark Project ranges from 0.6 to 1.5 times the first use. Where used for augmentation of wells, reuse potential is shown as zero.

(3) Water supplied by alluvial wells to be fully augmented using Fry-Ark Project water.

(4) Water supplied by alluvial wells to be fully augmented using Ft. Bent Ditch and Fry-Ark Project water. Transit losses will reduce actual yield of Fry-Ark Project water depending on the time of year and river conditions.

### TABLE 6.3

## WATER SUPPLY VS. DEMAND
## YEAR 2020 HIGH FORECAST

| Municipal Entity | Reported Non-Project Firm Yield | Fry-Ark Project Allocation (1) | Allocated But Available for Other Uses | Total Available Supply | Year 2020 Demand | Surplus/ (Deficit) | Range of Potential Fry-Ark Reuse (2) | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | Low | High |
| **Entities West of Pueblo** | | | | | | | | |
| Buena Vista | 2,809 | 29 | | 2,838 | 948 | 1,890 | 17 | 44 |
| Salida | 2,240 | 1,016 | | 3,256 | 3,256 | 0 | 610 | 1,524 |
| Chaffee County | 2,428 | 486 | | 2,914 | 2,914 | 0 | 292 | 729 |
| Canon City | 23,891 | 90 | | 23,981 | 9,550 | 14,431 | 54 | 135 |
| Park Center | 1,131 | 40 | | 1,171 | 1,004 | 167 | 24 | 60 |
| Florence | 4,835 | 9 | | 4,844 | 3,951 | 893 | 5 | 14 |
| Penrose | 1,000 | 416 | | 1,416 | 516 | 900 | 250 | 624 |
| Fremont County | 166 | 19 | | 185 | 185 | 0 | 11 | 29 |
| Subtotal | 38,500 | 2,105 | 0 | 40,605 | 22,324 | 18,281 | 1,263 | 3,158 |
| | | | | | | | | |
| **Pueblo West** | 13,656 | 0 | 0 | 13,656 | 7,451 | 6,205 | 0 | 0 |
| | | | | | | | | |
| **Pueblo Board of Water Works** | 74,032 | 0 | 8,040 | 74,032 | 42,372 | 31,660 | 0 | 0 |
| | | | | | | | | |
| **Fountain Valley Authority** | | | | | | | | |
| Colorado Springs Utilities | 97,000 | 14,353 | | 111,353 | 134,190 | **(22,837)** | 8,612 | 21,530 |
| Fountain | 3,300 | 2,000 | | 5,300 | 5,439 | **(139)** | 1,200 | 3,000 |
| Security | 3,336 | 1,646 | | 4,982 | 6,028 | **(1,046)** | 988 | 2,469 |
| Widefield | 2,975 | 1,500 | | 4,475 | 5,181 | **(706)** | 900 | 2,250 |
| Stratmoor Hills | 770 | 601 | | 1,371 | 1,371 | 0 | 361 | 902 |
| El Paso County | 209 | 0 | | 209 | 270 | **(61)** | 0 | 0 |
| Subtotal | 107,590 | 20,100 | 0 | 127,690 | 152,479 | **(24,789)** | 12,060 | 30,150 |
| | | | | | | | | |
| **Entities East of Pueblo** | | | | | | | | |
| St. Charles Mesa | 1,884 | 1,576 | | 3,460 | 3,460 | 0 | 946 | 2,364 |
| Pueblo County | 262 | 81 | | 343 | 343 | 0 | 49 | 122 |
| Crowley County | 644 | 910 | | 1,554 | 1,554 | 0 | 546 | 1,365 |
| Fowler | 471 | 215 | | 686 | 362 | 324 | 129 | 323 |
| Rocky Ford | 2,385 | 30 | | 2,415 | 2,023 | 392 | 18 | 45 |
| LaJunta (3) | 0 | 1,618 | | 4,628 | 4,628 | 0 | 971 | 2,427 |
| Bents Fort WA | 116 | 310 | | 426 | 426 | 0 | 186 | 465 |
| Otero County | 856 | 0 | | 856 | 844 | 12 | 0 | 0 |
| Las Animas (3) | 0 | 451 | | 1,128 | 1,128 | 0 | 271 | 677 |
| Bent County | 141 | 57 | | 198 | 198 | 0 | 34 | 86 |
| Lamar (4) | 1,100 | 2,100 | | 3,200 | 2,723 | 477 | 1,260 | 3,150 |
| May Valley WA | 686 | 0 | | 686 | 617 | 69 | 0 | 0 |
| Prowers and Kiowa Counties | 525 | 254 | | 779 | 779 | 0 | 152 | 381 |
| Subtotal | 9,070 | 7,602 | 2,041 | 20,359 | 19,085 | 1,274 | 4,561 | 11,403 |
| | | | | | | | | |
| Total | 242,848 | 29,807 | 10,081 | 276,342 | 243,711 | | 17,884 | 44,711 |
| | | | | | **Deficit** | **(24,789)** | | |

(1) Based on needs for additional water with assumed use of Fry-Ark water to minimize deficits up to the allocation limitations for Entities west of Pueblo (3,200 af), Pueblo (8,040 af), FVA (20,100 af), and Entities East of Pueblo (9,643 af).

(2) Assumes that reuse of Fry-Ark Project ranges from 0.6 to 1.5 times the first use. Where used for augmentation of wells, reuse potential is shown as zero.

(3) Water supplied by alluvial wells to be fully augmented using Fry-Ark Project water.

(4) Water supplied by alluvial wells to be fully augmented using Ft. Bent Ditch and Fry-Ark Project water. Transit losses will reduce actual yield of Fry-Ark Project water depending on the time of year and river conditions.

TABLE 6.4

# WATER SUPPLY VS. DEMAND
# YEAR 2030 HIGH FORECAST

| Municipal Entity | Reported Non-Project Firm Yield | Fry-Ark Project Allocation (1) | Allocated But Available for Other Uses | Total Available Supply | Year 2030 Demand | Surplus/ (Deficit) | Range of Potential Fry-Ark Reuse (2) | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | Low | High |
| Entities West of Pueblo | | | | | | | | |
| Buena Vista | 2,809 | 29 | | 2,838 | 1,043 | 1,795 | 17 | 44 |
| Salida | 2,240 | 1,764 | | 4,004 | 4,271 | **(267)** | 1,058 | 2,646 |
| Chaffee County | 2,428 | 700 | | 3,128 | 3,205 | **(77)** | 420 | 1,050 |
| Canon City | 23,891 | 90 | | 23,981 | 11,389 | 12,592 | 54 | 135 |
| Park Center | 1,131 | 40 | | 1,171 | 1,051 | 120 | 24 | 60 |
| Florence | 4,835 | 144 | | 4,979 | 5,028 | **(49)** | 86 | 216 |
| Penrose | 1,000 | 416 | | 1,416 | 541 | 875 | 250 | 624 |
| Fremont County | 166 | 17 | | 183 | 183 | 0 | 10 | 26 |
| Subtotal | 38,500 | 3,200 | 0 | 41,700 | 26,711 | 14,989 | 1,920 | 4,800 |
| Pueblo West | 13,656 | 0 | 0 | 13,656 | 8,735 | 4,921 | 0 | 0 |
| Pueblo Board of Water Works | 74,032 | 0 | 8,040 | 74,032 | 53,571 | 20,461 | 0 | 0 |
| Fountain Valley Authority | | | | | | | | |
| Colorado Springs Utilities | 97,000 | 14,353 | | 111,353 | 156,478 | **(45,125)** | 8,612 | 21,530 |
| Fountain | 3,300 | 2,000 | | 5,300 | 7,401 | **(2,101)** | 1,200 | 3,000 |
| Security | 3,336 | 1,646 | | 4,982 | 5,900 | **(918)** | 988 | 2,469 |
| Widefield | 2,975 | 1,500 | | 4,475 | 6,608 | **(2,133)** | 900 | 2,250 |
| Stratmoor Hills | 770 | 601 | | 1,371 | 1,414 | **(43)** | 361 | 902 |
| El Paso County | 209 | 0 | | 209 | 291 | **(82)** | 0 | 0 |
| Subtotal | 107,590 | 20,100 | 0 | 127,690 | 178,092 | **(50,402)** | 12,060 | 30,150 |
| Entities East of Pueblo | | | | | | | | |
| St. Charles Mesa | 1,884 | 1,811 | | 3,695 | 3,695 | 0 | 1,087 | 2,717 |
| Pueblo County | 262 | 99 | | 361 | 361 | 0 | 59 | 149 |
| Crowley County | 644 | 957 | | 1,601 | 1,601 | 0 | 574 | 1,436 |
| Fowler | 471 | 221 | | 692 | 376 | 316 | 133 | 332 |
| Rocky Ford | 2,385 | 30 | | 2,415 | 2,271 | 144 | 18 | 45 |
| LaJunta (3) | 0 | 1,735 | | 4,962 | 4,962 | 0 | 1,041 | 2,603 |
| Bents Fort WA | 116 | 313 | | 429 | 429 | 0 | 188 | 470 |
| Otero County | 856 | 20 | | 876 | 876 | 0 | 12 | 30 |
| Las Animas (3) | 0 | 500 | | 1,251 | 1,251 | 0 | 300 | 750 |
| Bent County | 141 | 59 | | 200 | 200 | 0 | 35 | 89 |
| Lamar (4) | 1,100 | 2,100 | | 3,200 | 2,706 | 494 | 1,260 | 3,150 |
| May Valley WA | 686 | 0 | | 686 | 640 | 46 | 0 | 0 |
| Prowers and Kiowa Counties | 525 | 248 | | 773 | 773 | 0 | 149 | 372 |
| Subtotal | 9,070 | 8,093 | 1,550 | 21,141 | 20,141 | 1,000 | 4,856 | 12,140 |
| Total | 242,848 | 31,393 | 9,590 | 278,219 | 287,250 | | 18,836 | 47,090 |
| | | | | | **Deficit** | **(50,795)** | | |

(1) Based on needs for additional water with assumed use of Fry-Ark water to minimize deficits up to the allocation limitations for Entities west of Pueblo (3,200 af), Pueblo (8,040 af), FVA (20,100 af), and Entities East of Pueblo (9,643 af).

(2) Assumes that reuse of Fry-Ark Project ranges from 0.6 to 1.5 times the first use. Where used for augmentation of wells, reuse potential is shown as zero.

(3) Water supplied by alluvial wells to be fully augmented using Fry-Ark Project water.

(4) Water supplied by alluvial wells to be fully augmented using Ft. Bent Ditch and Fry-Ark Project water. Transit losses will reduce actual yield of Fry-Ark Project water depending on the time of year and river conditions.

TABLE 6.5

## WATER SUPPLY VS. WATER DEMAND
## YEAR 2040 HIGH FORECAST

| Municipal Entity | Reported Non-Project Firm Yield | Fry-Ark Project Allocation (1) | Allocated But Available for Other Uses | Total Available Supply | Year 2040 Demand | Surplus/ (Deficit) | Range of Potential Fry-Ark Reuse (2) | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | Low | High |
| **Entities West of Pueblo** | | | | | | | | |
| Buena Vista | 2,809 | 29 | | 2,838 | 1,133 | 1,705 | 17 | 44 |
| Salida | 2,240 | 1,764 | | 4,004 | 4,637 | **(633)** | 1,058 | 2,646 |
| Chaffee County | 2,428 | 700 | | 3,128 | 3,481 | **(353)** | 420 | 1,050 |
| Canon City | 23,891 | 90 | | 23,981 | 13,582 | 10,399 | 54 | 135 |
| Park Center | 1,131 | 40 | | 1,171 | 1,090 | 81 | 24 | 60 |
| Florence | 4,835 | 144 | | 4,979 | 6,056 | **(1,077)** | 86 | 216 |
| Penrose | 1,000 | 416 | | 1,416 | 561 | 855 | 250 | 624 |
| Fremont County | 166 | 19 | | 185 | 185 | 0 | 11 | 29 |
| Subtotal | 38,500 | 3,202 | 0 | 41,702 | 30,725 | 10,977 | 1,921 | 4,803 |
| | | | | | | | | |
| **Pueblo West** | 13,656 | 0 | 0 | 13,656 | 8,545 | 5,111 | 0 | 0 |
| | | | | | | | | |
| **Pueblo Board of Water Works** | 74,032 | 0 | 8,040 | 74,032 | 67,117 | 6,915 | 0 | 0 |
| | | | | | | | | |
| **Fountain Valley Authority** | | | | | | | | |
| Colorado Springs Utilities | 97,000 | 14,353 | | 111,353 | 183,724 | **(72,371)** | 8,612 | 21,530 |
| Fountain | 3,300 | 2,000 | | 5,300 | 9,273 | **(3,973)** | 1,200 | 3,000 |
| Security | 3,336 | 1,646 | | 4,982 | 5,772 | **(790)** | 988 | 2,469 |
| Widefield | 2,975 | 1,500 | | 4,475 | 6,922 | **(2,447)** | 900 | 2,250 |
| Stratmoor Hills | 770 | 601 | | 1,371 | 1,383 | **(12)** | 361 | 902 |
| El Paso County | 209 | 0 | | 209 | 312 | **(103)** | 0 | 0 |
| Subtotal | 107,590 | 20,100 | 0 | 127,690 | 207,386 | **(79,696)** | 12,060 | 30,150 |
| | | | | | | | | |
| **Entities East of Pueblo** | | | | | | | | |
| St. Charles Mesa | 1,884 | 2,033 | | 3,917 | 3,917 | 0 | 1,220 | 3,050 |
| Pueblo County | 262 | 117 | | 379 | 379 | 0 | 70 | 176 |
| Crowley County | 644 | 1,063 | | 1,707 | 1,707 | 0 | 638 | 1,595 |
| Fowler | 471 | 234 | | 705 | 389 | 316 | 140 | 351 |
| Rocky Ford | 2,385 | 121 | | 2,506 | 2,506 | 0 | 73 | 182 |
| LaJunta (3) | 0 | 1,859 | | 5,318 | 5,318 | 0 | 1,115 | 2,789 |
| Bents Fort WA | 116 | 316 | | 432 | 432 | 0 | 190 | 474 |
| Otero County | 856 | 49 | | 905 | 905 | 0 | 29 | 74 |
| Las Animas (3) | 0 | 547 | | 1,368 | 1,368 | 0 | 328 | 821 |
| Bent County | 141 | 61 | | 202 | 202 | 0 | 37 | 92 |
| Lamar (4) | 1,100 | 2,100 | | 3,200 | 2,687 | 513 | 1,260 | 3,150 |
| May Valley WA | 686 | 0 | | 686 | 664 | 22 | 0 | 0 |
| Prowers and Kiowa Counties | 525 | 242 | | 767 | 767 | 0 | 145 | 363 |
| Subtotal | 9,070 | 8,742 | 901 | 22,092 | 21,241 | 851 | 5,245 | 13,113 |
| | | | | | | | | |
| Total | 242,848 | 32,044 | 8,941 | 279,172 | 335,014 | | 19,226 | 48,066 |
| | | | | | **Deficit** | **(81,759)** | | |

(1) Based on needs for additional water with assumed use of Fry-Ark water to minimize deficits up to the allocation limitations for Entities west of Pueblo (3,200 af), Pueblo (8,040 af), FVA (20,100 af), and Entities East of Pueblo (9,643 af).

(2) Assumes that reuse of Fry-Ark Project ranges from 0.6 to 1.5 times the first use. Where used for augmentation of wells, reuse potential is shown as zero.

(3) Water supplied by alluvial wells to be fully augmented using Fry-Ark Project water.

(4) Water supplied by alluvial wells to be fully augmented using Ft. Bent Ditch and Fry-Ark Project water. Transit losses will reduce actual yield of Fry-Ark Project water depending on the time of year and river conditions.

### 6.1.2 Deficits in the M&I Sector--Base Demand Forecast

Tables 6.6 through 6.9 indicate potential water supply deficits among the municipal entities in the District under the base demand forecast. Overall, water demand for the municipal sector of the District is forecast to increase by 65 percent from 148,000 to 244,000 af by the year 2040. Because of the smaller increment of additional water demand, the water resources currently available to municipal entities appear to be able to meet increasing demands until late in the 40-year planning horizon. The tabulation, shown below is summarized from Tables 6.6 through 6.9 and indicates a potential deficit of 21,300 af by the year 2040.

| | Forecast Deficit (Acre-Feet) Base Forecast | | | | |
|---|---|---|---|---|---|
| **Region Year:** | **Current** | **2010** | **2020** | **2030** | **2040** |
| Entities West of Pueblo | 0 | 0 | 0 | 0 | 901 |
| Pueblo West | 0 | 0 | 0 | 0 | 0 |
| Pueblo | 0 | 0 | 0 | 0 | 0 |
| Fountain Valley | 0 | 503 | 5,541 | 7,954 | 20,421 |
| Entities East of Pueblo | 0 | 0 | 0 | 0 | 0 |
| Total (Base): | 0 | 503 | 5,541 | 7,954 | 21,322 |

As with the high forecast, a significant portion of the forecast deficit (20,400 af by the year 2040) is expected to occur in the FVA, where population growth is expected to be the greatest within the District over the next 40 years. Water supplies available to Pueblo, Pueblo West, and the entities East of Pueblo appear to be adequate to meet anticipated demands through the year 2030. Graphical depictions of water supply, demand, and potential deficits for the base forecast in the year 2040 are provided in Figures 6.5 through 6.8.

TABLE 6.6

## WATER SUPPLY VS. DEMAND
## YEAR 2010 BASE FORECAST

| Municipal Entity | Reported Non-Project Firm Yield | Fry-Ark Project Allocation [1] | Allocated But Available for Other Uses | Total Available Supply | Year 2010 Demand | Surplus/ (Deficit) | Range of Potential Fry-Ark Reuse [2] | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | Low | High |
| **Entities West of Pueblo** | | | | | | | | |
| Buena Vista | 2,809 | 29 | | 2,838 | 848 | 1,990 | 17 | 44 |
| Salida | 2,240 | 354 | | 2,594 | 2,594 | 0 | 212 | 531 |
| Chaffee County | 2,428 | 209 | | 2,637 | 2,637 | 0 | 125 | 314 |
| Canon City | 23,891 | 90 | | 23,981 | 7,123 | 16,858 | 54 | 135 |
| Park Center | 1,131 | 40 | | 1,171 | 919 | 252 | 24 | 60 |
| Florence | 4,835 | 9 | | 4,844 | 2,822 | 2,022 | 5 | 14 |
| Penrose | 1,000 | 0 | | 1,000 | 493 | 507 | 0 | 0 |
| Fremont County | 166 | 14 | | 180 | 180 | 0 | 8 | 21 |
| Subtotal | 38,500 | 745 | 0 | 39,245 | 17,616 | 21,629 | 447 | 1,118 |
| | | | | | | | | |
| **Pueblo West** | 13,656 | 0 | 0 | 13,656 | 5,053 | 8,603 | 0 | 0 |
| | | | | | | | | |
| **Pueblo Board of Water Works** | 74,032 | 0 | 8,040 | 74,032 | 30,647 | 43,385 | 0 | 0 |
| | | | | | | | | |
| **Fountain Valley Authority** | | | | | | | | |
| Colorado Springs Utilities | 97,000 | 5,051 | | 102,051 | 102,051 | 0 | 3,031 | 7,577 |
| Fountain | 3,300 | 1,600 | | 4,900 | 3,360 | 1,540 | 960 | 2,400 |
| Security | 3,336 | 1,646 | | 4,982 | 5,418 | **(436)** | 988 | 2,469 |
| Widefield | 2,975 | 1,500 | | 4,475 | 4,214 | 261 | 900 | 2,250 |
| Stratmoor Hills | 770 | 601 | | 1,371 | 1,400 | **(29)** | 361 | 902 |
| El Paso County | 209 | 0 | | 209 | 247 | **(38)** | 0 | 0 |
| Subtotal | 107,590 | 10,398 | 9,702 | 117,988 | 116,690 | 1,298 | 6,239 | 15,597 |
| | | | | | | | | |
| **Entities East of Pueblo** | | | | | | | | |
| St. Charles Mesa | 1,884 | 1,327 | | 3,211 | 3,211 | 0 | 796 | 1,991 |
| Pueblo County | 262 | 61 | | 323 | 323 | 0 | 37 | 92 |
| Crowley County | 644 | 777 | | 1,421 | 1,260 | 161 | 466 | 1,166 |
| Fowler | 471 | 0 | | 471 | 370 | 101 | 0 | 0 |
| Rocky Ford | 2,385 | 30 | | 2,415 | 1,762 | 653 | 18 | 45 |
| LaJunta [3] | 0 | 1,200 | | 3,426 | 3,426 | 0 | 720 | 1,800 |
| Bents Fort WA | 116 | 273 | | 389 | 389 | 0 | 164 | 410 |
| Otero County | 856 | 25 | | 881 | 812 | 69 | 15 | 38 |
| Las Animas [3] | 0 | 215 | | 998 | 998 | 0 | 129 | 323 |
| Bent County | 141 | 54 | | 195 | 195 | 0 | 32 | 81 |
| Lamar [4] | 1,100 | 2,100 | | 3,200 | 2,740 | 460 | 1,260 | 3,150 |
| May Valley WA | 686 | 0 | | 686 | 567 | 119 | 0 | 0 |
| Prowers and Kiowa Counties | 525 | 260 | | 785 | 785 | 0 | 156 | 390 |
| Subtotal | 9,070 | 6,322 | 3,321 | 18,401 | 16,838 | 1,563 | 3,793 | 9,483 |
| | | | | | | | | |
| Total | 242,848 | 17,465 | 21,063 | 263,322 | 186,844 | | 10,479 | 26,198 |
| | | | | | **Deficit** | **(503)** | | |

(1) Based on needs for additional water with assumed use of Fry-Ark water to minimize deficits up to the allocation limitations for Entities west of Pueblo (3,200 af), Pueblo (8,040 af), FVA (20,100 af), and Entities East of Pueblo (9,643 af).

(2) Assumes that reuse of Fry-Ark Project ranges from 0.6 to 1.5 times the first use. Where used for augmentation of wells, reuse potential is shown as zero.

(3) Water supplied by alluvial wells to be fully augmented using Fry-Ark Project water.

(4) Water supplied by alluvial wells to be fully augmented using Ft. Bent Ditch and Fry-Ark Project water. Transit losses will reduce actual yield of Fry-Ark Project water depending on the time of year and river conditions.

TABLE 6.7

## WATER SUPPLY VS. DEMAND
## YEAR 2020 BASE FORECAST

| Municipal Entity | Reported Non-Project Firm Yield | Fry-Ark Project Allocation (1) | Allocated But Available for Other Uses | Total Available Supply | Year 2020 Demand | Surplus/ (Deficit) | Range of Potential Fry-Ark Reuse (2) | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | Low | High |
| **Entities West of Pueblo** | | | | | | | | |
| Buena Vista | 2,809 | 29 | | 2,838 | 948 | 1,890 | 17 | 44 |
| Salida | 2,240 | 488 | | 2,728 | 2,728 | 0 | 293 | 732 |
| Chaffee County | 2,428 | 486 | | 2,914 | 2,914 | 0 | 292 | 729 |
| Canon City | 23,891 | 90 | | 23,981 | 8,967 | 15,014 | 54 | 135 |
| Park Center | 1,131 | 40 | | 1,171 | 1,004 | 167 | 24 | 60 |
| Florence | 4,835 | 9 | | 4,844 | 3,951 | 893 | 5 | 14 |
| Penrose | 1,000 | 0 | | 1,000 | 516 | 484 | 0 | 0 |
| Fremont County | 166 | 19 | | 185 | 185 | 0 | 11 | 29 |
| Subtotal | 38,500 | 1,161 | 0 | 39,661 | 21,213 | 18,448 | 697 | 1,742 |
| | | | | | | | | |
| **Pueblo West** | 13,656 | 0 | 0 | 13,656 | 7,451 | 6,205 | 0 | 0 |
| | | | | | | | | |
| **Pueblo Board of Water Works** | 74,032 | 0 | 8,040 | 74,032 | 33,610 | 40,422 | 0 | 0 |
| | | | | | | | | |
| **Fountain Valley Authority** | | | | | | | | |
| Colorado Springs Utilities | 97,000 | 14,353 | | 111,353 | 114,942 | **(3,589)** | 8,612 | 21,530 |
| Fountain | 3,300 | 2,000 | | 5,300 | 5,439 | **(139)** | 1,200 | 3,000 |
| Security | 3,336 | 1,646 | | 4,982 | 6,028 | **(1,046)** | 988 | 2,469 |
| Widefield | 2,975 | 1,500 | | 4,475 | 5,181 | **(706)** | 900 | 2,250 |
| Stratmoor Hills | 770 | 601 | | 1,371 | 1,371 | 0 | 361 | 902 |
| El Paso County | 209 | 0 | | 209 | 270 | **(61)** | 0 | 0 |
| Subtotal | 107,590 | 20,100 | 0 | 127,690 | 133,231 | **(5,541)** | 12,060 | 30,150 |
| | | | | | | | | |
| **Entities East of Pueblo** | | | | | | | | |
| St. Charles Mesa | 1,884 | 1,576 | | 3,460 | 3,460 | 0 | 946 | 2,364 |
| Pueblo County | 262 | 81 | | 343 | 343 | 0 | 49 | 122 |
| Crowley County | 644 | 777 | | 1,421 | 1,412 | 9 | 466 | 1,166 |
| Fowler | 471 | 0 | | 471 | 362 | 109 | 0 | 0 |
| Rocky Ford | 2,385 | 30 | | 2,415 | 2,023 | 392 | 18 | 45 |
| LaJunta (3) | 0 | 1,329 | | 3,798 | 3,798 | 0 | 797 | 1,994 |
| Bents Fort WA | 116 | 273 | | 389 | 381 | 8 | 164 | 410 |
| Otero County | 856 | 25 | | 881 | 844 | 37 | 15 | 38 |
| Las Animas (3) | 0 | 215 | | 1,128 | 1,128 | 0 | 129 | 323 |
| Bent County | 141 | 57 | | 198 | 198 | 0 | 34 | 86 |
| Lamar (4) | 1,100 | 2,100 | | 3,200 | 2,723 | 477 | 1,260 | 3,150 |
| May Valley WA | 686 | 0 | | 686 | 617 | 69 | 0 | 0 |
| Prowers and Kiowa Counties | 525 | 260 | | 785 | 779 | 6 | 156 | 390 |
| Subtotal | 9,070 | 6,723 | 2,920 | 19,175 | 18,068 | 1,107 | 4,034 | 10,085 |
| | | | | | | | | |
| Total | 242,848 | 27,984 | 10,960 | 274,214 | 213,573 | | 16,790 | 41,976 |
| | | | | | **Deficit** | **(5,541)** | | |

(1) Based on needs for additional water with assumed use of Fry-Ark water to minimize deficits up to the allocation limitations for Entities west of Pueblo (3,200 af), Pueblo (8,040 af), FVA (20,100 af), and Entities East of Pueblo (9,643 af).

(2) Assumes that reuse of Fry-Ark Project ranges from 0.6 to 1.5 times the first use. Where used for augmentation of wells, reuse potential is shown as zero.

(3) Water supplied by alluvial wells to be fully augmented using Fry-Ark Project water.

(4) Water supplied by alluvial wells to be fully augmented using Ft. Bent Ditch and Fry-Ark Project water. Transit losses will reduce actual yield of Fry-Ark Project water depending on the time of year and river conditions.

## TABLE 6.8

## WATER SUPPLY VS. DEMAND
## YEAR 2030 BASE FORECAST

| Municipal Entity | Reported Non-Project Firm Yield | Fry-Ark Project Allocation (1) | Allocated But Available for Other Uses | Total Available Supply | Year 2030 Demand | Surplus/ (Deficit) | Range of Potential Fry-Ark Reuse (2) | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | Low | High |
| Entities West of Pueblo | | | | | | | | |
| Buena Vista | 2,809 | 29 | | 2,838 | 1,043 | 1,795 | 17 | 44 |
| Salida | 2,240 | 1,342 | | 3,582 | 3,582 | 0 | 805 | 2,013 |
| Chaffee County | 2,428 | 777 | | 3,205 | 3,205 | 0 | 466 | 1,166 |
| Canon City | 23,891 | 90 | | 23,981 | 10,180 | 13,801 | 54 | 135 |
| Park Center | 1,131 | 40 | | 1,171 | 1,051 | 120 | 24 | 60 |
| Florence | 4,835 | 193 | | 5,028 | 5,028 | 0 | 116 | 290 |
| Penrose | 1,000 | 0 | | 1,000 | 541 | 459 | 0 | 0 |
| Fremont County | 166 | 17 | | 183 | 183 | 0 | 10 | 26 |
| Subtotal | 38,500 | 2,488 | 0 | 40,988 | 24,813 | 16,175 | 1,493 | 3,732 |
| | | | | | | | | |
| Pueblo West | 13,656 | 0 | 0 | 13,656 | 8,735 | 4,921 | 0 | 0 |
| | | | | | | | | |
| Pueblo Board of Water Works | 74,032 | 0 | 8,040 | 74,032 | 36,419 | 37,613 | 0 | 0 |
| | | | | | | | | |
| Fountain Valley Authority | | | | | | | | |
| Colorado Springs Utilities | 97,000 | 14,353 | | 111,353 | 114,030 | **(2,677)** | 8,612 | 21,530 |
| Fountain | 3,300 | 2,000 | | 5,300 | 7,401 | **(2,101)** | 1,200 | 3,000 |
| Security | 3,336 | 1,646 | | 4,982 | 5,900 | **(918)** | 988 | 2,469 |
| Widefield | 2,975 | 1,500 | | 4,475 | 6,608 | **(2,133)** | 900 | 2,250 |
| Stratmoor Hills | 770 | 601 | | 1,371 | 1,414 | **(43)** | 361 | 902 |
| El Paso County | 209 | 0 | | 209 | 291 | **(82)** | 0 | 0 |
| Subtotal | 107,590 | 20,100 | 0 | 127,690 | 135,644 | **(7,954)** | 12,060 | 30,150 |
| | | | | | | | | |
| Entities East of Pueblo | | | | | | | | |
| St. Charles Mesa | 1,884 | 1,811 | | 3,695 | 3,695 | 0 | 1,087 | 2,717 |
| Pueblo County | 262 | 99 | | 361 | 361 | 0 | 59 | 149 |
| Crowley County | 644 | 808 | | 1,452 | 1,452 | 0 | 485 | 1,212 |
| Fowler | 471 | 0 | | 471 | 376 | 95 | 0 | 0 |
| Rocky Ford | 2,385 | 30 | | 2,415 | 2,271 | 144 | 18 | 45 |
| LaJunta (3) | 0 | 1,379 | | 3,940 | 3,940 | 0 | 827 | 2,069 |
| Bents Fort WA | 116 | 273 | | 389 | 373 | 16 | 164 | 410 |
| Otero County | 856 | 25 | | 881 | 876 | 5 | 15 | 38 |
| Las Animas (3) | 0 | 215 | | 1,251 | 1,251 | 0 | 129 | 323 |
| Bent County | 141 | 59 | | 200 | 200 | 0 | 35 | 89 |
| Lamar (4) | 1,100 | 2,100 | | 3,200 | 2,706 | 494 | 1,260 | 3,150 |
| May Valley WA | 686 | 0 | | 686 | 640 | 46 | 0 | 0 |
| Prowers and Kiowa Counties | 525 | 260 | | 785 | 773 | 12 | 156 | 390 |
| Subtotal | 9,070 | 7,059 | 2,584 | 19,726 | 18,914 | 812 | 4,235 | 10,589 |
| | | | | | | | | |
| Total | 242,848 | 29,647 | 10,624 | 276,092 | 224,525 | | 17,788 | 44,471 |
| | | | | | Deficit | (7,954) | | |

(1) Based on needs for additional water with assumed use of Fry-Ark water to minimize deficits up to the allocation limitations for Entities west of Pueblo (3,200 af), Pueblo (8,040 af), FVA (20,100 af), and Entities East of Pueblo (9,643 af).

(2) Assumes that reuse of Fry-Ark Project ranges from 0.6 to 1.5 times the first use. Where used for augmentation of wells, reuse potential is shown as zero.

(3) Water supplied by alluvial wells to be fully augmented using Fry-Ark Project water.

(4) Water supplied by alluvial wells to be fully augmented using Ft. Bent Ditch and Fry-Ark Project water. Transit losses will reduce actual yield of Fry-Ark Project water depending on the time of year and river conditions.

TABLE 6.9

## WATER SUPPLY VS. WATER DEMAND
## YEAR 2040 BASE FORECAST

| **Municipal Entity** | **Reported Non-Project Firm Yield** | **Fry-Ark Project Allocation (1)** | **Allocated But Available for Other Uses** | **Total Available Supply** | **Year 2040 Demand** | Surplus/ (Deficit) | **Range of Potential Fry-Ark Reuse (2)** | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | Low | High |
| **Entities West of Pueblo** | | | | | | | | |
| Buena Vista | 2,809 | 29 | | 2,838 | 1,133 | 1,705 | 17 | 44 |
| Salida | 2,240 | 1,476 | | 3,716 | 3,891 | **(175)** | 886 | 2,214 |
| Chaffee County | 2,428 | 897 | | 3,325 | 3,481 | **(156)** | 538 | 1,346 |
| Canon City | 23,891 | 90 | | 23,981 | 11,557 | 12,424 | 54 | 135 |
| Park Center | 1,131 | 40 | | 1,171 | 1,090 | 81 | 24 | 60 |
| Florence | 4,835 | 651 | | 5,486 | 6,056 | **(570)** | 391 | 977 |
| Penrose | 1,000 | 0 | | 1,000 | 561 | 439 | 0 | 0 |
| Fremont County | 166 | 17 | | 183 | 183 | 0 | 10 | 26 |
| Subtotal | 38,500 | 3,200 | 0 | 41,700 | 27,952 | 13,748 | 1,920 | 4,800 |
| | | | | | | | | |
| **Pueblo West** | 13,656 | 0 | 0 | 13,656 | 8,545 | 5,111 | 0 | 0 |
| | | | | | | | | |
| **Pueblo Board of Water Works** | 74,032 | 0 | 8,040 | 74,032 | 39,075 | 34,957 | 0 | 0 |
| | | | | | | | | |
| **Fountain Valley Authority** | | | | | | | | |
| Colorado Springs Utilities | 97,000 | 14,353 | | 111,353 | 124,449 | **(13,096)** | 8,612 | 21,530 |
| Fountain | 3,300 | 2,000 | | 5,300 | 9,273 | **(3,973)** | 1,200 | 3,000 |
| Security | 3,336 | 1,646 | | 4,982 | 5,772 | **(790)** | 988 | 2,469 |
| Widefield | 2,975 | 1,500 | | 4,475 | 6,922 | **(2,447)** | 900 | 2,250 |
| Stratmoor Hills | 770 | 601 | | 1,371 | 1,383 | **(12)** | 361 | 902 |
| El Paso County | 209 | 0 | | 209 | 312 | **(103)** | 0 | 0 |
| Subtotal | 107,590 | 20,100 | 0 | 127,690 | 148,111 | **(20,421)** | 12,060 | 30,150 |
| | | | | | | | | |
| **Entities East of Pueblo** | | | | | | | | |
| St. Charles Mesa | 1,884 | 2,033 | | 3,917 | 3,917 | 0 | 1,220 | 3,050 |
| Pueblo County | 262 | 117 | | 379 | 379 | 0 | 70 | 176 |
| Crowley County | 644 | 906 | | 1,550 | 1,550 | 0 | 544 | 1,359 |
| Fowler | 471 | 0 | | 471 | 389 | 82 | 0 | 0 |
| Rocky Ford | 2,385 | 121 | | 2,506 | 2,506 | 0 | 73 | 182 |
| LaJunta (3) | 0 | 1,430 | | 4,086 | 4,086 | 0 | 858 | 2,145 |
| Bents Fort WA | 116 | 273 | | 389 | 365 | 24 | 164 | 410 |
| Otero County | 856 | 49 | | 905 | 905 | 0 | 29 | 74 |
| Las Animas (3) | 0 | 215 | | 1,368 | 1,368 | 0 | 129 | 323 |
| Bent County | 141 | 61 | | 202 | 202 | 0 | 37 | 92 |
| Lamar (4) | 1,100 | 2,100 | | 3,200 | 2,687 | 513 | 1,260 | 3,150 |
| May Valley WA | 686 | 0 | | 686 | 664 | 22 | 0 | 0 |
| Prowers and Kiowa Counties | 525 | 260 | | 785 | 767 | 18 | 156 | 390 |
| Subtotal | 9,070 | 7,565 | 2,078 | 20,444 | 19,785 | 659 | 4,539 | 11,348 |
| | | | | | | | | |
| Total | 242,848 | 30,865 | 10,118 | 277,522 | 243,468 | | 18,519 | 46,298 |
| | | | | | **Deficit** | **(21,322)** | | |

(1) Based on needs for additional water with assumed use of Fry-Ark water to minimize deficits up to the allocation limitations for Entities west of Pueblo (3,200 af), Pueblo (8,040 af), FVA (20,100 af), and Entities East of Pueblo (9,643 af).

(2) Assumes that reuse of Fry-Ark Project ranges from 0.6 to 1.5 times the first use. Where used for augmentation of wells, reuse potential is shown as zero.

(3) Water supplied by alluvial wells to be fully augmented using Fry-Ark Project water.

(4) Water supplied by alluvial wells to be fully augmented using Ft. Bent Ditch and Fry-Ark Project water. Transit losses will reduce actual yield of Fry-Ark Project water depending on the time of year and river conditions.

## 6.2 Fry-Ark Supplies for Municipal Use

Fry-Ark Project water will play a significant role in meeting long-range municipal water supply needs. However, the amount of Fry-Ark water dedicated over the long term to municipal use (51 percent of 80,400 af or approximately 41,000 af) will not be adequate, even with reallocation, to preclude water supply deficits under the high water forecast demand. Pueblo appears to have adequate non-Project supplies to meet its long-range needs. Therefore, the 8040 af of Project water allocated to Pueblo perhaps could be made available to other municipal users or it could continue to be available to agricultural entities. Similarly, the supply demand comparison for entities east of Pueblo indicates that the need for Fry-Ark water may not fully mature under the high forecast until after the year 2040. In 2040, under the high forecast, approximately 900 af of the 9,643 af allocated to entities east of Pueblo may be available for other users.

As shown in Figure 6.9A for the high forecast, demand will develop by the year 2040 for approximately 32,000 af of the 41,000 af of Fry-Ark Project water dedicated to municipal use. With changes in the Allocation Principles, the remaining municipal Fry-Ark water could be made available to municipal users in other District regions. If not reallocated, this water would continue to be available to agricultural users. By the year 2040, assuming no municipal reallocation, the amount of Fry-Ark water available to agricultural entities will decline from approximately 68,840 af (85 percent of the total Fry-Ark Project yield of 80,400 af) in the year 2000 to 48,400 af (60 percent) under the high forecast. Fry-Ark water allocated to Pueblo and entities east of Pueblo, for which demand does not develop in their regions, could perhaps be reallocated to meet municipal demands in other regions (FVA in particular) that will be occurring by the year 2000. If this occurs, agricultural use of Fry-Ark Project water could be reduced to an average of 39,420 af per year (49 percent of the average Fry-Ark Project yield of 80,400 af).

As shown on Figure 6.10A, under the base forecast, approximately the same amount of Project water would continue to be available for other uses in comparison to the high forecast based on an estimated Project yield of 80,400 af.

The forecast availability of municipal Fry-Ark Project water to agricultural entities also is depicted on Figures 6.9B and 6.10B, based on the historically available Fry-Ark Project supply. This supply is estimated to be 56,900 af for the 1981-98 period. This period was selected because all of the West Slope diversions for the Fry-Ark Project became operational in 1981. During 1981-90, 54,800 af was diverted from the West Slope. With transit losses of 10 percent, this volume is reduced to 49,300 af. Approximately 10,600 af of water is developed from the Project's East Slope water rights. Adding the West Slope and East Slope supplies and 5 percent for evaporation, the average historical Fry-Ark Project supply is estimated to be 56,900 af. Figure 6.98 indicates how this supply will be distributed over time for the high forecast and Figure 6.10B shows the same for the base forecast. The municipal water currently being used by agriculture will be reduced by 17,460 af under the high forecast, as well as the base forecast, when historical Fry-Ark supplies are considered.

One advantage of greater municipal use of Fry-Ark water is that municipal carryover storage will reduce, providing more storage for divertable West Slope and East Slope water under the Project's water rights. This situation should help to increase the Project yield much closer to the estimated yield of 80,400 af per year.

## 6.3 Distribution of Deficits in the Municipal Sector by Month

The monthly distribution of water demand by regions within the District is presented in Section 5 of this report. Water supply deficits for entities west of Pueblo and for the FVA entities are assumed to follow the demand patterns in the respective regions. As indicated on Figure 6.11 (West of Pueblo for the years 2030 and 2040) and Figure 6.12 (FVA for the years 2020, 2030, and 2040) monthly deficits under the forecast would be greatest in the April through September periods.

Figures 6.13 and 6.14 indicate the distribution of deficits in the year 2040 under the base forecast for the entities west of Pueblo and the FVA.

## 6.4 Agricultural Water Deficits

Transmountain imports of water from the Fry-Ark Project are critically important to both the M&I and agricultural water supply entities in the District. Without Fry-Ark Project water, many irrigators would not have late season irrigation water in many years or the ability to replace water diverted by well pumping. Many municipal entities rely extensively on Fry-Ark water, particularly those entities obtaining water from Pueblo Reservoir via the Fountain Valley Pipeline. The District has allocated on average 52,000 af per year during the 1985-96 period, ranging from a low of 13,250 af in 1987 to 111,250 af in 1989. During recent years, which have been above normal, in terms of runoff, the lack of available Project storage on the East Slope has precluded diversion of all the transmountain water to which the Project is entitled. The Project's East Slope water rights come into priority during higher flow years. The storage limitations can preclude fully exercizing these West Slope and East Slope supplies for use by the Project beneficiaries.

The amount of water currently available to agricultural water users will be impacted by the increased use of Fry-Ark Project water in the municipal sector. Changes in the operation of Fry-Ark facilities to provide for storage of non-Project water in Project storage space also may affect agricultural water users. Project Water is important to the agricultural sector because it is a supplemental supply that helps to assure successful crops with reliable, "late-season" supplies. As shown on Figure 6.9A under the high forecast, additional water now available for agricultural use, which is not being used in the municipal sector, is approximately 30,000 af. This amount of water will decline to about 9,000 af by 2040. With reallocation of Project water among municipal entities, this "additional" water currently available to agriculture could be further reduced.

The increased use of Fry-Ark water by municipal entities will facilitate more diversions of West Slope water under existing decrees that are currently being foregone. During the 28-year period of Fry-Ark Project operations, an estimated total of nearly 200,000 af of legally available water was not diverted to the East Slope, because storage space was not available. These "foregone" diversions occurred in 1986-88, 1996, and 1998 (total of 5 years) and ranged from 2,900 af (1998) to 55,100 af (1987). Over the 28-year period foregone diversions from the West Slope averaged 7,100 af per year. Additional storage on the East Slope would have enabled some of this water to have been diverted and put to beneficial use.

Figure 6.15 shows the average monthly stream depletions for 1986-95 caused by irrigation wells located within the District and downstream of Pueblo Reservoir. The depletions were calculated using the State's ground water accounting model, average monthly well pumpage for wells within each of the 16 user groups, and a weighted well head depletion rate for each user group. Allowances for pre-compact pumping and for pumping as alternate points of diversion for senior surface water rights were not deducted from the pumping volumes because these allowances are small or are not dependable. The stream depletions averaged 31,154 af annually, and monthly ranged from 1,592 af in March to 3,788 af in September. Figure 6.15 also shows the monthly return flows of project water used for irrigation. SECWCD sells these return flows to well associations for replacement of depletions caused by irrigation well pumpage. The return flows were estimated based on: 1) an annual allocation of 49% of the project water supply to irrigation, 2) the reported irrigated acreage of each canal company which historically purchased project water, 3) the historical monthly distribution pattern, 4) 40 percent of the delivered water becoming deep percolation, and 5) timing of the return flows calculated by the State's ground water accounting model. Figure 6.15 is based on the historical allocations in 1986 through 1995 resulting in return flows totaling 9,790 af annually. The monthly volumes ranged from 791 af in March to 2,658 af in August. The shortfall between depletions and project return flows total 21,360 af annually.

The return flows also were estimated using an annual allocation to irrigation of 40,000 af which results in return flows averaging 14,400 af annually. This scenario results in a shortfall of 16,750 af annually, which is depicted on Figure 6.16. The 40,000 af volume is 49 percent of the total Fry-Ark Project allocation of 80,400 af.

Another source of water currently available to agricultural users is the purchase of water from municipal entities who currently are not using all of their transmountain water. As municipal demands for water increase, this source may be significantly reduced. This supply is estimated to be approximately 22,440 af.

In summary, the potential agricultural water supply deficits that may develop during the planning horizon include:

| Component | Acre Feet |
|---|---|
| Reduced availability of Fry-Ark Project Water [1] | 20,000 |
| Additional replacement water to offset well pumping [2] | 17,000 |
| Reduced availability of water currently purchased from municipal entities [3] | 22,000 |
| **Total** | 59,000 |

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Note: Amounts are rounded.

[1] For the high M&I water demand forecast assuming average annual yield of 80,400 acre-feet. This is water that currently could be used by agricultural entities, which will be allocated to municipal entities as their demands on the Project increase.

[2] For average annual yield of 80,400 acre-feet from Fry-Ark Project with 49 percent allocated to agriculture. See Figure 6.15.

[3] See Table 5.7, "Other Transmountain Water."

The need for additional agricultural water supplies will begin to materialize in the 2010-2015 time frame. This "pressure" on agricultural water supply means that it is vitally important to provide dedicated Project storage for the Winter Water Storage Program. Municipal Fry-Ark return flows may be available to help offset well depletions; however, municipal entities do have the right to repurchase these return flows. Therefore, these return flows cannot be counted on for as a source of replacement water for well depletions. Storage is likely to be needed to regulate water used to offset well pumping depletions. This amount of storage is estimated to be 26,000 af, based on an approximate storage-to-water supply factor of 1.5.

## 6.5 Need for Additional Water Storage

The primary future water need for District entities is additional water storage capacity. Additional storage would provide the following benefits:

- Additional water could be diverted from the West Slope under existing water rights. Currently, diversions must be curtailed when existing storage space is full.

- Existing water rights owned by entities in the District could be maximized. For example, additional 45,000 af of storage in the Arkansas Basin would provide Colorado Springs with a major portion of the firm yield needed to meet its long-range water needs using its existing water rights. Without this option, Colorado Springs would need to find other ways to use its existing water rights.

- Strategically placed additional storage could provide enhanced abilities to effect exchanges between water providers, thereby increasing overall system efficiency.

- The Winter Water Storage Program is an integral part of the Fry-Ark Project. The concept of storing water during the winter months, rather than applying it to the land to build up soil moisture, as was practiced before the Project was implemented, was envisioned in original development and authorization of the Project. Dedicated storage space in the Project for the Winter Water Storage Program is needed to avoid the relatively frequent spilling of winter water under current operations. Direct flow participants in the Winter Water Storage Program have identified a need for 40,000 af of dedicated storage space in the Project. Section 7 of this report describes modeling work performed by the USBR in 1990 to assess the benefits and impacts on Project operations of dedicating 40,000 af of storage to the Winter Water Storage Program.

- Additional storage also may play an important role in meeting Colorado's obligations resulting from conclusion of the Kansas versus Colorado litigation over the Arkansas River Compact. For example, storage of transmountain and consumable return flows to provide replacement water to well pumping could provide significant benefits to the region at least over the short term.

### 6.5.1 Initial Storage Needs Identified by District Entities

A precise determination of the amount of storage needed would involve complex study of at least the major water supply systems in the region to a level of detail similar to that undertaken by Colorado Springs and documented in a recent report (Gronning, 1995). While such a study is beyond the scope of the Assessment Project, we have approached the evaluation of storage need in a two-step process. Initially, we obtained inputs from District entities relative to storage need. During the course of the data collection, the consultant team did obtain input from various water supply entities relative to individual storage needs within the Arkansas Basin. These reported storage needs are summarized below:

| | **Storage (Acre-Feet)** |
|---|---|
| Colorado Springs Utilities | 45,000 |
| Pueblo Board of Water Works | 10,000 - 20,000 |
| Public Service Company of Colorado | 5,000 |
| Pueblo West | 5,500 |
| St. Charles Mesa(1) | 3,600 |
| Florence | 2,300 |
| Winter Water Storage | 40,000 |
| **Total** | **111,400-121,400** |

(1) Reduced by amount of Fry-Ark water made available.

As described in Section 7, the USBR held meetings with prospective users of East Slope Project storage and long-term storage service contracts totaling 131,500 to 141,500 af were requested, including 59,500 af of "if and when" storage. These requests tend to support the storage needs provided more recently.

Generally, storage is desired by water supply entities in the upper Basin. Water held higher in storage provides greater delivery flexibility, and less evaporation losses. However, additional storage in the "middle" portion of the Basin, for example at Pueblo Reservoir or Lake Meredith, also would be advantageous for certain entities. Colorado Springs, for example, has identified a need for 10,000 af of storage in the upper Basin. This storage should be located upstream of Clear Creek to maintain exchange potential and to facilitate expansion of the Otero Delivery System. Therefore, Twin Lakes or Turquoise Reservoir would be suitable locations. Similarly, Pueblo has identified a need for 10,000 af of storage in the upper Basin. An enlargement of Clear Creek Reservoir, or a new dam and reservoir on Tennessee Creek, have been identified as potential storage options.

Pueblo has, since 1967, requested the USBR to provide storage in Fry-Ark Project facilities for non-Project water. In 1981, Pueblo requested 20,000 af of storage space in Pueblo Reservoir; however, no action was taken by the USBR. Colorado Springs would benefit by having dedicated storage of at least 35,000 af in Pueblo Reservoir. An enlargement of Lake Meredith could meet this lower Basin storage need.

PSCo shares in the Las Animas Consolidated Canal Company, Consolidated Extension Canal Company, and the Twin Lakes Reservoir and Canal Company. Storage will be eventually needed to provide adequate water supplies for the Comanche Generating Station. Storage of up to 5,000 af is required for leased water, as well as to facilitate exchanges.

### 6.5.2 Rationale for Determination of Storage Need for District Entities

While the storage needs identified individually by District entities provide one basis for project definition, a more rigorous assessment is required to provide justification for a future storage project.

Needs for additional water in the municipal sector will occur primarily in the Fountain Valley area, with 85 percent of the year 2040 water need occurring in the Colorado Springs water service area. Based on review of Colorado Springs' water supply planning documents, they require additional storage capacity to maximize the yield from their existing developed and conditional water rights. Storage of 45,000 af of non-Project water in Project storage space has been proposed as a critical element of Colorado Springs' long-term water supply strategy. This action, coupled with "local" projects will alleviate projected water supply deficits through the year 2040.

As described in Section 7, active storage space in Project reservoirs is approximately 305,000 af, of which 159,000 af are allocated to carry-over storage for the Fountain Valley Authority entities (78,000 af), Arkansas Valley towns east of Pueblo (37,400 af), Pueblo (51,200 af), and Arkansas Valley towns west of Pueblo (12,400 af). The Project can divert a maximum of 120,000 af from the West Slope in any year, subject to the Project's Operating Principles. If Project storage space is dedicated in the Project reservoirs to meet other needs, the amount of "foregone" West Slope diversions is likely to increase. This may be offset in part by the increasing use of Fry-Ark water by the M&I sector over the next 10 to 15 years as the M&I sector moves toward its full 51 percent allocation of Project water.

According to the Colorado Springs long-range water plan, future water needs will be met by a combination of non-potable development, conservation, improvements to the existing system, and a major new delivery system. Roughly 70 to 75 percent of future water needs will be met by a major new delivery system. Currently, the "Southern Project" is the City's preferred option. This project will withdraw water from Pueblo Reservoir and deliver it to the City via a new pipeline parallel to the Fountain Valley Aqueduct. As shown in Table 6.5, the total deficit forecast under the high growth scenario for Colorado Springs in the year 2040 is 72,400 af. Assuming 70 percent of this identified need is met by the Southern Project, the delivery requirement would be approximately 50,000 af. As described in Section 7, Colorado Springs has requested storage of 45,000 af in the Project for its non-Project water. Under the base forecast, the year 2040 deficit for Colorado Springs is estimated to be 13,000 af (see Table 6.9). Therefore, the need for storage in Project facilities may be smaller under the base forecast. However, Colorado Springs has indicated that its plans for expansion of the Otero Pumping Station and for the Southern Supply Project will require that the full storage request (45,000 af) be available in order to justify major investments in pipeline construction.

The other FVA entities have estimated deficits totaling approximately 7,300 af by the year 2040 under the high forecast and the base forecast. These entities will need additional sources of supply. The FVA entities have indicated their desire to participate on a regional basis with Colorado Springs in a second Fountain Valley Aqueduct and in having storage dedicated in the Project to meet their needs. Assuming that these entities would acquire surface water rights in the District and use Project storage to regulate their supplies, storage of approximately 22,000 af may be needed under the high forecast. Deficits and potential need for storage under the base forecast are similar to the high forecast. (This is based on a storage/yield ratio of 3 to 1, typical for relatively senior agricultural rights converted and stored for M&I use. Similarly, year 2040 deficits under the high forecast for the entities West of Pueblo total approximately 2,100 af. Storage of 5,000 to 6,000 af is likely to be needed to meet these future demands under the high forecast. For the entities west of Pueblo, the base forecast deficits are similar in magnitude to the high forecast.

Participants in the Winter Water Storage Program have identified a need for 40,000 af of dedicated space in the Project to reduce the incidence of spills of Winter Water. As described in Section 7 and based on the Bureau's modeling of the 1966-85 period, 40,000 af of space for Winter Water would reduce potential spills by over 113,000 af during a 20-year period. (This is based on municipal demand of 21,000 af/yr and municipal storage of 81,500 af.) At higher municipal demand and storage levels (28,000 to 41,000 af/yr and 159,000 af), the 40,000 af of dedicated storage for Winter Water will maintain total winter spills in the range of 90,000 to 120,000 af over the 20-year Bureau model period. (Spills would occur on average in 6 to 8 of the 20 years.) Therefore, the need for dedicated storage for Winter Water is evident.

Estimated storage needs are summarized below:

| **Entity** | **Required Storage (af)** | |
|---|---|---|
| | High Forecast | Base Forecast |
| Studied Needs | | |
| Colorado Springs Utilities | 45,000 | 21,000 |
| Other FVA entities | 22,000 | 22,000 |
| Entities West of Pueblo | 3,700 | 5,000 |
| Florence | 2,300 | 0 |
| Winter Water Program | 40,000 | 40,000 |
| Storage to Regulate Replacement Water for Well Pumping | 26,000 | 26,000 |
| Subtotal | 139,000 | 114,000 |

| Entity | Required Storage (af) | |
|---|---|---|
| Other Reported Needs | | |
| Pueblo Water Works | 20,000 | 20,000 |
| Public Service Company | 5,000 | 5,000 |
| Pueblo West MD | 5,500 | 5,500 |
| St. Charles Mesa | 3,600 | 3,600 |
| Subtotal | 34,100 | 34,100 |
| Total | 173,100 | 148,100 |

---

Note: Subtotal (A) is the storage need documented during the Assessment Project studies. Subtotal (B) is the storage need studied by entities participating in the Assessment Project.

Planning for water development to meet District needs should be tentatively based on storage needs for the high forecast, i.e., 173,000 af. As described in Section 8, it is unlikely that a single storage project could provide the entire storage volume. If two (or more) storage projects are implemented, they could be staged, perhaps with the initial project targeted to meet storage requirements under the base forecast. This approach would avoid "overbuilding" in the event that the high forecast does not materialize as currently planned.

Based on inputs gained during the course of undertaking the Assessment Project, we believe that other entities may be interested in participating in a storage project. One of these entities is the City of Aurora, which has water interests within the Arkansas Basin but is not within the District. Aurora is considering development of approximately 10,000 af of storage in the Arkansas Basin to help manage its existing water resources. Another potential partner in a storage project is the State of Colorado. Interest by the State of Colorado will be dependent on the results of ongoing studies relative to the Kansas versus Colorado settlement.

Given these considerations, total storage requirements could be greater than 173,000 af, perhaps up to 200,000 af, or more.

## SUPPLY - DEMAND COMPARISON
## ENTITIES WEST OF PUEBLO
## YEAR 2040 - HIGH FORECAST

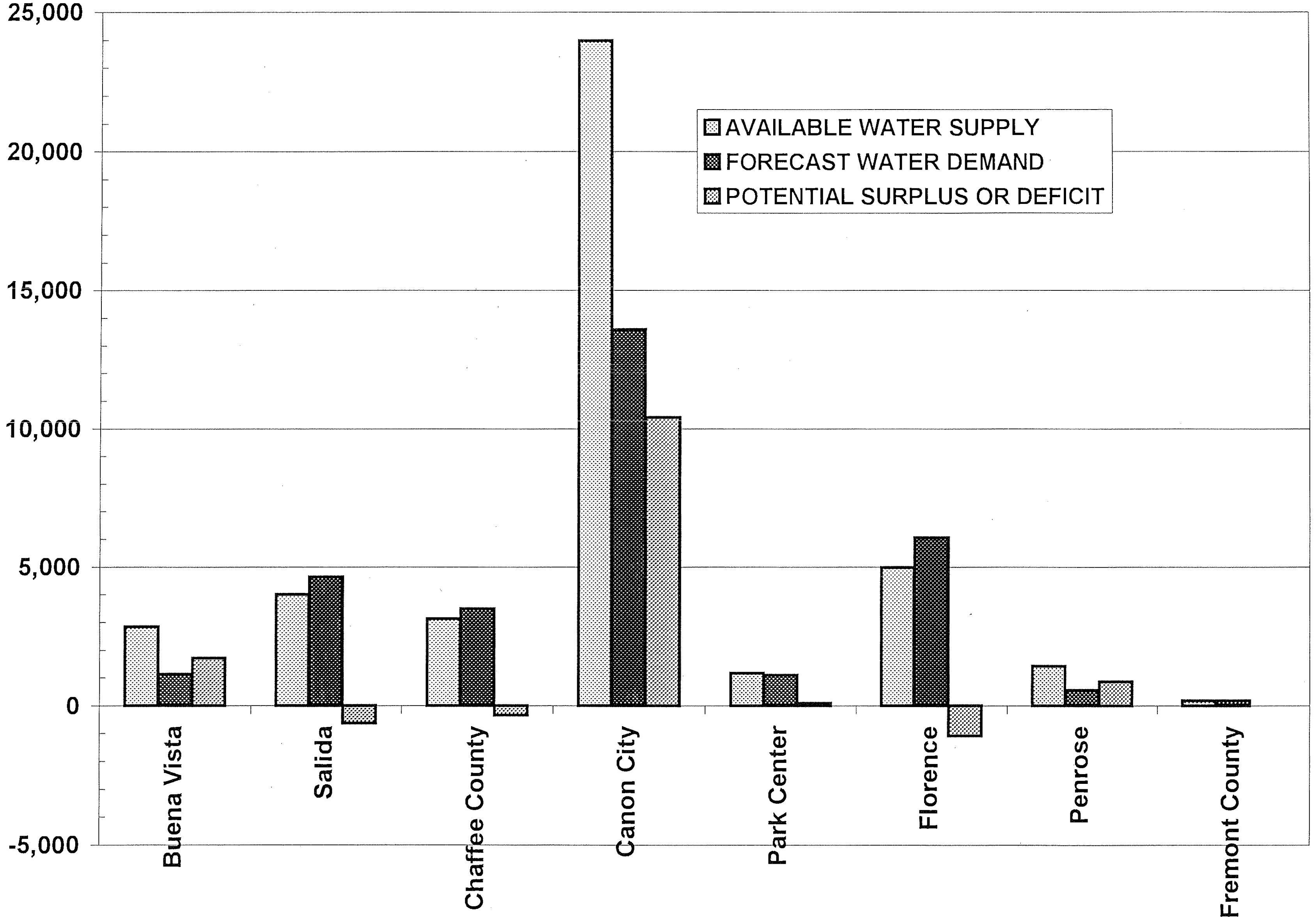

**FIGURE 6.1**

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svd_final_high.xls/YEAR 2040 - WEST OF PUEBLO

SUPPLY - DEMAND COMPARISON
PUEBLO WEST AND PUEBLO
YEAR 2040 - HIGH FORECAST

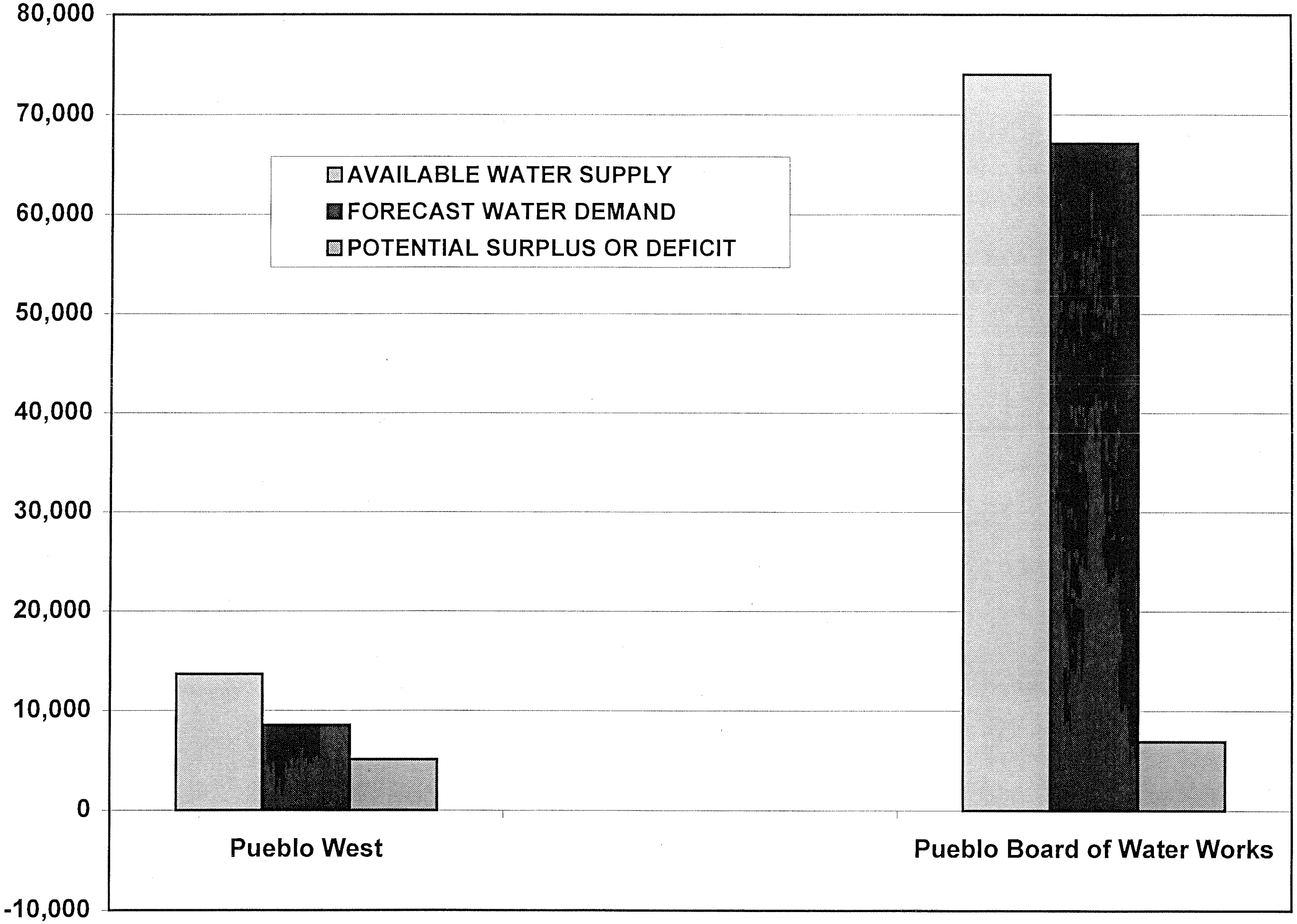

**FIGURE 6.2**

GEI CONSULTANTS, INC.
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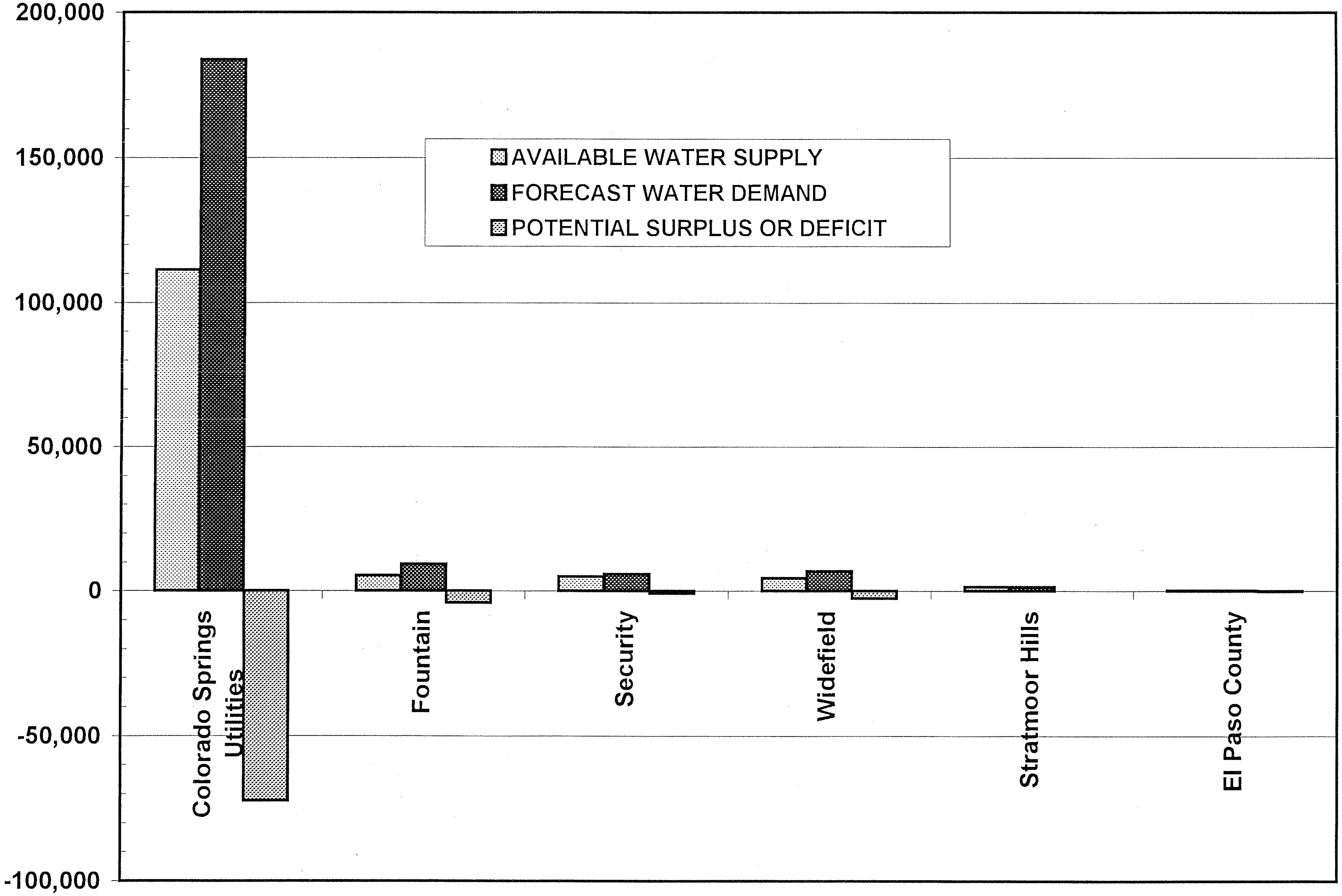
svd_final_high.xls/PUEBLO WEST AND PUEBLO

SUPPLY - DEMAND COMPARISON
FVA ENTITIES
YEAR 2040 - HIGH FORECAST



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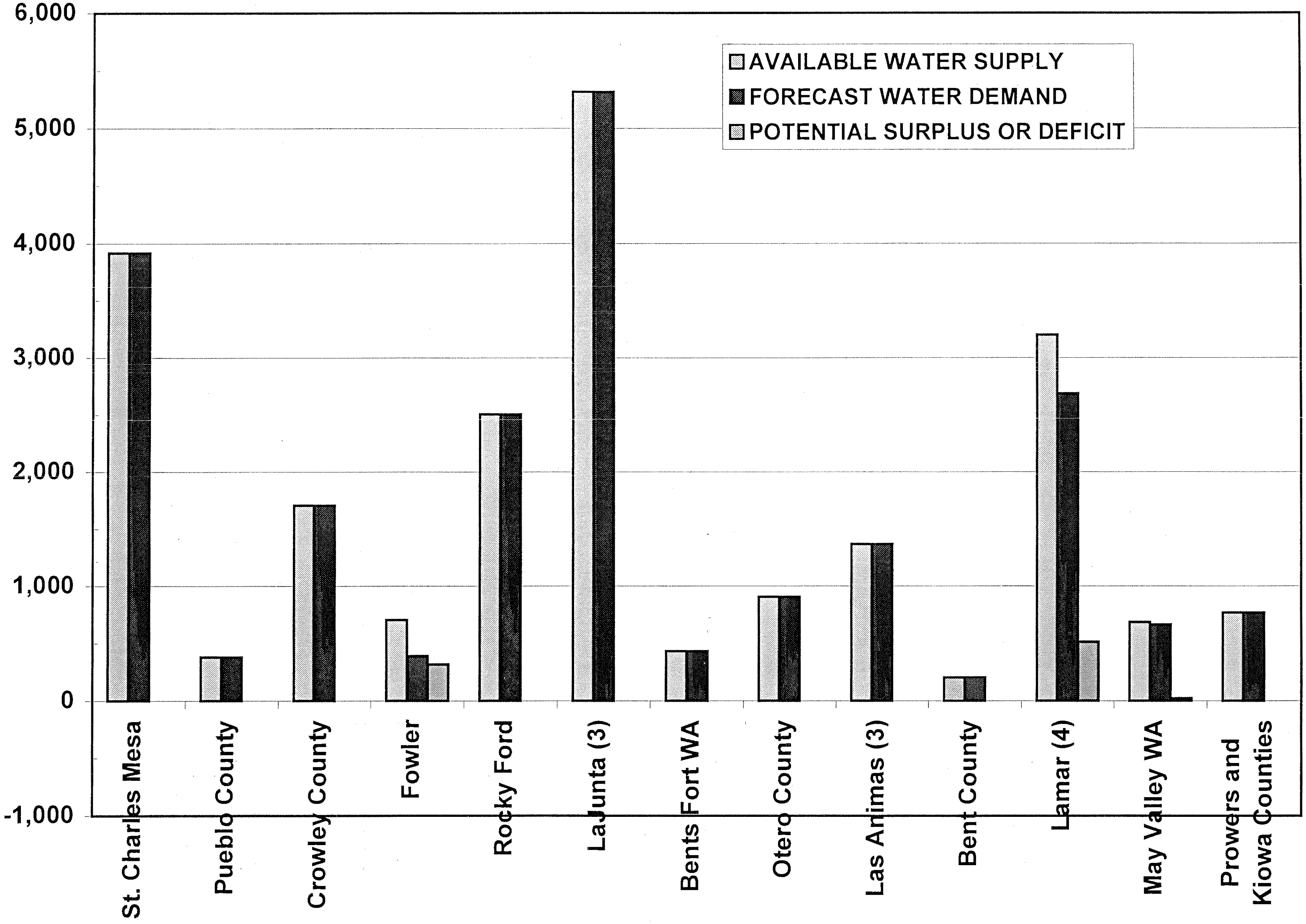
12/8/98

svd_final_high.xls/YEAR 2020 - FVA

**FIGURE 6.3**

SUPPLY - DEMAND COMPARISON
ENTITIES EAST OF PUEBLO
YEAR 2040 - HIGH FORECAST



GEI CONSULTANTS, INC.
12/8/98

svd_final_high.xls/YEAR 2040 - EAST OF PUEBLO

FIGURE 6.4

## SUPPLY - DEMAND COMPARISON
ENTITIES WEST OF PUEBLO
YEAR 2040 - BASE FORECAST

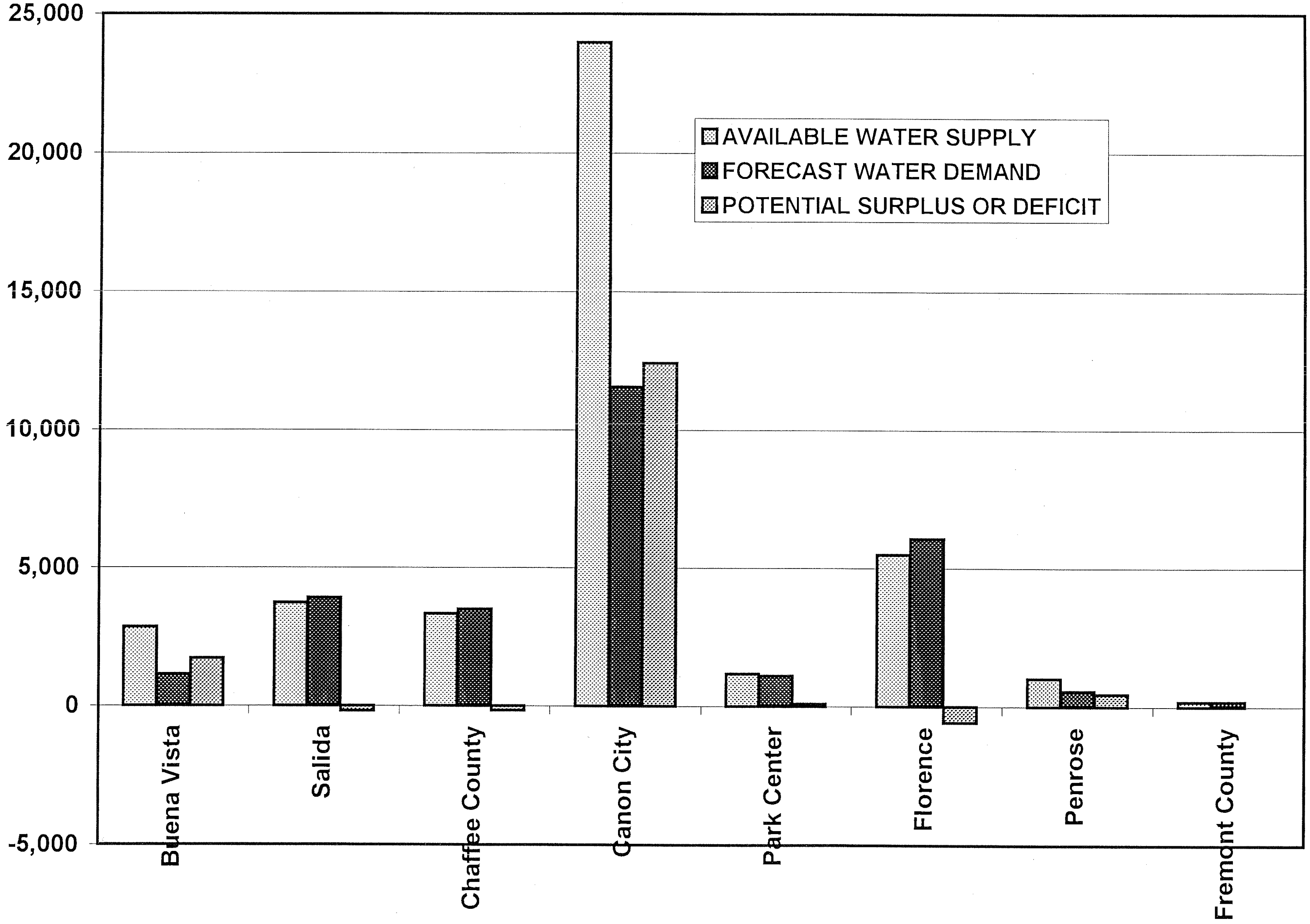


**FIGURE 6.5**

GEI CONSULTANTS, INC.
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svd_basefin_rpt.XLS/YEAR 2040 - WEST OF PUEBLO

SUPPLY - DEMAND COMPARISON
PUEBLO WEST AND PUEBLO
YEAR 2040 - BASE FORECAST

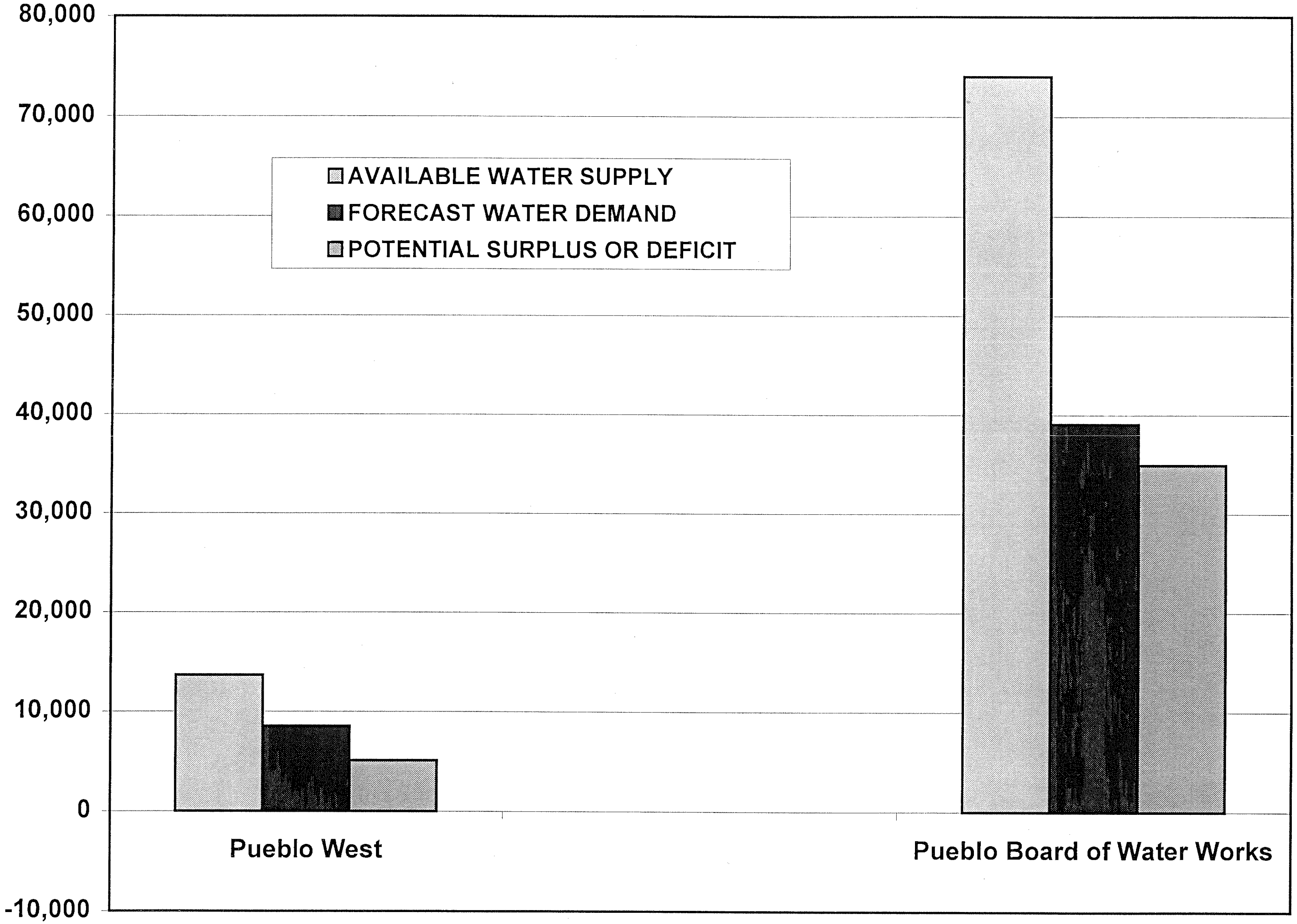

**FIGURE 6.6**

GEI CONSULTANTS, INC.
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svd_basefin_rpt.XLS/PUEBLO WEST AND PUEBLO

SUPPLY - DEMAND COMPARISON
FVA ENTITIES
YEAR 2040 - BASE FORECAST

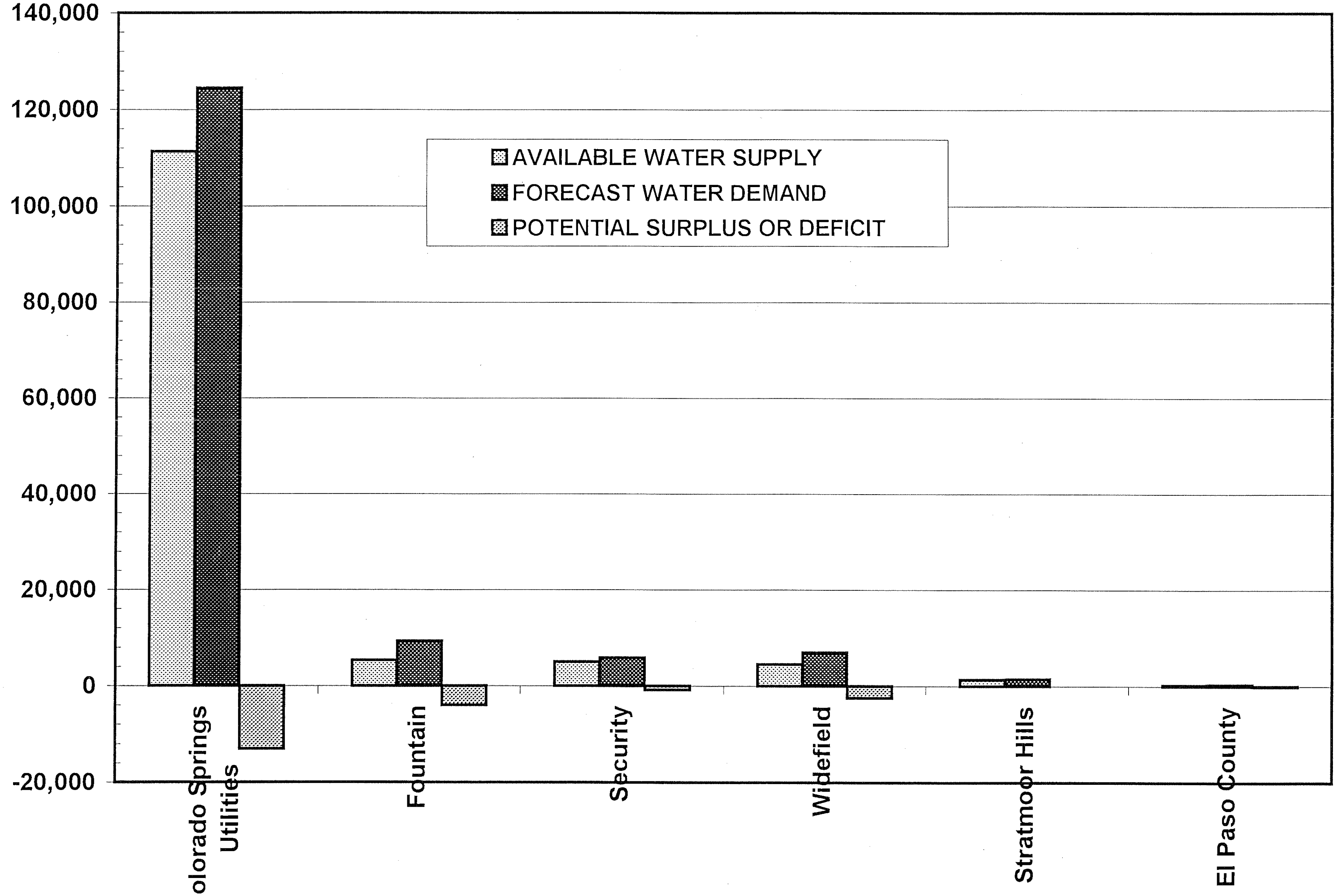

FIGURE 6.7

GEI CONSULTANTS, INC.
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svd_basefin_rpt.XLS/YEAR 2020 - FVA

## SUPPLY - DEMAND COMPARISON
## ENTITIES EAST OF PUEBLO
## YEAR 2040 - BASE FORECAST

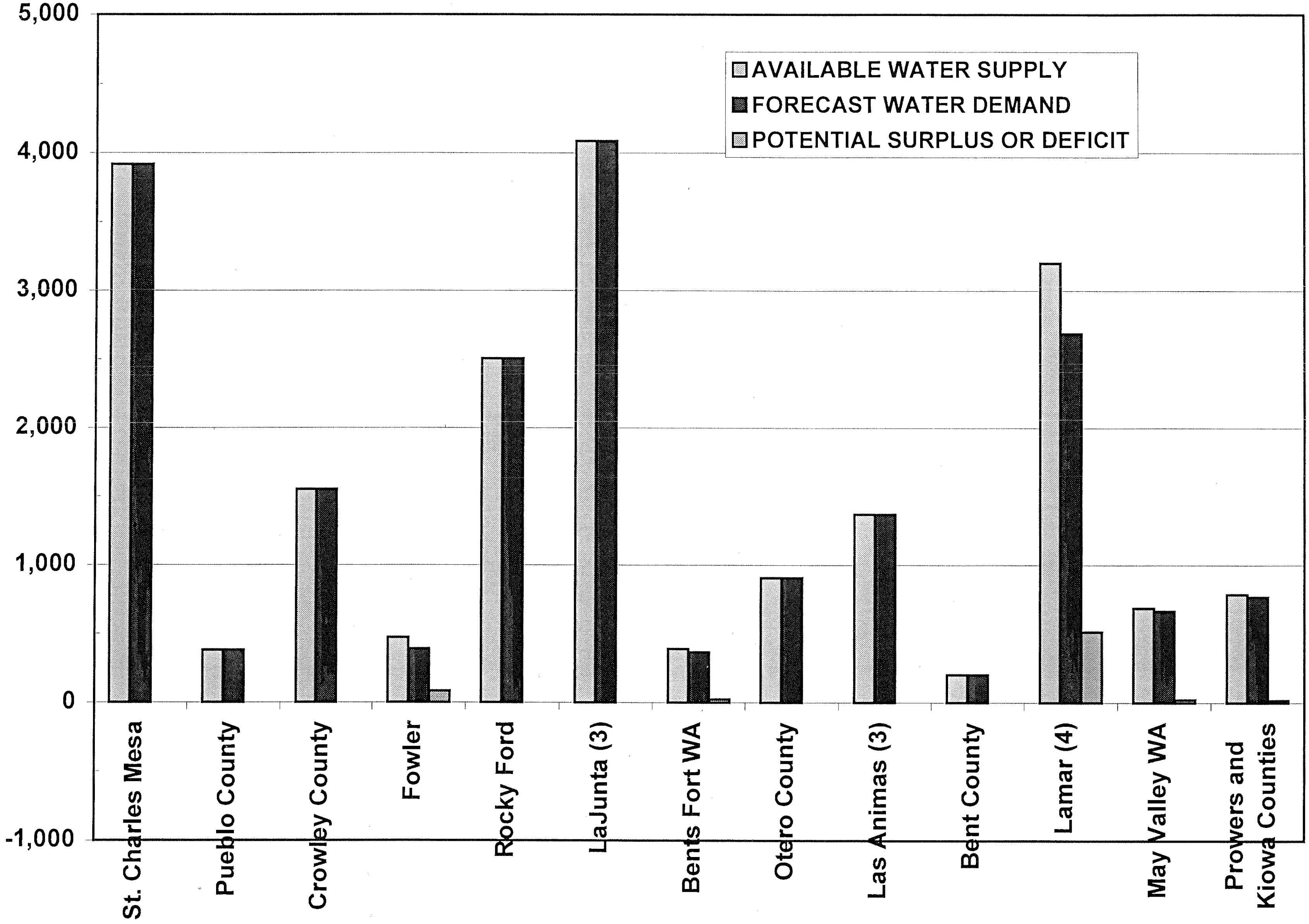

**FIGURE 6.8**

GEI CONSULTANTS, INC.
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svd_basefin_rpt.XLS/YEAR 2040 - EAST OF PUEBLO

## FUTURE USE OF FRY-ARK PROJECT WATER
(HIGH FORECAST WITH CONSERVATION)

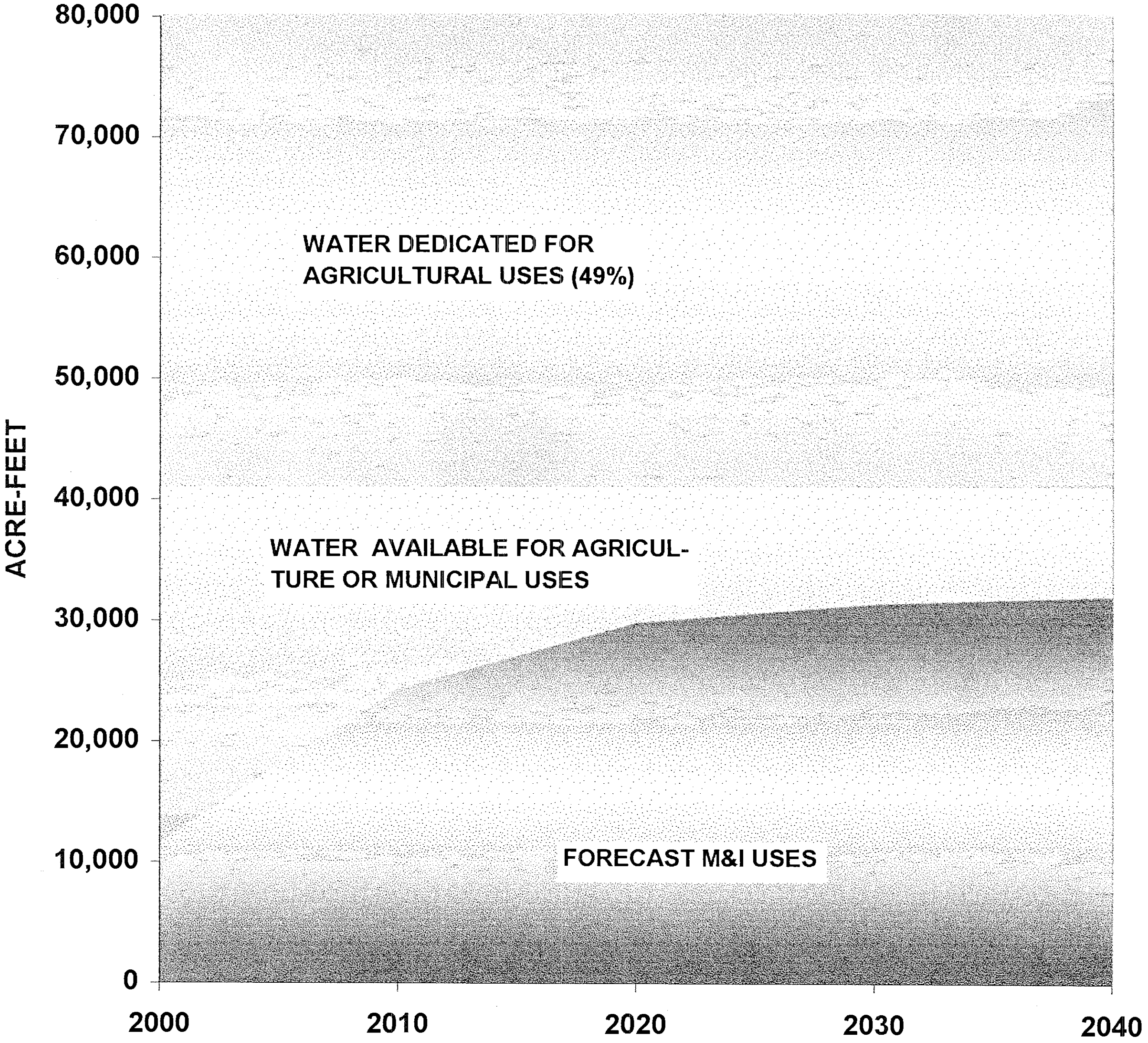

**FIGURE 6.9A**
**FORECAST FRY-ARK WATER USE - BASED ON ESTIMATED ANNUAL YIELD**

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svd_final_high.xls/
FRY-ARK USE - 80,400 af

## FUTURE USE OF FRY-ARK PROJECT WATER
(HIGH FORECAST WITH CONSERVATION)

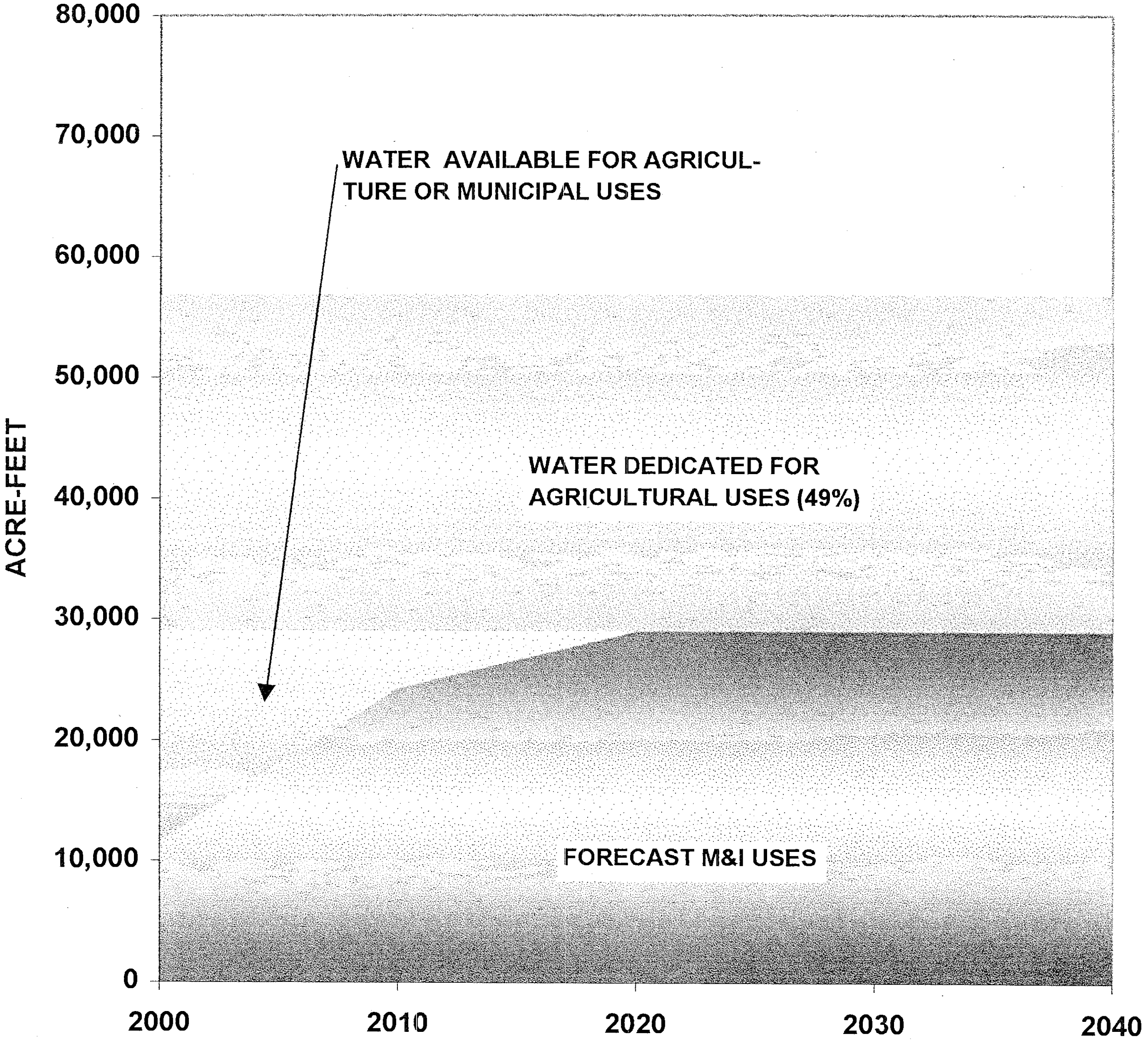

**FIGURE 6.9B**

**FORECAST FRY-ARK WATER USE - BASED ON HISTORICAL SUPPLY**

GEI CONSULTANTS, INC
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svd_final_high.xls/
FRY-ARK USE - 56,900 af

# FUTURE USE OF FRY-ARK PROJECT WATER
## (BASE FORECAST WITH CONSERVATION)

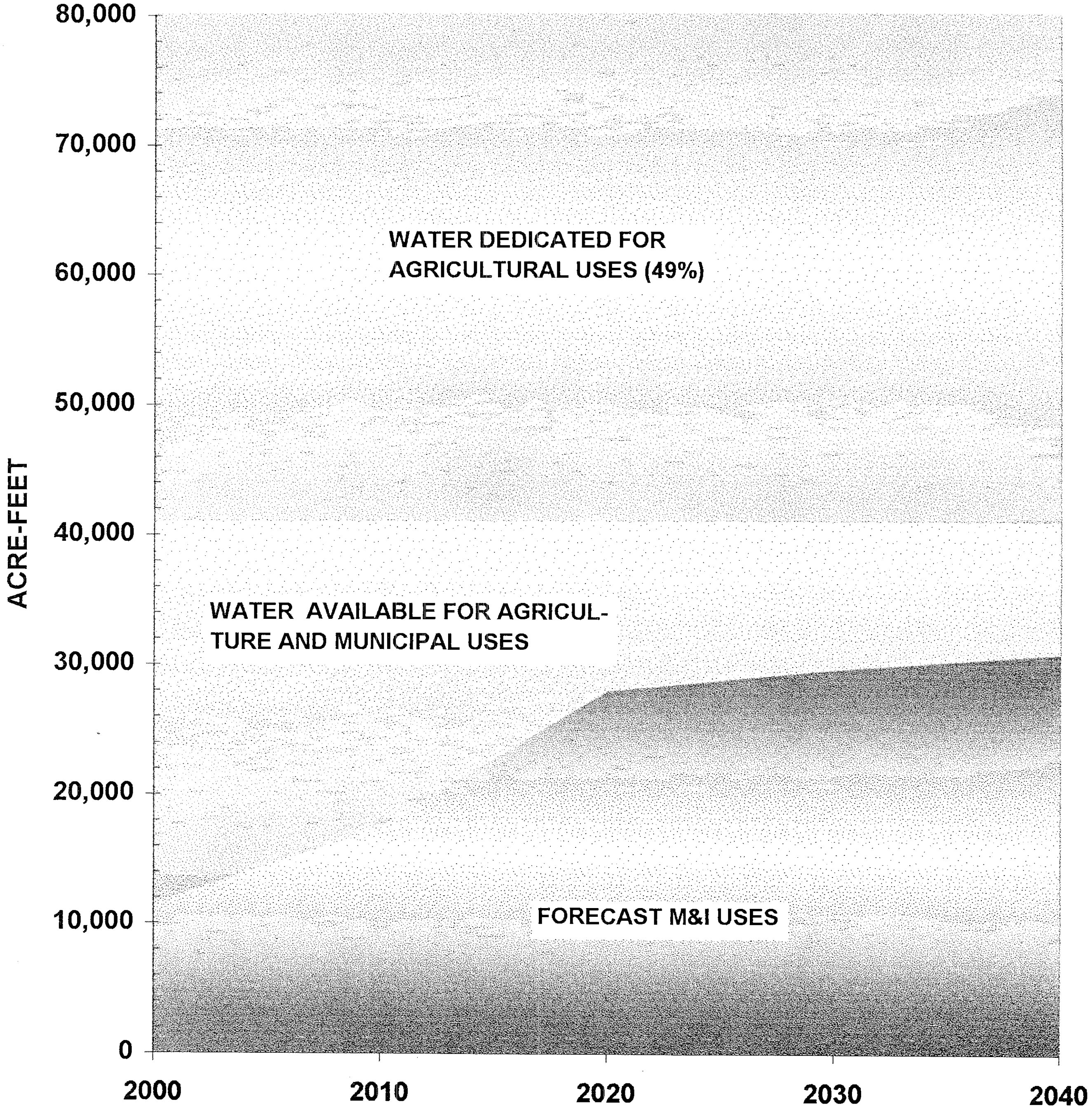

**FIGURE 6.10A**
**FORECAST FRY-ARK WATER USE**

GEI CONSULTANTS, INC
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svd_basefin_rpt.XLS/
FRY-ARK USE - 80,400 af

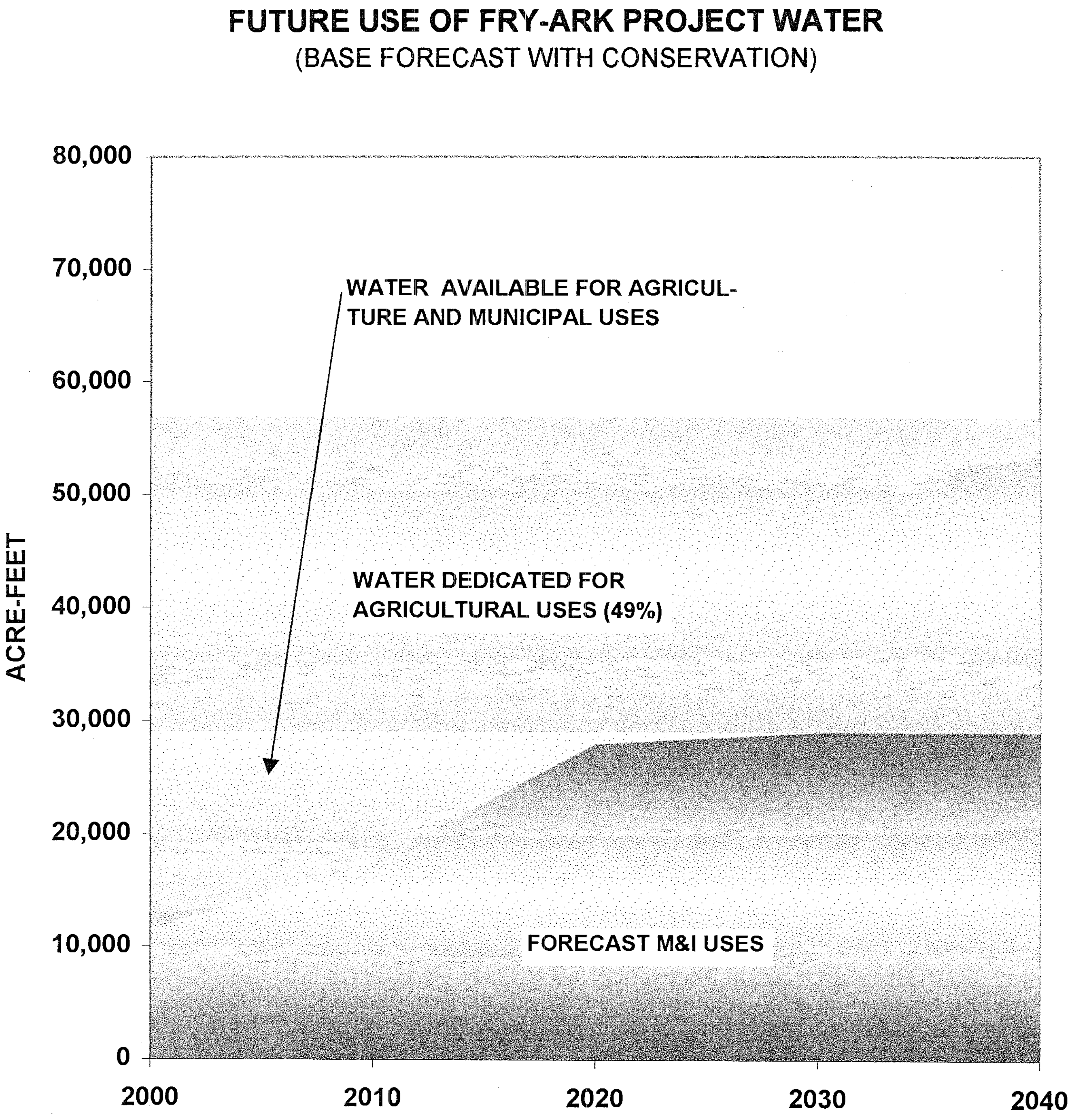
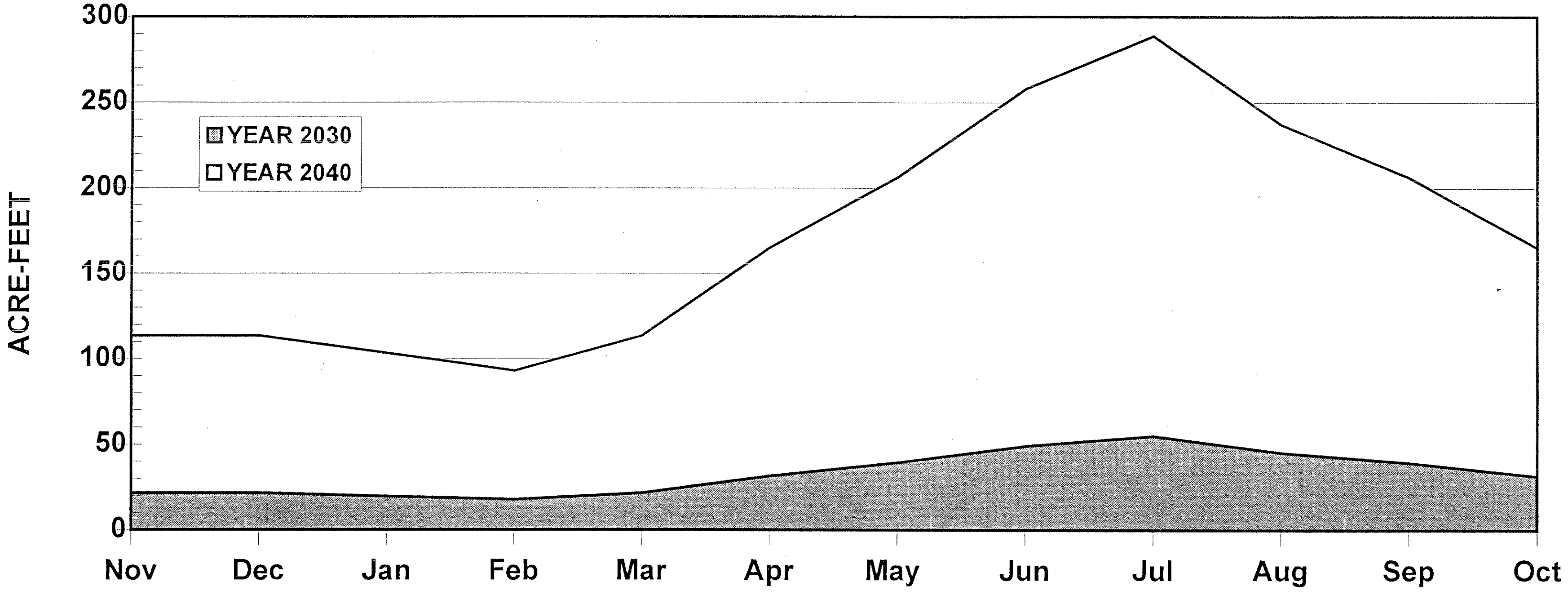


**FIGURE 6.10B**
**FORECAST FRY-ARK WATER USE - BASED ON HISTORICAL SUPPLY**

GEI CONSULTANTS, INC
12/8/98

svd_basefin_rpt.XLS/
FRY-ARK USE - 56,900 af

## MONTHLY WATER SUPPLY DEFICITS
## ENTITIES WEST OF PUEBLO
(HIGH FORECAST)



GEI CONSULTANTS, INC.
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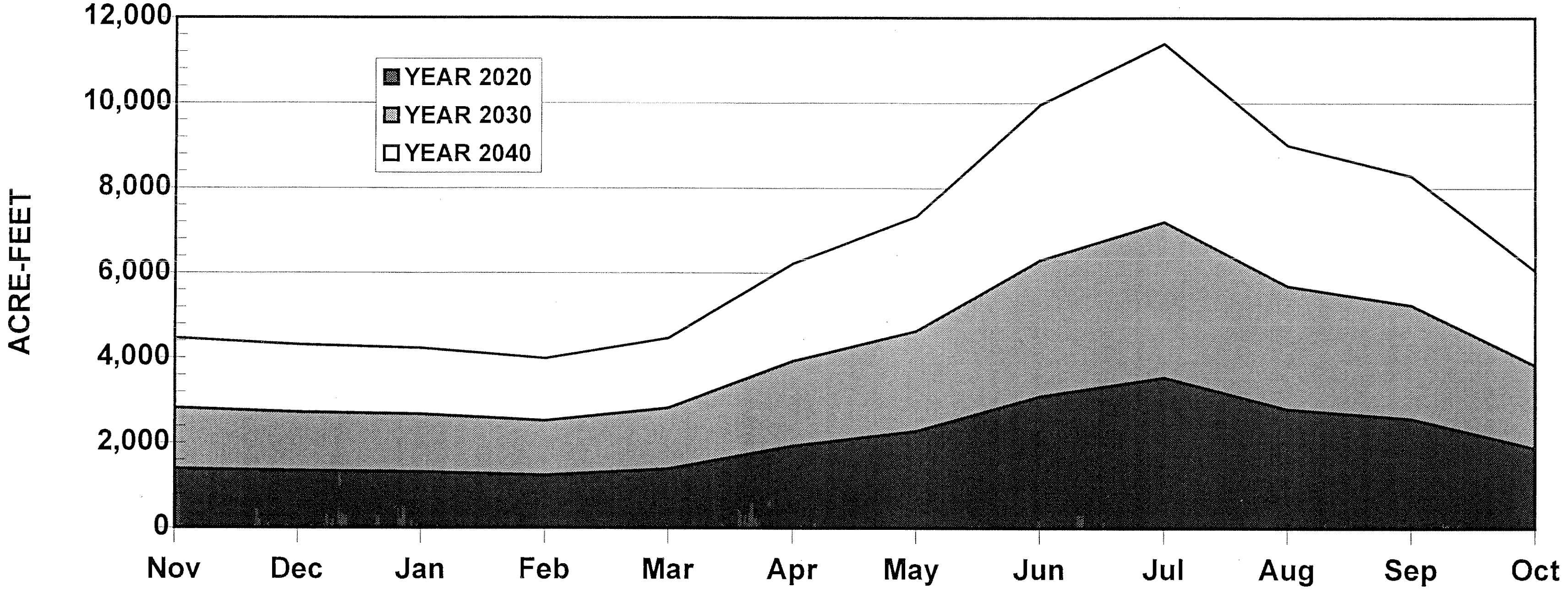
svd_final_high.xls/
WEST OF PUEBLO DEFICITS

**FIGURE 6.11**
**MONTHLY DEFICITS**
**WEST OF PUEBLO**

## MONTHLY WATER SUPPLY DEFICITS
## FVA ENTITIES
(HIGH FORECAST)



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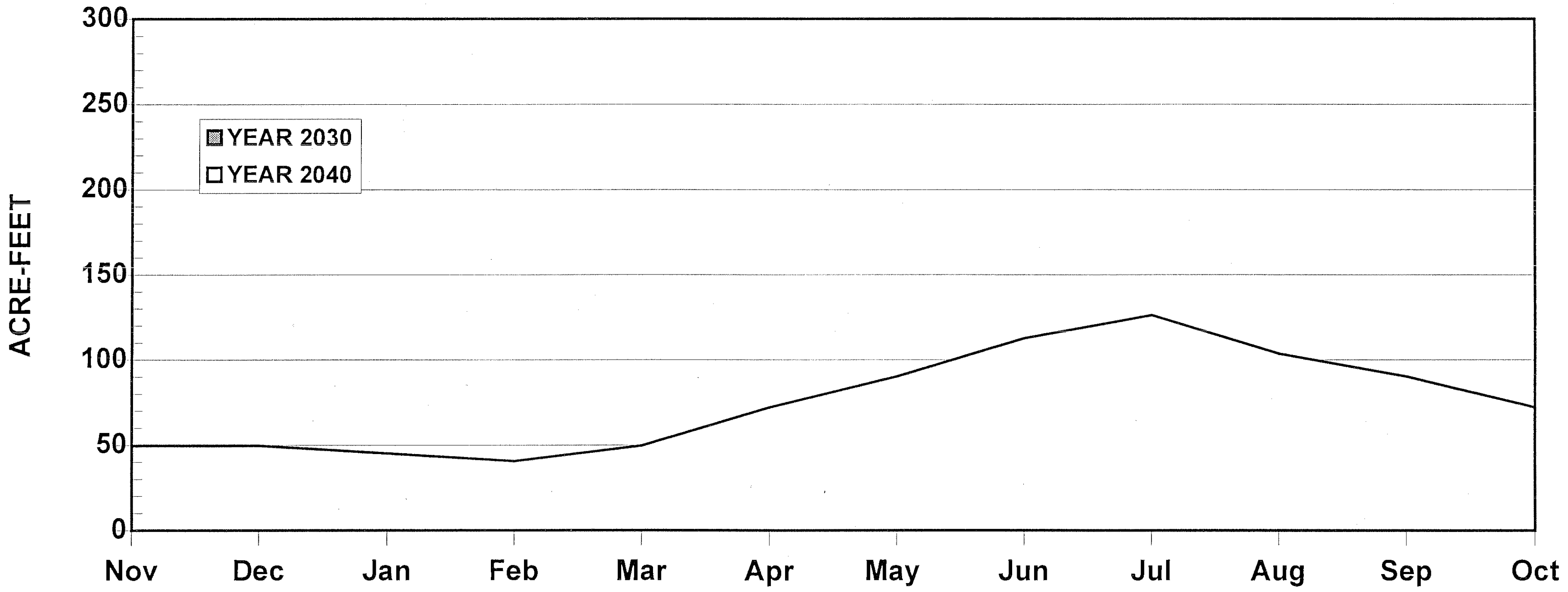
svd_final_high.xls/
FVA DEFICITS

**<u>FIGURE 6.12</u>**
**MONTHLY DEFICITS**
**FVA ENTITIES**



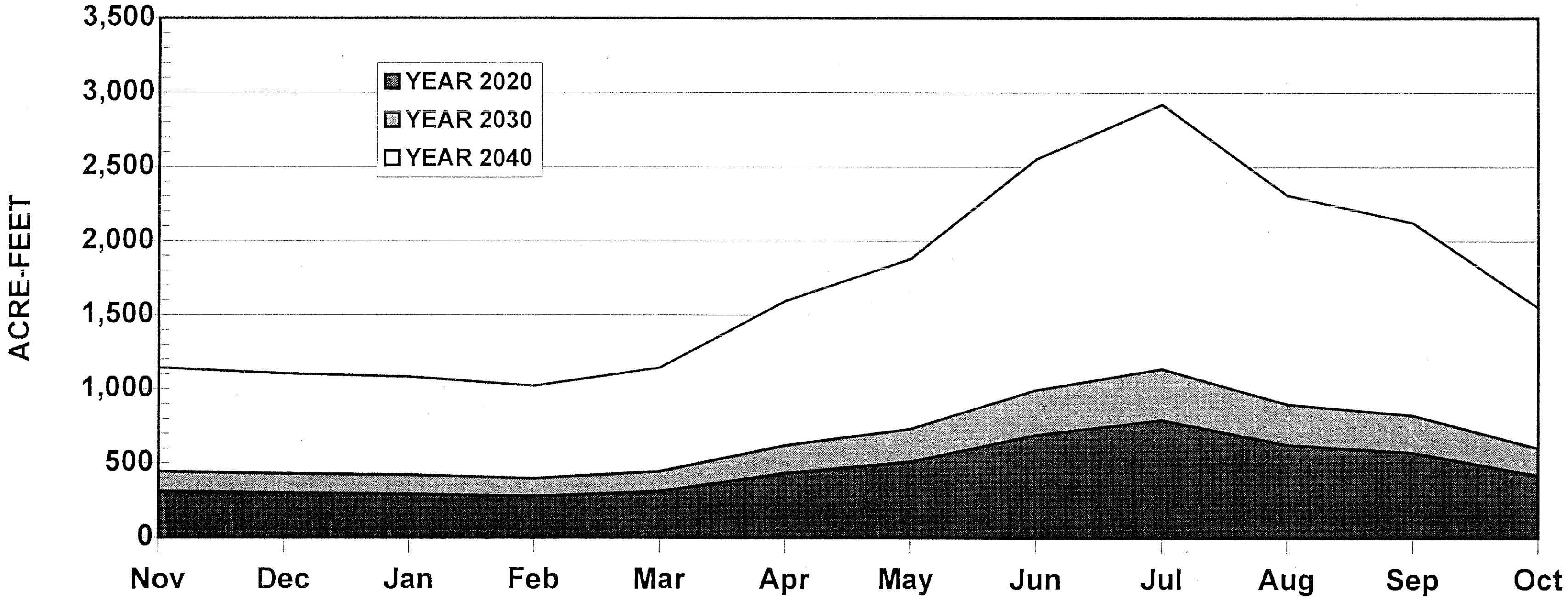
MONTHLY WATER SUPPLY DEFICITS
ENTITIES WEST OF PUEBLO
(BASE FORECAST)

GEI CONSULTANTS, INC.
12/8/98

svd_basefin_rpt.XLS/
WEST OF PUEBLO DEFICITS

**FIGURE 6.13**
**MONTHLY DEFICITS**
**WEST OF PUEBLO**

## MONTHLY WATER SUPPLY DEFICITS
## FVA ENTITIES
(BASE FORECAST)



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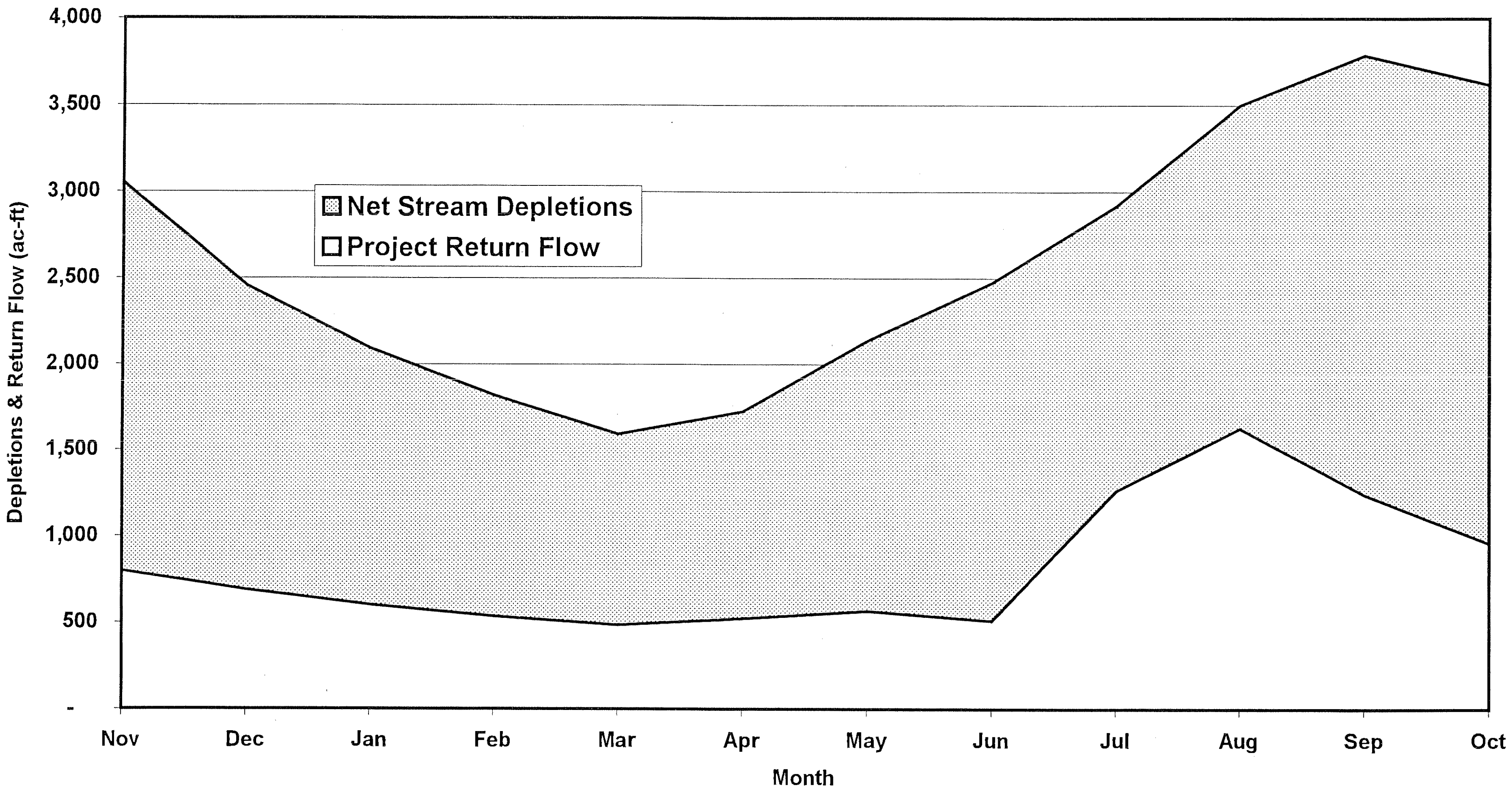
svd_basefin_rpt.XLS/
FVA DEFICITS

**FIGURE 6.14**
**MONTHLY DEFICITS**
**FVA ENTITIES**

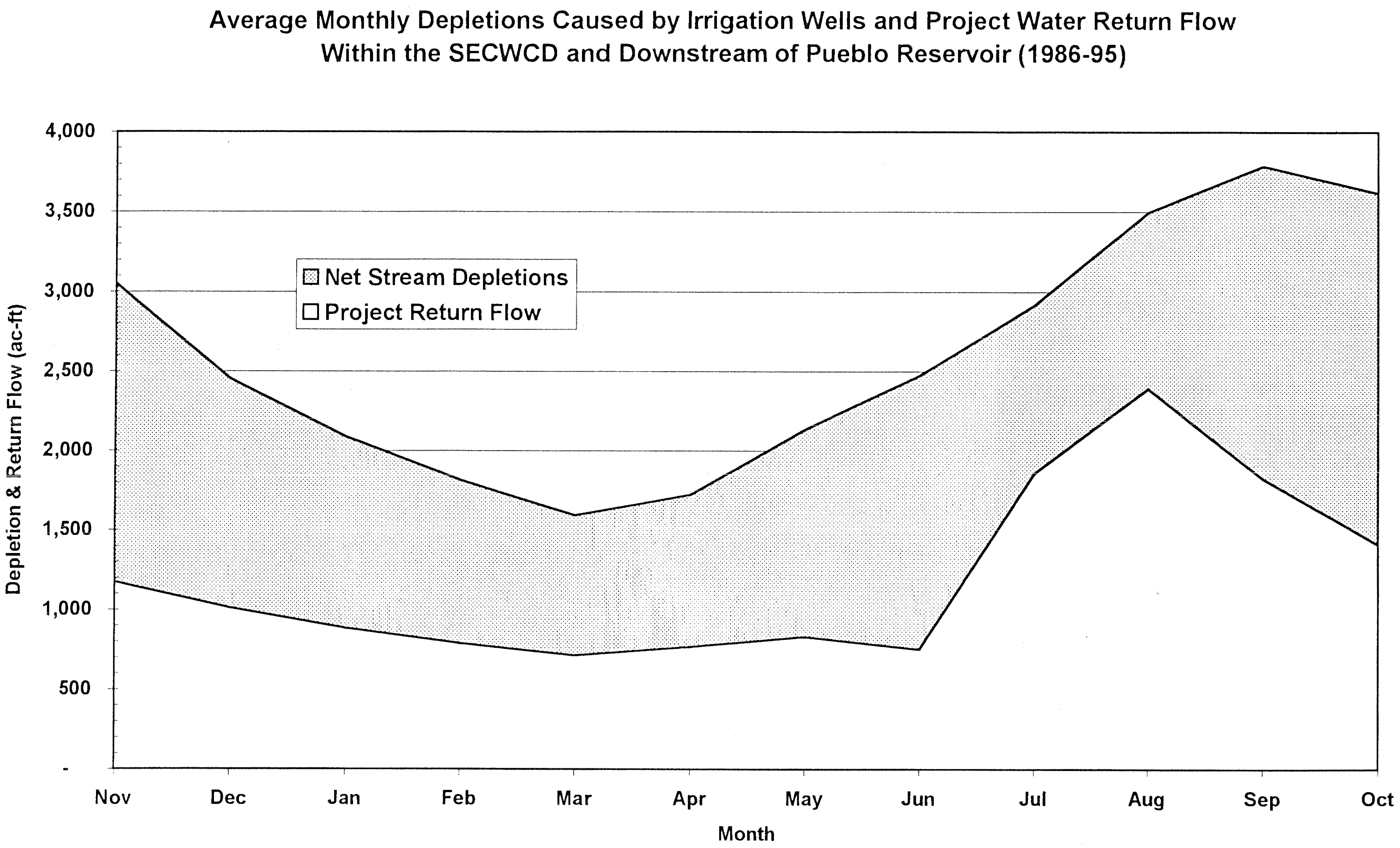
Average Monthly Depletions Caused by Irrigation Wells and Project Water Return Flows
Within the SECWCD and Downstream of Pueblo Reservoir (1986-95)



Note: Annual depletions caused by wells averaged 31,154 acre-feet. Project water return flows averaged 9,790 acre-feet annually based on an allocation to irrigation of 49 percent of the historical allocation, distributed to the ditches based on reported acreage and historical pattern of use, transit loss of 10 percent and return flows equivalent to 40 percent of the delivery.

**FIGURE 6.15**
**POTENTIAL SHORTFALL TO**
**OFFSET WELL DEPLETIONS**
**(HISTORIC FRY-ARK ALLOCATION)**

Divsum1.xls/1986-95 Stream Effect Chart



Note: Annual depletions caused by wells averaged 31,154 acre-feet. Project water return flows averaged 14,400 acre-feet annually based on an allocation to irrigation of 40,000 acre-feet, distributed to the ditches based on reported acreage and historical pattern of use, and return flows equivalent to 40 percent of the delivery.

FIGURE 6.16
POTENTIAL SHORTFALL TO
OFFSET WELL DEPLETIONS
(FULL FRY-ARK ALLOCATION)

Φ

# Section 7

# 7. FRYINGPAN-ARKANSAS PROJECT SUPPLIES

## 7.1 Project Description

### 7.1.1 Authorization of the Project

On August 16, 1962 the Congress of the United States authorized the construction of the Fryingpan-Arkansas Project. Public Law 87-590 authorized the construction and operation of the multipurpose project. On January 21, 1965, the Board of Directors of the Southeastern Colorado Water Conservancy District (District) entered into a repayment contract with the United States to repay the District's share of the reimbursable cost involved in construction of the project. The District was created April 29, 1958, by the District Court in Pueblo, Colorado, for the purpose of developing and administering the Fryingpan-Arkansas Project. The final repayment contract was signed between the District and the United States on October 23, 1981.

Construction began with Ruedi Dam and Reservoir in 1964, and continued without interruption until September 28, 1990 when the Project was declared completed with the dedication of the Fish Hatchery at Pueblo Reservoir. Construction is completed on all of the water supply-related features that were expected to be initially developed. On the Western Slope portion of the project, there exists a potential to expand the North Side Collection System to Last Chance and Lime Creeks, tributaries of the Fryingpan River. However, plans to pursue this expansion have been deferred. Also, plans to construct the Arkansas Valley Conduit to serve towns and cities east of Pueblo with treated Project Water have been deferred.

### 7.1.2 Description of Project Facilities

There are two distinct portions of the Project. The Western Slope, located in the Hunter Creek and Fryingpan River watersheds, and the Eastern Slope in the Arkansas River Valley. These areas are separated by the Continental Divide, which in many places, exceeds an elevation of 14,000 feet. The Project consists of diversion, conveyance, and storage facilities designed primarily to divert water from Colorado River tributaries on the Western Slope for use in water-short areas of the Arkansas River on the Eastern Slope. The North and South Side Collection System and Ruedi Dam and Reservoir are located on the Western Slope in the Fryingpan River Basin. Sugarloaf Dam and Turquoise Lake, Mt. Elbert Conduit, Halfmoon Diversion Dam, Mt. Elbert Forebay Dam and Reservoir, Twin Lakes Dam and Reservoir, and Pueblo Dam and Reservoir are all located on the Eastern Slope in the Arkansas River Basin.

**The Western Slope-Features.** Ruedi Dam and Reservoir provide storage for replacement and regulation of water for the western slope users. This water is used for irrigation, municipal, industrial, recreation, and fish and wildlife purposes.

The North and South Side Collection Systems on the western slope collect the high mountain runoff and convey the diverted waters into the inlet portal of the Charles H. Boustead Tunnel. Sixteen diversion structures on the Western Slope are used to divert water into the Project collection system. The system includes eight tunnels with a combined length of 21.5 miles. The 5 mile-long Boustead Tunnel conveys water from the North and South Collection Systems under the Continental Divide to Turquoise Lake.

**The Eastern Slope-Features.** Turquoise Reservoir and Sugarloaf Dam are located just east of the Continental Divide, approximately 5 miles west of Leadville, Colorado and provide storage capacity for the regulation of Project water delivered from the Boustead Tunnel.

The Mt. Elbert Conduit, a 10.7 mile, 90 inch diameter pipe, conveys water from Turquoise Reservoir to Mt. Elbert Forebay. The Halfmoon Diversion Dam diverts available flows of Halfmoon Creek into the Mt. Elbert Conduit. Water delivered to the Forebay is used to generate power at the Mt. Elbert Pumped-Storage Powerplant, which is located approximately 13 miles southwest of Leadville at the northwest corner of the lower lake of Twin Lakes. The powerplant has two reversible pump-turbine/motor-generator units, each with a nameplate capacity of 100 megawatts.

Water from the Mt. Elbert Forebay flows into Twin Lakes through the powerplant. From Twin Lakes Project water is released to Lake Creek and the Arkansas River for delivery to Project water users upstream of Pueblo Dam and Reservoir or for storage in Pueblo Reservoir. The distance from the confluence of Lake Creek and the Arkansas River to Pueblo Dam is approximately 143 river miles.

Project Water is released from Pueblo Reservoir to the Arkansas River for irrigation and municipal use, to: (1) the Fountain Valley Conduit for municipal use by the members of the Fountain Valley Authority, City of Colorado Springs, City of Fountain, Security Water District, Stratmoor Hills Water District, and Widefield Water District; (2) the Bessemer Ditch for irrigation use; and (3) the downstream users. Pueblo Reservoir is the terminal storage feature for the Project. As shown in Table 7.1, West Slope Project storage is 102,373 of (all in Ruedi Reservoir). East Slope storage totals 620,193, of which 56 percent is in Pueblo Reservoir.

## Table 7.1
## Fry-Ark Project
## Reservoir Storage Allocation Data

| Reservoir | Dead (acre feet) | Inactive (acre Feet) | Active Conservation (acre feet) | Joint Use (acre feet) | Flood Control (acre feet) | Total Capacity Storage (acre feet) |
|---|---|---|---|---|---|---|
| West Slope | | | | | | |
| Ruedi | 63 | 1,032 | 101,278 | 0 | 0 | 102,373 |
| East Slope | | | | | | |
| Turquoise | 2,810 | 6,110 | 120,478 | 0 | 0 | 129,398 |
| Mt. Elbert | 561 | 3,264 | 7,318 | 0 | 0 | 11,143 |
| Twin Lakes | 63,324 | 9,614 | 67,917 | 0 | 0 | 140,855 |
| Pueblo | 2,329 | 25,792 | 228,828 | 66,000 | 26,991 | 349,940 |
| Total | 68,463 | 41,516 | 417,223 | 66,000 | 26,991 | 620,193 |

(1) Does not include Mt. Elbert Forebay

Some of the storage space in Project facilities on the East Slope is dedicated by long-term contract to water users both within and outside the District. As shown in Table 7.2, this storage space, which is not available for Project water, totals 111,898 of, approximately 18 percent of the total East Slope storage, and approximately 27 percent of the active storage (417,223 af).

## Table 7.2
## Fry-Ark Project
## Non-Project Storage Space

| Entities (1) Storage in Project Reservoirs | Storage Amount (af) |
|---|---|
| Homestake Project | 30,000 |
| Colorado Springs Utilities | 17,416 |
| City of Aurora | 5,000 |
| Pueblo Board of Water Works | 5,000 |
| Twin Lakes Reservoir and Canal Company | 54,452 |
| Total | 111,898 |

(1) Does not include Mt. Elbert

With deduction of dedicated non-Project storage (111,898 af in Table 7.2) from the total active storage volume of 417,223 (Table 7.1), the available storage space for Project water in the Fry-Ark Project reservoirs is 305,325 af.

Fry-Ark Project Water may be stored in long-term contract space when it is not being used by the contracting entity. However, it must be evacuated when the contracting entity requires such space for storage of non-project water. Long-term contract storage of non-project water may not invade Project space. West Slope Project Water and non-project water stored in long-term contract space are not subject to spill.

Non-project water may be stored in Project facilities under If -and-When contracts. Water stored under the Winter Storage Program decree and any non-project water stored under short term If-and-When contracts are subject to spill if the storage space occupied within the conservation pool is required for the storage of Project Water or if the space it occupies is within the joint-use pool which must be evacuated pursuant to Project flood control criteria by April 15 of each year.

The operation of East Slope Project reservoirs during those occasions when water must be spilled is subject to Amendment No. 4 of the District's Contract, which was executed on January 23, 1986. Amendment No. 4 includes an article entitled Reservoir Spills. This article is quoted in part below:

> *13. (a) Whenever water is evacuated from Pueblo, Twin Lakes, and Turquoise Reservoirs to meet the necessities of Project flood control, power generation purposes, storage of transmountain Project water, storage of native Project water, and Project operational requirements;* ***except as provided in Article 13.(b) below****; the water evacuated shall be charged in the following order:*
>
> *1. Against water stored under contracts for if-and-when available storage space for entities which will use the water outside the District boundaries.*
>
> *2. Against water stored under contracts for if-and-when available storage space for entities which will use the water within the District boundaries. This evacuation will be charged pro rata against water stored under all such like contracts at the time of evacuation.*
>
> *3. Against any winter storage water in excess of 70,000 acre-feet.*

4. *Against water stored under contracts with municipal entities within the boundaries of the District, which water is neither Project water nor return flow from Project water and which is limited to 163,100 acre-feet less any Project water purchased and stored by municipal users. This evacuation will be charged pro rata against water stored under all such like contracts at the time of evacuation.*

5. *Against winter storage water not in excess of 70,000 acre-feet.*

6. *Against Project water accumulated from the Arkansas River and its tributaries.*

*13. (b) Notwithstanding the order of evacuation of water listed in Subarticle 13.(a) above, evacuation of water from storage pursuant to existing firm storage contracts, the Highline storage contract and future storage contracts that may be entered into with the Board of Waterworks of Pueblo, Colorado and Twin Lakes Reservoir and Canal Company to satisfy prior commitments will be made pursuant to the terms of such storage contracts.*

### 7.1.3 Legal Status

**Project Water Rights.** The District obtained the water rights for all of the Project facilities, except Ruedi Dam and Reservoir. The decree for the North and South Side Collection Systems including Charles H. Boustead Tunnel was entered in Civil Action No. 4613 in the District Court in and for the County of Garfield, State of Colorado. The decree is dated August 3, 1959, with a date of appropriation of July 29, 1957. The decreed uses are irrigation, domestic, municipal, power, manufacturing, and other beneficial purposes.

Decrees for the east slope Project facilities were entered in District Courts in and for the Counties of Chaffee and Pueblo, State of Colorado. The Chaffee County District Court decree entered in Civil Action No. 5141 includes Turquoise Lake, Twin Lakes Reservoir, Mt. Elbert Forebay, Mt. Elbert Conduit, and Halfmoon Diversion Dam. This decree, dated July 9, 1969, established a date of appropriation of February 10, 1939. However, the decree states:

> *"As to water rights heretofore adjudicated in this district (11), priorities for irrigation granted by this decree shall be enforceable only as of July 14, 1942, and priorities for purposes other than irrigation granted by this decree shall be enforceable only as of December 15, 1942."*

The Pueblo County District Court decree entered in Civil Action No. B-42135 for Pueblo Reservoir, dated June 25, 1962, established a date of appropriation of February 10, 1939.

The Colorado River Water Conservation District holds the decree for storage at Ruedi Reservoir. The decree was entered in Civil Action No. 4613 in and for the County of Garfield, State of Colorado, and is dated May 12, 1958, with a date of appropriation of July 29, 1957.

The estimated average annual yield of the Project facilities and water rights available for use in the Arkansas River Basin by entities within the boundaries of the Southeastern Colorado Water Conservancy District is 80,400 acre-feet. This estimate includes water diverted from the West Slope and any East Slope (native) water stored pursuant to the 1962 storage decree, which has a 1939 appropriation date.

**Southeastern Colorado Water Conservancy District.** The District was created under Colorado State Statutes on April 29, 1958 by the District Court in Pueblo, Colorado, for the purpose of developing and administering the Fryingpan-Arkansas Project. The District extends along the Arkansas River from Buena Vista to Lamar, and along Fountain Creek from Colorado Springs to Pueblo. The District consists of parts of nine counties deriving benefits from the Project.

The District is the legal agency responsible for repayment of the reimbursable costs of the Project. In addition to administering this repayment responsibility, the District makes supplemental water from the Fryingpan-Arkansas Project available for use by approximately 280,600 acres of irrigated land under various private and mutual ditch companies, and for use by the many municipal and domestic water suppliers who directly serve the District's approximately 600,000 constituents. The District is governed by a 15 member board of directors representing the nine counties within the Conservancy District. Each Board member is appointed by the State's District Court system. Members serve for four-year terms and are then subject to re-appointment.

### 7.1.4 Fryingpan-Arkansas Project Operating Principles

Operating Principles for the Fry-Ark Project, as amended December 9, 1960, were adopted by the State of Colorado. The signatory parties are the Colorado Water Conservation Board, Southeastern Colorado Water Conservancy District, Colorado River Water Conservation District, and Southwestern Water Conservation District.

The Secretary of Interior through the Bureau of Reclamation is to operate the Project in accordance with the provisions of the Operating Principles, which quoted (in part) below:

> 9.(1) *That the demand on the waters available under such decrees shall be allocated in the following sequence: (a) for diversions to the Arkansas Valley through the collection system and the facilities of the Fryingpan-Arkansas Project in an amount not exceeding an aggregate of 120,000 acre-feet in any year, but not to exceed a total aggregate of 2,352,800 acre-feet in any period of 34 consecutive years reckoned in continuing progressive series starting with the first full year of diversions, both limitations herein being exclusive of Roaring Fork exchanges,...and exclusive of diversions for the Busk-Ivanhoe decree....*
>
> 13. *The Project will be operated in such a manner that those in eastern Colorado using Project water imported from the Colorado River Basin for domestic purposes shall have a preference over those claiming or using water for any other purpose.*
>
> 14. *The Project is to be operated in such a manner as to secure the greatest benefit from the use and reuse of imported Project waters within the Project boundaries in the state of Colorado...*
>
> 18. *No Transmountain diversion of water shall ever be made through the collection and diversion system of the Fryingpan-Arkansas Project in excess of the quantitative limitations and conditions established by this document: Provided, however, that when under the laws of the State of Colorado, there may be additional water available for such collections and diversion which is not at the time required for beneficial use in western Colorado or for filling interstate water compact agreements, then such water may be collected and diverted for beneficial use in the Arkansas Valley: Provided further, that such additional diversion shall only be made with the mutual consent of each of the following agencies of the State of Colorado, to wit: The Colorado Water Conservation Board, the Southwestern Colorado Conservation District, the Colorado River Water Conservation District, and the Southeastern Colorado Water Conservancy District.*

The Operating Principles contain much detail on the operation of West Slope facilities but little concerning East Slope operations. The EIS for the Project contains specifics on East Slope operations and the EIS was incorporated into 1978 authorizing legislation. The Bureau's Annual Operating Plans, which include public input, direct operations for each year. Project water releases, from the upper reservoirs to Pueblo Reservoir, are subject to annual agreement among the Bureau, Colorado Department of Natural Resources, and the District. The agreement is incorporated into the Annual Operating Plan each year.

### 7.1.5 District's Current Allocation Principles, Water Allocation Policies, and Process

On November 29, 1979, the members of the Board of Directors of the District unanimously approved the "Allocation Principles, Findings Determinations, and Resolutions", a copy of which is provided in Appendix C of this report. That document set out the principles for allocation of Project water available to the District between the municipal and agricultural water users and the use of Project storage by the municipal water users, as well as establishing the order of spill in Project facilities. The District's repayment contract also serves to govern the annual allocation of Project Water, as well as setting the rate for Project Water. The District also promulgated a "Water Allocation Policy", last amended on February 15, 1996.

Each year, the District's Allocation Committee directs the preparation of specific forms, letters, and other documents, and establishes a timetable for the annual allocation process. Appropriate letters and forms are mailed to eligible entities offering them the opportunity to apply for an allocation of Project water. Shortly thereafter, the Bureau of Reclamation notifies the District as to the amount of water available to the District that year. The Allocation Committee then meets to review the applications, and prepare recommendations concerning the applications received in light of the amount of water available. All recommendations of the Allocation Committee must be approved by the Board of Directors of the District. Recommendations from the Allocation Committee are considered at the next meeting of the Board of Directors of the District, and appropriate allocations are made. Applicants are afforded the opportunity to appear before the Board to request consideration of adjustments to their allocations. The Allocation Committee also may meet at times to discuss possible changes to the Water Allocation Policy, and any potential changes in the allocation process.

As directed by the District's Policies, Project Water for use by irrigation ditches is allocated based upon an acre-foot per irrigated acre basis. Therefore, when demand exceeds supply, each ditch receives a proportionate share of available Project Water. This allocation is made only after the municipal requests are met up to 51 percent of the annual Project yield. This allocation is distributed, as requested, to Arkansas Valley cities, towns and entities lying east of Pueblo (12 percent), and towns west of Pueblo (4 percent), Pueblo (10 percent), and the Fountain Valley Authority participants (25 percent). Finally, after all other municipal and agricultural have been met, the Pueblo West Metropolitan District is given notice that they may make a request. The Allocation Principles also allow the M&I share of Project water to increase above 51 percent if agricultural lands irrigated with Project water are taken out of production.

The District's Allocation Policy provides that Project water purchased for agriculture must be used by a certain date as determined by the Board, otherwise the allocation and sale will be canceled, and money paid will be forfeited. Such unused Project water is subject to reallocation by the District. The District Board has in years when storage space was available allowed agricultural users additional time to use their allocations. However, in 1997 and 1998 agricultural users returned a total of 26,644 acre-feet of Project water to the District.

Project water purchased for municipal or domestic use shall be stored in the space set aside in the Allocation Principles. Project water stored for municipal and domestic purposes in carry-over space is not subject to reallocation.

The price for Project water is determined by the Bureau of Reclamation as directed by Bureau policy and the Project Repayment Contract. Rates are subject to adjustment depending upon an Ability to Pay Study and Repayment Analysis, which are prepared by the Bureau every 4 years.

### 7.1.6 Use and Reuse of Project Water

Pursuant to its repayment contract with the United States, the District retains dominion and control over return flows from delivery of Fryingpan-Arkansas Project water. The District has made return flows from the use of Project water available for use by eligible entities within the District boundaries, primarily for augmentation purposes, since the first deliveries of Project water occurred. The District, by resolution, created the Southeastern Colorado Water Activity Enterprise on September 21, 1995, to administer the sale of Project water return flows. On February 15, 1996 the Enterprise approved a "Policy Concerning the Sale of Return Flows From Fryingpan-Arkansas Project Water".

The sale of the Project water return flows are controlled by the provisions of the policy as quoted (in part) below:

1. *The purpose of this policy is to set forth a fair an orderly policy for the handling of sales of return flows from Fryingpan-Arkansas Project Water, consistent with the Allocation Principles and other policies of the Southeastern Colorado Water Conservancy District...*

2. *Fry-Ark return flows from Project water allocations to served entities thereby should be made available where physically possible on the basis of water which they acquire from the Project. The District's decreed Allocation Principles (¶ 11) provide such a first right of refusal for cities and towns receiving Project water. This right has been extended by the District to all eligible entities receiving Project water by allocation...*

10. *The Enterprise Allocation Committee will estimate the amount of Fry-Ark return flow water available for sale in a given year, and Fry-Ark return flows will be sold based on such estimate.*

12. *The purchaser of Fry-Ark return flows shall not resell, assign, lease, or trade Fry-Ark return flows without written consent of the Enterprise, except cities, towns, and domestic water companies, may resell Fry-ark return flows purchased from the Enterprise within their service areas.*

13. *Fry-Ark return flow water shall not be used, sold, or disposed of outside the Southeastern Colorado Water Conservancy District.*

14. *Purchasers of Fry-Ark return flows may use and reuse the water to extinction, if the user so chooses. Any Fry-Ark return flows purchased, but not used to extinction, will return to the Arkansas River stream system after the purchaser's approved use, and are the property of the Southeastern Colorado Water Conservancy District. Purchasers shall not waste Fry-Ark return flows.*

### 7.1.7 Winter Water Storage Program

During the early planning stages of the Project, individuals and entities envisioned what has become known as the Winter Water Storage Program. Prior to construction of Pueblo Dam, various irrigation entities would divert flows from the Arkansas River, when in priority, outside of the normal irrigation season to maintain soil moisture levels in the fields where crops would be grown during the following season. Problems associated with winter operation of canal and lateral systems, were frequently experienced.

As a result, the concept of a Winter Water Storage Program evolved with the objective of storing waters that otherwise would have been diverted unto the irrigated lands downstream of Pueblo Reservoir or into the reservoirs of those entities whose diversions to storage were located upstream of John Martin Reservoir. These waters, stored in Pueblo Reservoir, would then be released during the following irrigation season. Following the closure of Pueblo Dam in 1974, the District, with the cooperation of various entities in the Basin, promoted and operated voluntary Winter Water Storage Programs each year from 1975-76 through 1986-87, except 1977-78. With the experience and data gained each year, refinements and adjustments were made to the program with the goal of arriving at an equitable means of apportioning the stored water among the program participants and avoiding injury to non-participants.

Following intensive negotiations, an interlocutory decree, with an appropriation date of March 1, 1910, approved as to form by all the applicants and entered by consent, was approved by the Water Court Judge for Water Division No. 2 on November 10, 1987. The Water Court Judge entered an order making the interlocutory decree final on November 10, 1990.

## 7.2 Reoperation Potentials and Constraints

Possibilities for "reoperating" Project storage to store non-Project water and for storing Project water in non-Project reservoirs have been identified as potential ways of meeting a portion of long-term water needs within the District. For example, Colorado Springs Utilities has undertaken studies, which indicate that dedicating storage space in East Slope Project reservoirs for portions of their non-Project water rights would help to meet long-range water needs.

As described in Section 7.1.4, operation of the Fry-Ark Project is governed by Operating Principles, which generally set forth the timing of diversions, storage, and subsequent releases from storage.

Either type of operational change (i.e., storage of more non-Project water in Project reservoirs, or storage of Project water in non-Project reservoirs) would need to be carefully evaluated and is likely to be subject to extensive scrutiny and a variety of regulatory compliance requirements. Also, the effects of such changes on instream flows would need to be addressed, in terms of fisheries, recreational uses, and threatened and endangered species.

The primary constraints and challenges to changing the current methods of operations to free up Project storage space for non-Project water include:

- Any changes in operations must be consistent with the Operating Principles for the Project, the authorizing legislation for the Project, and other relevant federal reclamation laws. The USBR has advised that further legislative authorization may be needed for any future long-term contracts to store non-Project water in Project facilities for municipal use.

- Evaluation of potential impacts to other water users will be required before decision making by the District and the USBR.

- The order of spill priority at Project reservoirs would need to be changed via modification/amendment to the contract between the District and the Bureau of Reclamation.

- A change in the Allocation Principles may be required. To accomplish this, the District's Board of Directors would need to approve the change. Approval most likely also would need to be obtained from the District Court that appoints the Directors and has approved certain major actions of the District, including the Allocation Principles.

- Changes in operations, particularly if they involve changes to the Allocation Principles or the spill order, would need to avoid or mitigate adverse impacts to existing entitlements. For example, changes that would free up Project storage space for non-Project water may limit the availability of Project storage space for Project water, including water stored under the District's East Slope water rights. Such limits could reduce the revenues otherwise available to the District, and delay the District's repayment of Project costs. The mitigation of such impacts may involve significant cost.

- A change in storage allocations and Project operations is likely to constitute a major federal action requiring compliance activities under the National Environmental Policy Act (NEPA). A full range of operation studies and environmental investigations will need to be undertaken to support an Environmental Assessment or an Environmental Impact Statement.

### 7.2.1 Proposal by Colorado Springs

In 1995, the City of Colorado Springs undertook a study to estimate the availability of Project storage space for non-Project water (Gronning, 1995). That study indicated that Project storage space of approximately 92,500 af could be made available to manage non-Project water supplies. Of this total volume, approximately 57,880 af would be available in Pueblo Reservoir, with the balance distributed in other Project storage facilities.

Storage availability in Project reservoirs was estimated using the MODSIM model over a 25-year simulation period (1966-1990). The model was set up to estimate the amount of Project storage space required to store Project water and meet demands of municipal and agricultural users for Project water. This estimated storage space was deducted from Project conservation storage to estimate Project storage space that would be available for non-Project water. The study for Colorado Springs (Gronning, 1995) was completed with the following inputs and assumptions:

- Hydrology for the 1966-1990 period.

- Maximum potential imports through the Boustead Tunnel, as estimated by the USBR.

- Municipal water demands were modeled for the Fountain Valley Authority; municipal users west of Pueblo; municipal users east of Pueblo; and the City of Pueblo. The maximum amount of water to each area was assumed to be the average yield each would have received, based on a total Fry-Ark system yield of 80,400 af and the Allocation Principles (Section 7.1.5). Fifty-one (51) percent of the Boustead Tunnel import was assumed to be available for municipal purposes. Carry-over water was allowed to be accumulated, as required, to meet municipal demands. Annual demands were varied, based on hydrologic conditions or (for the FVA) the delivery schedule in the 1990 Review of Operations, Fryingpan-Arkansas Project (USBR and SECWCD, 1990). Demands also were varied by month, based on percentages of annual demand.

- Agricultural demands were assumed to total 49 percent of the Boustead Tunnel imports, with no carry-over storage. Transit loss of 10 percent and evaporation loss of 5 percent were applied. Demands were varied by month, based on percentages of annual Fry-Ark releases by month for agricultural entities east of Pueblo for the 1986-1991 period.

- Unallocated water was assumed to be accumulated in the reservoirs and not released. Native water stored in "free-river" periods would typically be unallocated Project water. Capture of native East Slope flows under the District's junior storage decrees on the east slope was not included in the Gronning analysis.

Results of the Colorado Springs analysis, outlined above, formed the basis of a request to the District for dedicated storage space in the Fry-Ark system for Colorado Springs to store non-Project water within the space currently allocated for Project water storage. A request for 45,000 af was made.

The study was based on current allocation percentages and rules, including the presumption that agricultural interests would take 49 percent of the annual yield and that agricultural interests would not be able to store water from year to year. The District may approve carry-over of agricultural water on a year-to-year basis; however, this was not considered in the model. Municipal entities were allocated 51 percent of the annual yield with varying percentages of the total taken, depending on the classification of a particular year as wet, average, or dry. The study also did not specifically address the potential for impacts on the Winter Water Storage Program.

As described previously, the District owns the native water rights for all of Project facilities on the East Slope. The native rights for the three reservoirs allow the Bureau to fill the three reservoirs with Project water when the East Slope rights are in priority. Since the Project rights are junior to most water rights on the Arkansas River, the reservoirs can typically be filled with native Project water during relatively infrequent high-flow periods. Therefore, a further limitation on the results is that the study did not consider exercising of the Project's East Slope storage rights. The District was able to store East Slope water under its Project storage decree (1939 appropriation date and 1962 storage decree date) in 1985-87, 1995, and 1998. Most of the storage occurred in Pueblo Reservoir; however, East Slope water was stored in Twin Lakes and Turquoise Reservoirs in 1985-87. During these periods when the District's East Slope rights were in priority, approximately 251,000 af of native water was stored in the Project's East Slope reservoirs. Regulation of storable East Slope flows is an essential part of Fry-Ark Project operations and developing the full yield of the Project.

The evaluation of Project storage space available for non-Project water also must consider water supplies on the West Slope that could be diverted if adequate East Slope storage was available. During the period of Project operations, diversion of nearly 200,000 af of legally available West Slope water was foregone due to lack of storage space on the East Slope. Foregone diversions occurred in 1986 (53,600 af), 1987 (55,100 af ), 1988 (40,500 af), 1996 (47,500 af), and 1998 (estimated 2,900 af).

Based on the above-noted limitations, we recommend that additional Fry-Ark Project operations studies be undertaken. Specifically, these studies should consider the District's East Slope water rights, the availability of water on the West Slope that could be diverted if additional space were available, Winter Water storage, and if-and-when storage.

If space in Pueblo Reservoir is dedicated for non-Project water, it is possible that the Project will be unable to store native water during a time of free river. It may be possible to compensate the Project for this outcome by releasing water from Lake Meredith or another reservoir used for storage by Colorado Springs.

The amount of storage space found to be theoretically available in the Gronning study was 92,500 af, without consideration of East Slope water rights. This volume exceeds the sum of the storage to meet Colorado Springs' needs (45,000 af) and the identified Winter Water dedication of 40,000 af. The dedication of storage for Winter Water would help to assure that Winter Water would not be spilled. As described in Section 7.1.2, water evacuated from Project storage is charged against "if and when" accounts first and then against Winter Water Storage in excess of 70,000 af.

### 7.2.2 Bureau of Reclamation Reoperation Studies

Prior to the Colorado Springs' study, the Bureau of Reclamation evaluated opportunities to store additional non-Project water in Project facilities (USBR, 1990), including both firm and "if and when" available storage. In 1990, the Bureau published a report entitled "Review of Operations: Fryingpan-Arkansas Project, Colorado" (USBR, 1990). The Bureau studied 13 scenarios for operating the Fry-Ark Project's east slope reservoirs. Modeling studies by the Bureau considered dedication of 40,000 af of Project space in Pueblo Reservoir to the Winter Water Storage Program and 30,000 af of Project space for storage of non-Project water. Direct flow agricultural users of Project water had requested the District and the Bureau to evaluate the potential of dedicating up to 40,000 af of Project storage to the Winter Water Storage Program. This would help to assure that stored winter water would not be spilled.

A Bureau operations model was used to evaluate several reservoir operations scenarios in the 1990 study. Variables included:

1. Municipal water delivery of 5,000, 21,000, 28,000, 33,000, 41,000, and 55,000 af/yr.
2. Municipal storage allocations of 81,500 af and 159,000 af.
3. Dedicated Winter Water Storage of 0 af and 40,000 af.
4. Dedicated storage space for non-Project water of 0 af and 30,000 af.

The municipal storage allocation of 159,000 af represents 52 percent of the active Project storage space (305,324 af as indicated in Section 7.1.2). Results of the Bureau's study for the 1965-86 (20-year) model period are presented in Table 7.3.

The following conclusions are drawn from review of the model results presented in Table 7.3:

1. As municipal deliveries from the Project increase, the amount of foregone diversions from the West Slope will decrease.
2. Dedicating storage for Winter Water will reduce the frequency and volumes of Winter Water spills.
3. Dedicating storage for non-Project water will increase the amount of foregone diversions from the West Slope.
4. As municipal deliveries from the Project increase, the frequency and volumes of irrigation water shortages will increase.

As described in Section 6, forecast municipal use of Project water in the year 2040 will reach approximately 32,000 af for the high forecast. Based on the model results in Table 7.3, it

# TABLE 7.3
# RESULTS OF 1990 USBR OPERATIONS STUDY OF FRY-ARK PROJECT

| Municipal Delivery (1,000 af/year) | Municipal Storage (1,000 af) | Winter Water Storage (1,000 af) | Non-Project Storage (1,000 af) | Irrigation Shortages[1] | | Winter Water Spills[1] | | Foregone West Slope Diversions[1] | | Project Water Delivered for Irrigation (1,000 af |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | (Years) | (1,000 af) | (Years) | (1,000 af) | (Years) | (1,000 af) | |
| 5 | 81.5 | 0 | 0 | 0 | 0 | 10 | 209.9 | 9 | 274.4 | 28.7 |
| 5 | 81.5 | 40 | 0 | 0 | 0 | 4 | 42.9 | 10 | 405.5 | 23.1 |
| 21 | 81.5 | 0 | 0 | 0 | 0 | 10 | 196.5 | 4 | 98.8 | 23.3 |
| 21 | 81.5 | 40 | 0 | 0 | 0 | 6 | 83.2 | 8 | 170.5 | 19.7 |
| 28 | 159 | 40 | 0 | 1 | 1.0 | 8 | 174.0 | 3 | 31.1 | 18.2 |
| 28 | 159 | 40 | 30 | 1 | 1.0 | 6 | 94.0 | 4 | 103.0 | 18.0 |
| 33 | 159 | 40 | 0 | 3 | 31.7 | 7 | 104.4 | 3 | 60.5 | 16.1 |
| 41 | 159 | 40 | 0 | 3 | 93.9 | 7 | 118.9 | 1 | 19.5 | 12.5 |
| 55 | 159 | 40 | 0 | 6 | 301.1 | 8 | 142.1 | 0 | 0 | 3.3 |

(1) The number of years indicated and the corresponding total volumes in each category are for the 20-year record 1965-86 used in the 1990 Bureau study.

appears that dedication of Project storage space for Winter Water and for non-Project water (up to a total of 70,000 af) can be accommodated without significant adverse effects on irrigation users, over and above that anticipated as municipal use of project water increases over time.

A conclusion from the Bureau study is that dedication of Project storage capacity to the Winter Water Storage Program and the set-aside of additional Project storage capacity for non-Project water would increase the frequency and amount of west slope water not diverted to the east slope. Another conclusion is that dedication of Project storage in Pueblo Reservoir for winter water would reduce spillage of winter water.

During 1985, the Bureau held two meetings with prospective users of east slope Project storage (USBR, 1990). Table 7.4 lists the requests for long-term storage service contracts:

### TABLE 7.4
### REQUESTS OBTAINED BY BUREAU OF RECLAMATION FOR LONG-TERM PROJECT STORAGE

| Entity | Storage Requested (af) | Type of Storage | |
|---|---|---|---|
| | | Firm | If-and-When |
| Twin Lakes Reservoir and Canal Company | 20,000 | X | |
| Pueblo Board of Water Works | 10,000-20,000 | X | |
| Colorado Springs Utilities | 45,000 | X | |
| CF&I Steel | 2,000 | | X |
| Public Service Company | 10,000 | | X |
| Pueblo West Metropolitan District | 4,500 | | X |
| Catlin Canal Company | 13,000 | | X |
| Holbrook Mutual Irrigating Company | 10,000 | | X |
| City of Aurora(1) | 20,000 | | X |

(1) Not within the District.

### 7.2.3 Project Water in Non-Project Space

Reoperation plans, such as those studied by the Bureau and the one proposed by Colorado Springs, would provide Project storage space for non-Project water. Another reoperation opportunity is to store Project water in non-Project reservoirs. This could free up more storage space in Project reservoirs for non-Project water. For example, Project water destined for agricultural use could be stored in Lake Meredith, rather than higher in the system. However, storage of Project water in a non-Project reservoir would require the "same level of protection" afforded in Project storage space. Seepage losses for conveyance of Project water currently are allocated before water leaves Pueblo Reservoir. An exchange plan conceivably could be implemented to minimize or avoid application of transit losses to a downstream storage location. The District would likely require an accounting to identify losses and a plan to makeup for water that would be lost through evaporation and/or conveyance. This type of change in operation would require a policy decision to be made by the District's Board of Directors, approval by the Bureau, and possibly legislative action.

## 7.3 Potential to Maximize West Slope Imports

Studies by the Bureau (1990) for the 1965-86 period is summarized in Table 7.3, also provide insights about the potential for importing additional West Slope water. With storage of 40,000 af dedicated to the Winter Water Storage Program and municipal demand of 33,000 af, imports totaling 60,500 af would be foregone without increasing Project storage. If the municipal demand increases to 41,000 af (full 51 percent), foregone imports are reduced to 19,500 af occurring in a single year of the 20-year period. As described in Section 6, the demand for Fry-Ark water the municipal sector is expected to increase to approximately 31,000 af by the year 2020 under the high demand forecast. If municipal demands remain lower, foregone diversions would be greater, perhaps as much as 200,000 to 300,000 af over 9 years.

The Bureau (1990) looked at a 5-foot and 10-foot raise of the operating pool in Pueblo Reservoir providing 29,000 and 60,500 of additional storage, respectively (See Section 8). However, the Bureau, did not estimate the amount of Project storage yield that could be provided from additional West Slope imports with the increased storage capacity in Pueblo Reservoir.

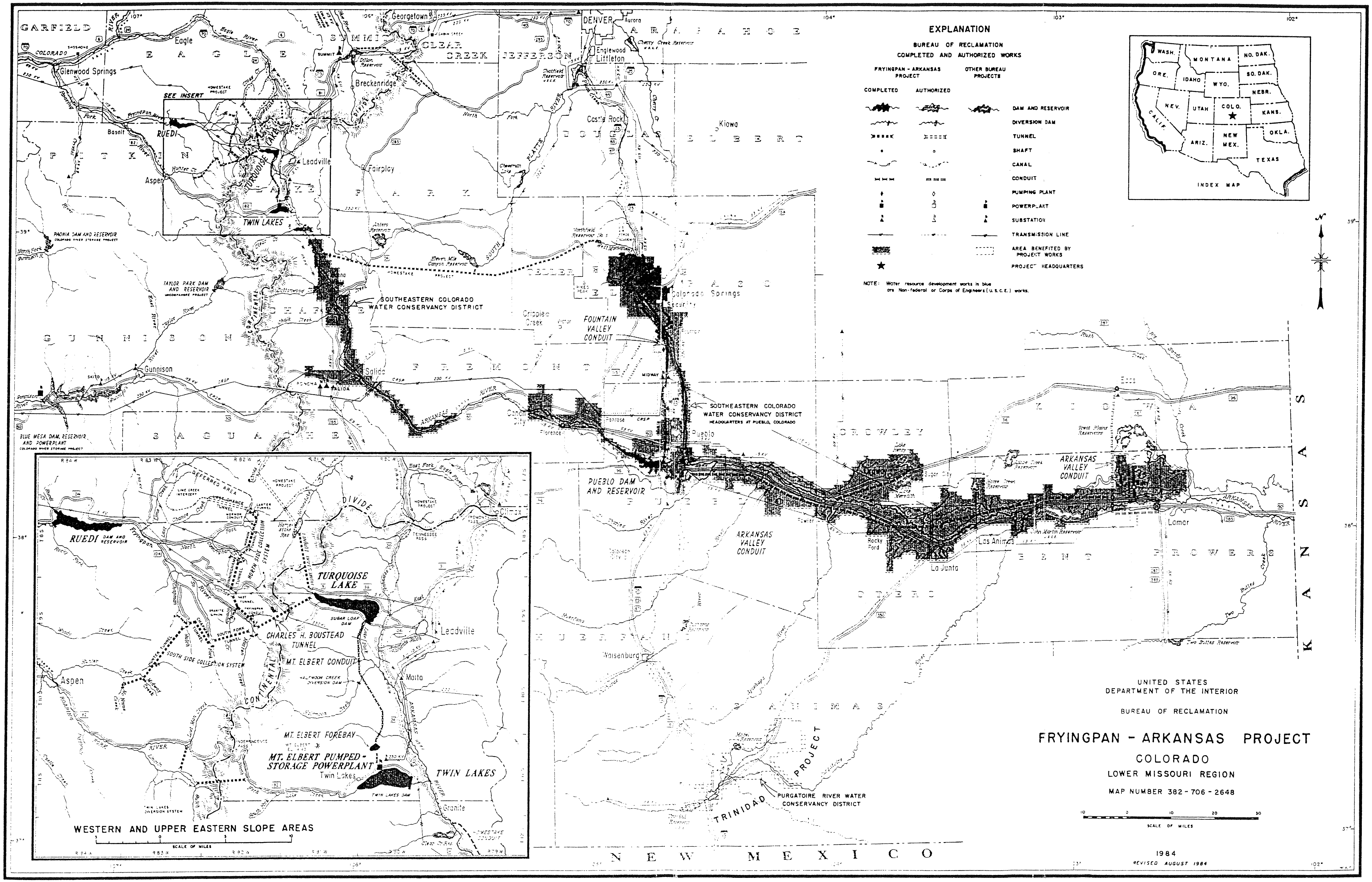

EXPLANATION
BUREAU OF RECLAMATION
COMPLETED AND AUTHORIZED WORKS
FRYINGPAN - ARKANSAS PROJECT
OTHER BUREAU PROJECTS
COMPLETED
AUTHORIZED
DAM AND RESERVOIR
DIVERSION DAM
TUNNEL
SHAFT
CANAL
CONDUIT
PUMPING PLANT
POWERPLANT
SUBSTATION
TRANSMISSION LINE
AREA BENEFITED BY PROJECT WORKS
PROJECT HEADQUARTERS
NOTE: Water resource development works in blue are Non-federal or Corps of Engineers (U.S.C.E.) works.
INDEX MAP
WASH.
MONTANA
NO. DAK.
ORE.
IDAHO
SO. DAK.
WYO.
NEBR.
NEV.
UTAH
COLO.
KANS.
CALIF.
ARIZ.
NEW MEX.
OKLA.
TEXAS
GARFIELD
EAGLE
SUMMIT
CLEAR CREEK
JEFFERSON
ARAPAHOE
DOUGLAS
ELBERT
PITKIN
LAKE
PARK
TELLER
EL PASO
CHAFFEE
GUNNISON
FREMONT
SAGUACHE
CROWLEY
KIOWA
PUEBLO
OTERO
BENT
PROWERS
HUERFANO
LAS ANIMAS
KANSAS
NEW MEXICO
Glenwood Springs
Eagle
Georgetown
DENVER
Aurora
Englewood
Littleton
Breckenridge
Dillon Reservoir
Basalt
RUEDI
SEE INSERT
TURQUOISE LAKE
Leadville
Aspen
Fairplay
TWIN LAKES
Castle Rock
Kiowa
Colorado Springs
Security
PAONIA DAM AND RESERVOIR
TAYLOR PARK DAM AND RESERVOIR
SOUTHEASTERN COLORADO WATER CONSERVANCY DISTRICT
FOUNTAIN VALLEY CONDUIT
Cripple Creek
Gunnison
Salida
Canon City
Florence
Penrose
Pueblo
MIDWAY
SOUTHEASTERN COLORADO WATER CONSERVANCY DISTRICT HEADQUARTERS AT PUEBLO, COLORADO
BLUE MESA DAM, RESERVOIR AND POWERPLANT
PUEBLO DAM AND RESERVOIR
ARKANSAS VALLEY CONDUIT
ARKANSAS RIVER
Sugar City
Rocky Ford
La Junta
Las Animas
John Martin Reservoir
Lamar
Eads
Great Plains Reservoirs
Two Buttes Reservoir
Walsenburg
TRINIDAD PROJECT
PURGATOIRE RIVER WATER CONSERVANCY DISTRICT
HOMESTAKE PROJECT
WESTERN AND UPPER EASTERN SLOPE AREAS
RUEDI DAM AND RESERVOIR
Fryingpan
DEFERRED AREA
DIVIDE
Climax
TURQUOISE LAKE
SUGAR LOAF DAM
CHARLES H. BOUSTEAD TUNNEL
MT. ELBERT CONDUIT
NORTH SIDE COLLECTION SYSTEM
SOUTH SIDE COLLECTION SYSTEM
CONTINENTAL
HALFMOON CREEK DIVERSION DAM
Malta
MT. ELBERT FOREBAY
MT. ELBERT PUMPED-STORAGE POWERPLANT
Twin Lakes
TWIN LAKES DAM
TWIN LAKES DIVERSION SYSTEM
Granite
SCALE OF MILES
UNITED STATES DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION
FRYINGPAN - ARKANSAS PROJECT
COLORADO
LOWER MISSOURI REGION
MAP NUMBER 382 - 706 - 2648
SCALE OF MILES
1984
REVISED AUGUST 1984

FIGURE 7.1

# 8. FORMULATION AND EVALUATION OF WATER SUPPLY AND STORAGE ALTERNATIVES

## 8.1 Overview and Storage Alternatives

Alternatives for developing water storage to meet long-range water needs of District water users have been identified as part of the Assessment Project. The initial set of options includes 31 alternatives, which are summarized in unranked fashion in Table 8.1. The locations of these alternatives are shown on Figure 8.1. The storage options were selected for initial inclusion in the Assessment Project studies without regard to the amount of storage volume that could be provided or the anticipated cost to develop the storage. The rationale for this approach is that alternatives, providing less than the desired volume of storage, could be combined to meet overall project objectives. Consideration was given to the location of storage within the Basin (and District) in order to provide a broad geographic range of storage options. Many of the storage opportunities were identified by water entities within the District or other users of Arkansas Basin water resources. These opportunities include enlargements of existing reservoirs, new dams and reservoirs, gravel lakes storage, conjunctive use of surface and ground water resources, and reoperation of Fry-Ark facilities.

The Future Water and Storage Needs Assessment Project is a reconnaissance-level investigation, focused primarily on assessing future demands for additional water supply and storage. As part of the assessment, the study team, working with the Storage Study Committee, identified a range of potential storage and water management alternatives for consideration by the District.

A preliminary evaluation of these alternatives also was conducted following a two-step process. This evaluation process is qualitative in nature; however, the basic structure of the evaluation process is designed to be expanded, refined, and used in more detailed alternatives evaluations that would be conducted in subsequent phases of planning for water development. Extensive, additional investigations of potential alternatives, beyond the scope of this reconnaissance-level study, will need to be conducted prior to reaching decisions about proceeding with development of any new water storage or water management project. These investigations will include engineering, environmental, legal, and institutional studies scoped in conformance with requirements of the National Environmental Policy Act (NEPA) and conducted in an open process involving all potential stakeholders, interest groups, and the public.

This report, as prepared for the Future Water and Storage Needs Assessment Project, does not include a detailed evaluation of potential alternatives and is not intended to serve as a NEPA document. However, we believe that the basic information, the range of alternatives considered, and the alternatives evaluation framework presented in this report provide an important frame

## TABLE 8.1

WATER AND STORAGE NEEDS ASSESSMENT

## POTENTIAL ALTERNATIVES (UNRANKED)

| Key No.[1] | Storage Option[2] | Description | Location | Storage Potential | Discussion |
|---|---|---|---|---|---|
| 1 | John Martin Reservoir<br>(Re-allocation of Flood Pool) | Existing Reservoir;<br>335,700 AF - Conservation Storage WSEL 3850<br>269,400 AF - Flood Control WSEL 3870<br>621,000 AF - Total Storage WSEL 3870 | Lower Basin 20 miles west of Lamar | 55,000 AF to 120,000 AF | Significant institutional issues are anticipated; Location may not be advantageous for exchange |
| 2 | Lake Meredith<br>(Enlargement) | Existing Reservoir; Colorado Canal Company<br>41,000 AF - Existing Storage @ WSEL 4255 | Lower Basin 10 miles north of Rocky Ford | 15,000 to 75,000 AF | High evaporation potential, high seepage potential; Provides exchange potential; Multiple interests in the existing storage; Possible to improve exchanges with outlet modifications. |
| 3 | Lake Henry<br>(Enlargement) | Existing Reservoir; Lake Henry Reservoir Company<br>9,500 AF - Normal Storage WSEL 4367<br>14,900 AF - Maximum Storage WSEL 4373<br>5000 AF - Raise Dam 5 feet WSEL 4378 | Lower Basin 15 miles north of Rocky Ford | 5,000 AF | Possibly high seepage and evaporation rates given its location |
| 4 | Horse Creek Reservoir<br>(Enlargement) | Existing Reservoir; Fort Lyon Canal Company<br>28,000 AF - Existing Storage WSEL 4104<br>43,000 AF - Raise Dam 5 feet WSEL 4109 | Lower Basin 7 miles north of Las Animas | 10,000 AF | Possibly high seepage and evaporation rates given its location |
| 5 | Adobe Creek Reservoir<br>(Enlargement) | Existing Reservoir; Fort Lyon Canal Company<br>71,000 AF - Existing Storage WSEL 4128<br>96,000 AF - Raise Dam 5 feet WSEL 4133 | Lower Basin 12 miles north of Las Animas | 25,000 AF | Possibly high seepage and evaporation rates given its location |
| 6 | Cheraw Lake<br>(Enlargement) | Existing Reservoir | Lower Basin 12 miles NE of Rocky Ford | Up to 4,000 AF | Possibly high seepage and evaporation rates given its location |
| 7 | Holbrook Reservoir<br>(Enlargement) | Existing Reservoir; Holbrook Mutual Irrigation Company<br>4,600 AF - Normal Storage WSEL 4162<br>8,000 AF - Maximum Storage WSEL 4167<br>4,000 AF - Raise Dam 5 feet WSEL 4172 | Lower Basin 8 miles east of Rocky Ford | 4,000 AF | Possibly high seepage and evaporation rates given its location |

# TABLE 8.1

## WATER AND STORAGE NEEDS ASSESSMENT

## POTENTIAL ALTERNATIVES (UNRANKED)

| Key No.[1] | Storage Option[2] | Description | Location | Storage Potential | Discussion |
|---|---|---|---|---|---|
| 8 | Williams Creek Reservoir | New Dam Site; Colorado Springs Utilities (Proposed)<br>28,000 AF - Conservation Storage WSEL 5463<br>31,000 AF - Total Storage WSEL 5467 | Lower Middle Basin 20 miles north of Pueblo | 12,000 to 28,000 Af | Identified in Colorado Springs Utilities' Water ResourcePlan; Provides storage for return flows on tributary of Fountain Creek. |
| 9 | Pueblo Reservoir | Existing Reservoir; Fryingpan-Arkansas Project<br>294,800 AF - Conservation/Joint Use Storage WSEL 4894<br>349,900 AF - Total Storage WSEL 4899<br>405,000 AF - Raise Dam 5 feet WSEL 4904 | Lower Middle Basin 2 miles west of Pueblo | 25,000 AF to 70,000 AF | Raise conservation pool 5 feet provides 55,000 af; Concerns re: flood control; USBR looking at costs of raising dam as adjunct to safety modifications. |
| 10 | St. Charles Reservoirs #2, #3 (Enlargement) | Existing Reservoir; CF&I LP<br>17,000 AF - #3 Existing Storage WSEL 4960<br>20,000 AF - Raise Dam 5 feet WSEL 4965 | Lower Middle Basin 7 miles south of Pueblo | 3,000 AF | Small storage potential, high evaporation.<br>Not suited to regional project or regulation of project water. |
| 11 | Cucharas Reservoir (Enlargement) | Existing Reservoir; Huerfano-Cucharas Irrigation Company<br>41,000 AF - Existing Storage WSEL 5766<br>63,000 AF - Raise Dam 5 feet WSEL 5871 | Lower Middle Basin 10 miles NE of Walsenburg | 22,000 AF | Significant sedimentation and evaporation concerns; History of safety concerns; Downstream dam has larger storage potential; Old dam would be difficult to raise. |
| 12 | Deweese Reservoir (Enlargement) | Existing Reservoir; DeWeese Dye and Ditch Reservoir Co.<br>1,800 AF - Normal Storage WSEL 7665<br>2,600 AF - Maximum Storage WSEL 7665+ | Upper Middle Basin 20 miles SW of Canon City | Up to 40,000 AF | Existing storage restriction and concerns re: dam stability; Old dam difficult to raise; Downstream site has larger storage potential |
| 13 | Fourmile Creek | New Dam | Upper Middle Basin Just north of Canon City | | Limited water availability for exchange.<br>Site not well suited for water management. |
| 14 | Badger Creek | New Dam | Upper Middle Basin 8 miles east of Salida | 1000 AF | Limited water availability for exchange.<br>Site not well suited for water management. |

# TABLE 8.1

## WATER AND STORAGE NEEDS ASSESSMENT

## POTENTIAL ALTERNATIVES (UNRANKED)

| Key No.[1] | Storage Option[2] | Description | Location | Storage Potential | Discussion |
|---|---|---|---|---|---|
| 15 | Turquoise Lake<br>(Sugarloaf Dam)<br>(Enlargement) | Existing Reservoir; Fryingpan-Arkansas Project<br>120,000 AF - Conservation Storage WSEL 9869<br>135,900 AF - Total Storage WSEL 9873<br>145,100 AF - Raise Dam 5 feet WSEL 9878 | Upper Basin 7 miles west of Leadville | 9,000 AF | Federal project facility; Adds additional layers of review; Raising dam could present significant technical challenges for raises greater than 5 feet. |
| 16 | Twin Lakes Reservoir (Enlargement or Access Dead Storage) | Existing Reservoir; Fringpan-Arkansas Project<br>67,900 AF - Conservation Storage WSEL 9200<br>55,000 AF - Dead Storage WSEL 9158<br>170,000 AF - Total Reservoir Capacity WSEL 9210<br>190,000 AF - Raise Dam 5 feet WSEL 9215 | Upper Basin 12 miles SW of Leadville | 55,000 AF - (Dead Storage)<br>20,000 AF - (Raise) | See above; Consider accessing dead storage with tunnel or pumped withdrawal of dead storage. |
| 17 | Clear Creek Reservoir (Enlargement) | Existing Reservoir; Pueblo<br>11,500 AF - Conservation Storage<br>12,300 AF - Total Storage WSEL 8880<br>15,300 AF - Raise Dam 10 feet WSEL 8890 | Upper Basin 12.5 miles south of Leadville | 3,000 to 100,000 AF | Concerns re: foundation seepage and ability to safely raise dam; Was in original Fry-Ark concept New dam required for 100,000 AF reservoir. |
| 18 | Tennessee Creek | New Dam Site; Pueblo Board of Water Works On Tennesssee Creek<br>29,000 AF - Potential Storage WSEL 9850 | Upper Basin 6 miles NW Leadville | Up to 29,000 AF | Pueblo has examined yield potential and assessed general site conditions; Permitting may be challenging due to wetlands. Could be filled by diversion from Turquoise Reservoir. |
| 19 | Halfmoon Creek | New Dam Site<br>30,000 AF - Potential Storage WSEL 10,400 | Upper Basin 10 miles SW of Leadville | Up to 100,000 AF | Water availability for exchange may be adequate. Site not as well suited for water management as sveral other Upper Basin options. |
| 20 | Upper Arkansas River Dam Site | New Dam Site; City of Aurora<br>Up to 50,000 AF - WSEL 9200 | Upper Basin 22 miles north of Buena Vista | Up to 50,000 AF | Mainstem dam site; Geologic reconnaissance completed 1/98; Significant permitting challenges. Filling from Project faclities appears to be feasible. |
| 21 | Box Creek Dam Site | New Dam Site; City of Aurora<br>Up to 30,000 AF - WSEL 9500 | Upper Basin 25 miles north of Buena Vista | Up to 30,000 AF | Full storage potential requires land exchange. Site is off-channel and filling from Project facilities appears to be feasible. |

## TABLE 8.1

WATER AND STORAGE NEEDS ASSESSMENT

### POTENTIAL ALTERNATIVES (UNRANKED)

| Key No.[1] | Storage Option[2] | Description | Location | Storage Potential | Discussion |
|---|---|---|---|---|---|
| 22* | Gravel Lakes Storage (Arkansas River) | Store water in mined gravel pits in river alluvium | Along Arkansas River near Pueblo | More than 13,000 AF | Requires cut-off wall or lining to meet SEO leakage criteria. Lesser permitting challenges in comparison to conventional storage reservoirs. |
|  | Gravel Lakes Storage (Fountain Creek) | Store water in mined gravel pits in river alluvium | Along Arkansas River near Fountain Creek |  | Requires cut-off wall or lining to meet SEO leakage criteria. Lesser permitting challenges in comparison to conventional storage reservoirs. |
| 23 | Elephant Rock [2] | New Mainstem Dam Site; Colorado Springs<br>Up to 68,000 AF - WSEL 8217 | Upper Basin<br>10 miles north of Buena Vista | Up to 68,000 AF | Construction requires relocation of Hwy 24 and the Denver & Rio Grande Western Railroad; Includes 2 pump stations and a 48", 70 mile pipeline to Upper Rampart Reservoir |
| 24 | Chalk Creek | New Dam Site<br>Upper Chalk Creek EL - 11,600<br>(Chalk Creek joins Arkansas at EL - 7600) | Upper Basin<br>7 miles south of Buena Vista | 15,000 AF | Significant flow is reported available; Storage potential limited by developments in canyon. |
| 25 | Fooses Creek | New Dam Site<br>Upper Fooses Creek EL - 11,000<br>(Fooses Creek joins Arkansas at EL - 9000) | Upper Basin<br>15 miles west of Salida | Up to 50,000 AF | Only a small portion of the South Arkansas Basin would be controlled; A large reservoir is possible but water management benefits appear to be minimal. |
| 26 | Boss Lake | Rebuild existing dam on Upper Lake Fork | Upper Basin<br>North of Buena Vista on Lake Fork | 600 AF to 1000 AF | Limited storage potential. |
| 27* | Aquifer Storage/Conjunctive Use | Valley Fill<br>Ogallala Formation<br>Dakota Sandstone | Along Arkansas | Varies w/ Location | Groundwater recharge would work best in Valley Fill or Dakota Sandstone. With high water tables storage volume for water management may be limited. |
| 28 | Fountain Reservoir | New Dam Site;<br>Up to 317,000 AF - WSEL 4932 | Lower Middle Basin<br>5 miles north of Pueblo on Fountain Creek | Up to 317,000 AF | Originally developed as a flood control project (Corps of Engineers) |

# TABLE 8.1

## WATER AND STORAGE NEEDS ASSESSMENT

## POTENTIAL ALTERNATIVES (UNRANKED)

| Key No.[1] | Storage Option[2] | Description | Location | Storage Potential | Discussion |
|---|---|---|---|---|---|
| 29 | Granada Reservoir | New Dam Site | Lower Basin on Kansas-Colorado State Line | Up to 30,000 AF | Could store winter, return flows, and some flood flows; Provides supplemental irrigation; would be in coordination with and compliment John Martin Res.; Originally conceived in 1950's. |
| 30 | Amsley Reservoir | New Dam Site | Lower Basin 8 miles west of Las Animas | Up to 30,000 AF | Would be used to transfer "Great Plains Reservoirs" storage; and may save evaporation losses; Originally conceived in 1950's as part of overall Basin plan |
| 31 | Reoperation of Fry-Ark Facilities | Operational changes only. No new facilities or storage. | At existing reservoirs and conveyance facilities | Up to 90,000 AF | Changes in operation that would enhance overall performance of the project in meeting long-range M&I and agricultural user needs in the District. |

(1) See Figure A. General Location of Potential Storage Sites

(2) Pursuant to a stipulation filed in Case No. 90CW56, Water Division 2, the City of Colorado Springs may be dismissing the water court application associated with storage at the Elephant Rock site.

* Not shown on Figure 1.

of reference for subsequent NEPA compliance activities relative to implementing a water project to meet District-wide objectives.

## 8.2 Description of Alternatives

Descriptions of the 31 alternatives are provided in the following paragraphs. These descriptions are based on information from a variety of data services, which are noted in the discussions. As discussed in Section 8.3, an initial screening of these options was performed to identify those alternatives having the greatest potential for effectively meeting identified needs. The description of each alternative includes a brief discussion of the rationale for advancing (or not advancing) a particular alternative to the next level of review and evaluation.

### 8.2.1 John Martin Reservoir

The existing John Martin Reservoir is located on the lower Arkansas River approximately 20 miles west of Lamar. The dam was constructed by the U.S. Army Corps of Engineers and completed in 1948. In addition to providing flood control, John Martin Reservoir is the primary accounting point for administration of the Arkansas River Compact. The reservoir has nearly 336,000 of conservation storage and 269,000 of flood control storage. Water stored in the conservation pool is delivered to Colorado irrigators and to the State of Kansas, using the Arkansas River channel as the conveyance mechanism. The allocation of John Martin Reservoir storage is summarized on page 8-9.

**John Martin Reservoir Data**

| | Elevation (ft) | Surface Area (ac) | Capacity (af) |
|---|---|---|---|
| Inactive(1) | 3,795 | 1,800 | 10,000 |
| Conservation | 3,851 | 11,394 | 335,700 |
| Flood Control | 3,870 | 17,151 | 269,415 |
| **Total** | | | **605,115** |

(1)The inactive allocation, which is the same as the recreation pool, may go below 10,000 acre-feet during periods when extremely low water supply is accompanied by high evaporation losses.

John Martin Reservoir may store two types of water. River flows are stored in the reservoir's conservation space. In the winter season, November through March, all water entering the reservoir is retained, up to the conservation pool level. In the summer season, April through October, river inflow to the reservoir is captured and re-regulated to meet the needs of users downstream in Colorado and Kansas. Inflows in excess of the needs of Colorado users are placed in conservation storage and allocated between Colorado and Kansas.

The second type of water that is stored at John Martin is water diverted under the Winter Water Storage Program. Under the program, the Las Animas Canal Company may store 5,000 af, the Fort Lyon Canal Company may store 20,000 af, and the Amity Canal Company may store 50,000 af. Amity Canal has the option of storing its 50,000 af either in John Martin or in the Great Plains Reservoir System.

The possibility of reallocating 55,000 to 120,000 af of conservation storage and/or flood storage space, in order to facilitate water exchanges, has been suggested in the past. Input from District water users indicated that the location of this storage may not be advantageous for exchange purposes. Also, significant institutional challenges would need to be addressed relative to dealing with the Corps of Engineers and changing operations of a reservoir that is a key feature of the Arkansas River Compact. For these reasons, the John Martin option was not advanced to the next level of evaluation.

### 8.2.2 Lake Meredith

Up to 75,000 af of additional storage could be provided by raising the embankment dam, which creates Lake Meredith. This project is currently under study by the City of Colorado Springs, which is a primary shareholder in the Colorado Canal Company. Colorado Spring's Utilities is assessing potentials for greater storage of native water, winter water, transmountain water, and Fry-Ark Project water to optimize the possibilities for water exchanges. Exchanges would occur between Lake Meredith and upstream reservoirs including Pueblo, Twin Lakes, Turquoise Lake, and Clear Creek reservoirs.

Lake Meredith is located 10 miles north of Rocky Ford and is an off-channel reservoir supplied by diversion from the Arkansas River into the Colorado Canal. Water flowing in the Colorado Canal also can be diverted into storage in Lake Henry. Additional storage capacity in Lake Meredith in the range of 15,000 to 75,000 af is being considered by Colorado Springs. Preliminary studies prepared for the City have indicated that raising the dam is technically feasible; however, specific information concerning the technical aspects of the dam raise have not yet been published. In GEI's experience with similar projects, the main issues with raising Lake Meredith Dam are likely to related to increased seepage potentials and design of effective measures to control, intercept, and safely handle seepage flows.

Lake Meredith is well positioned in the basin to facilitate exchanges. Releases from storage in Lake Meredith can compensate for direct flow diversions or storage of water by municipal entities with facilities in the upper portion of the Arkansas Basin. Agricultural interests have expressed concerns about the potential impacts on water quality associated with increased exchanges.

The Lake Meredith enlargement has several positive attributes, mainly related to enhanced exchange potentials and low unit cost of storage, and has been included in the list of preferred storage options on the Assessment Project.

### 8.2.3 Lake Henry

The Lake Henry enlargement option is similar to Lake Meredith; however, lesser volumes of storage could potentially be developed. A 5-foot raise of Lake Henry Dam would produce an additional 5,000 af of usable storage capacity. Because of the larger storage potential associated with Lake Meredith, the Lake Henry enlargement option was not included in the group of alternatives studied in greater detail.

### 8.2.4 Horse Creek Reservoir

Horse Creek Reservoir is part of the Fort Lyon Canal system. It is located 7 miles north of Las Animas, as shown on Figure 8.1. A 5-foot raise of this existing earthfill dam could provide an additional 10,000 af of storage. However, the storage would not be favorably located with respect to providing exchange potential or for regulating Project water. This option was dismissed from further study during the initial screening phase, primarily because a similar storage concept could be developed more efficiently at Lake Meredith.

### 8.2.5 Adobe Creek Reservoir

Enlargement of the existing reservoir could provide up to 25,000 af of additional storage with a 5-foot rise of the dam. Like Horse Creek, the Adobe Creek dam and reservoir are owned by the Fort Lyon Canal Company. The reservoir is located 12 miles north of Las Animas, as indicated in Figure 8.1. While storage potential is significant (25,000 af with a relatively minor raise of the dam), by virtue of its location, the reservoir is not well suited for managing water on a District-wide basis.

### 8.2.6 Cheraw Lake

This existing reservoir is located 12 miles northeast of Rocky Ford. Up to 4,000 af of additional storage could be provided. However, this site is not well positioned relative to water management needs within the District. Due to the fact, and the relatively small volume of potential storage, this site was not considered in subsequent planning.

### 8.2.7 Holbrook Reservoir

A 5-foot raise of Holbrook Dam could provide another 4,000 af of storage. Like the previous off-channel sites, other than Lake Meredith, storage at this site would not provide significant water management benefits for the District.

### 8.2.8 Williams Creek Reservoir

Colorado Springs Utilities have included this storage site in its long-range water supply plans. As currently envisioned, Williams Creek will provide regulation of reusable return flows via a diversion from Fountain Creek, in order to maximize river exchange potential. The reservoir site is on Williams Creek, a tributary of Fountain Creek which joins Fountain Creek between the City of Fountain and the City of Pueblo.

In the Colorado Springs long-range water resources plan, Williams Creek is the last component of the "Southern Delivery System" which includes acquiring dedicated storage space in the Fry-Ark Project, a pipeline from Pueblo Reservoir, terminal storage at the Jimmy Camp Creek site and Williams Creek Reservoir. According to planning studies by Colorado Springs Utilities, the amount of storage provided in Williams Creek is directly related to the amount of storage that can be made available in the Fry-Ark system. For example, modeling studies show that decreasing Fry-Ark storage dedicated for Colorado Springs from 45,000 to 44,000 af would substantially increase the storage capacity required in Williams Creek Reservoir from 12,000 to 25,000 af. Currently, Colorado Springs is planning to implement the Williams Creek Reservoir Project by the year 2034 with an active storage capacity of 12,000 af (total capacity of 15,000 af).

Williams Creek Reservoir, while currently planned to meet Colorado Springs future needs, could be sized to serve as a "regional" project. The damsite appears to be suitable for a reservoir with total storage of 31,000 af (active volume of 28,000 af). Above that volume, topography begins to limit the efficiency of storage. At 31,000 af, the dam would need to be approximately 90-feet high, assuming 10-feet of freeboard for flood storage and routing. A 12,000 af reservoir would involve a dam approximately 75-feet high. The dam would be an earthfill structure with an inlet/outlet works to Fountain Creek, a large capacity emergency drawdown outlet, and a spillway designed for an inflow design flood equal to the probable maximum flood.

Because of its integration with Colorado Springs raw water system, Williams Creek Reservoir would be an important feature of long-range water management. However, the storage potential over and above Colorado Springs' needs is relatively small (approximately 16,000 af). This storage option has sufficient positive attributes for inclusion in the list of alternatives for more detailed evaluation.

### 8.2.9 Pueblo Reservoir

Pueblo Reservoir is the terminal storage facility for the Fry-Ark Project and the centerpiece for water management in the District's service area. The dam is located on the Arkansas River in Pueblo County, just upstream from the City of Pueblo, has a total storage capacity of 357,000 acre-feet; 30,000 acre-feet of dead and inactive capacity; 234,000 acre-feet of conservation capacity; 66,000 acre-feet of joint-use capacity; and 27,000 acre-feet of exclusive flood-control capacity. The concrete dam and massive-head buttress-type spillway structure is the principal control structure for the reservoir. The concrete section is 1,750 feet wide with a maximum spill discharge of 191,500 cubic feet per second (cfs). The river outlet works is controlled by two 4-foot-square high-pressure gates that regulate normal releases to the river. Additional releases may be made to the river through three separate outlet works located in the spillway buttresses. Each is controlled by two 6-foot by 6.5-foot high-pressure gates. Delivery of water for municipal and industrial use is made from the south outlet works, which is connected to a multilevel intake structure capable of taking water from the reservoir at different levels, thus providing a degree of control over water temperature and quality. Water deliveries from the outlet works supplying the downstream fish hatchery have similar controls. Included in the outlet works are a stilling basin and outlet channel, a concrete river plug in the river channel, and the Bessemer Ditch headworks.

Currently, the maximum storage in Pueblo Reservoir is restricted due to safety concerns with the concrete portion of the dam. The Bureau will be initiating repair work in the Fall of 1998, with completion scheduled for the year 2000, by which time the storage restriction will be lifted. The restriction in storage, therefore, is short-term only and is not being considered in assessment of storage needs for District entities.

As described previously, Colorado Springs is interested in obtaining dedicated storage space is Pueblo Reservoir, and other Fry-Ark storage vessels, for its non-Project water. The Winter Water Storage Program (WSSP) relies heavily on Pueblo Reservoir for storage and also would benefit from dedicated space to reduce the frequency of spilling of water stored under the WSSP. Operation studies described in Section 7, suggest that space may be made available in Pueblo Reservoir (and other Fry-Ark facilities) to accommodate dedicated storage of non-Project water. Nonetheless, a physical increase in storage capacity in Pueblo Reservoir may be a desirable long-term water management strategy.

The Bureau currently is evaluating the technical feasibility of, and costs associated with, increasing storage in Pueblo Reservoir by 25,000 to 75,000 af. The smaller addition of storage volume could be accomplished with approximately a 5-foot raise of the dam. This could be accomplished with a parapet wall and raising of the spillway ogee. The 75,000 af volume addition would require additional earthfill on the embankment, a parapet wall for wave runup, and a higher raise of the spillway ogee.

Cost estimates are not yet available from the Bureau (as of September 22, 1998). However, the relatively large volumes of additional storage that could be developed, with relatively modest physical changes to the dam, suggest that this storage option must be carefully considered in any long-range planning for District water users. Additional storage on the East Slope could provide for additional imports of West Slope Project water that have not been delivered due to storage space limitations. However, as discussed in Section 7, the increase in municipal water demand over time will help to free up space in Pueblo Reservoir that currently is used for municipal carryover storage.

### 8.2.10 St. Charles Reservoirs No. 2 and No. 3

These two existing reservoirs are located 7 miles south of Pueblo and are owned by CF&I. They are located just west of I-25 at Stem Beach, in an area of relatively flat topography. Raising Reservoir No. 2 could pose safety issues for Reservoir No. 3, which is immediately upstream. Raising Reservoir No. 3 by 5 feet would create additional storage of approximately 3,000 af. Enlargement of these reservoirs was suggested in earlier meetings of Storage Study Committee. However, the small amount of additional storage and its position in the Basin suggest that this storage option should not be considered as part of a regional project.

### 8.2.11 Cucharas Reservoir

Cucharas Reservoir (No. 5) is located on the Huerfano River 10 miles northeast of Walsenburg. The reservoir capacity is approximately 41,000 af. The dam has a history of safety issues, including a partial failure of the upstream concrete facing of the rockfill dam. Repairs to the facing have been made. Storage capacity is limited by extensive sediment buildup in the reservoir. Having worked on the dam in the past, GEI believes that raising the existing dam is not technically feasible.

The reservoir has extensive recreational and fisheries potential, in addition to its primary purpose of irrigation water storage. Several private entities have examined the water rights and storage potentials, but have not taken subsequent actions relative to purchasing these water assets.

The only feasible option for significantly increasing storage at Cucharas Reservoir is to construct a new dam of modern design downstream of the present dam. The geology appears to be suitable for a roller-compacted concrete (RCC) gravity dam. With a normal pool at elevation 5871 (5 feet higher than the existing dam), an additional 22,000 af of storage could be provided. A new dam 10 feet or more higher than the existing dam appears to be feasible.

The drainage basin above Cucharas Dam is large and the Huerfano River is subject to significant seepage losses, except during flood periods. Therefore, the flexibility to operate Cucharas Reservoir to meet downstream needs along the Arkansas River is limited in the absence of a man-made conveyance system. We recommend that the District and Basin water users be prepared to consider the opportunities for possible participation in a project involving Cucharas Reservoir. Based on interest in this project expressed by developers over the years, it appears likely that opportunities to market Cucharas Reservoir water and develop additional storage may be brought forward during the next 10 years. The District and its member entities should consider such proposals as they are brought forward to assess possible benefits to District water users.

### 8.2.12 DeWeese Reservoir

Like the Cucharas Reservoir, increased storage at DeWeese Reservoir or further downstream on Grape Creek, has been the subject of consideration by one or more water developers, DeWeese Dam impounds a 4,000 af reservoir, located 20 miles southwest of Canon City. The existing dam is a concrete gravity structure. The upper portion of the dam has suffered concrete deterioration over the years. The DeWeese-Dye Ditch and Reservoir Company has studied the problem, and the CWCB will help to fund final design and construction of a project to remove and replace the upper 12 feet of the dam. This work will be completed over the next one to two years. Raising the old dam could provide additional storage, but likely would require major strengthening of the existing dam. However, a modern RCC dam at a downstream site could provide over 40,000 af of total storage (36,000 af of storage in addition to the existing reservoir).

Streamflows on Grape Creek are sufficient to permit consideration of storage by exchange; however, the present reservoir develops a sizable portion of the available supply. It is possible that water developers may study the enlargement of DeWeese Reservoir as a source of supply to be marketed to municipal entities. If this happens, the District should consider the proposal in light of how it may integrate with long-range water management objectives of the District as a whole.

### 8.2.13 Fourmile Creek Site

Fourmile Creek flows from the north to the south joining the Arkansas River near Canon City. Storage on this creek was suggested during an early SSC meeting. There are several sites that appear topographically suitable for storage. Conceivably, a reservoir of over 200,000 af capacity could be developed with a dam nearly 250 feet high. However, native runoff from Fourmile Creek would not be adequate to support a reservoir even a fraction of this size. While storage potential is significant, the site is too far away from major water conveyance facilities to permit filling with transmountain water or water from the Upper Arkansas Basin. Therefore, this storage option was not considered further.

### 8.2.14 Badger Creek Site

Badger Creek is a north-south tributary of the Arkansas located east of Salida. It joins the Arkansas River approximately 3 miles downstream of Wellsville. The creek flows within a fairly deeply incised canyon. It appears that several damsites could store up to 25,000 af. However, to provide this storage a dam over 200 feet high would be required. Badger Creek does have sufficient drainage area to support a reservoir of that size and a reservoir at this location could not be filled using existing water conveyance facilities associated with the Fry-Ark Project. Therefore, this option was not considered further.

### 8.2.15 Turquoise Reservoir

This existing reservoir, created by Sugarloaf Dam, is located in the Upper Basin and near Leadville and is the first storage facility of the Fry-Ark Project. Turquoise stores West Slope The reservoir storage capacity is 129,000 af, of which 120,000 af is active storage. Sugarloaf Dam is an earthfill structure, has a length of 2,020 feet, a height above riverbed of 135 feet, and contains approximately 1.8 million cubic yards (cy) of fill material. In addition to the main earthfill section of the dam, there is a dike about 6,000 feet to the northeast. This dike is 475 feet long and 11 feet high. The spillway has a capacity of 2,920 cubic feet per second and consists of a morning-glory intake structure, a 16.5-foot-diameter monolithic concrete conduit, a chute and a stilling basin. The outlet works consists of: an intake structure with trashtracks; a 7-foot-diameter concrete conduit with a steel liner; a gate chamber housing a 5-foot by 6-foot high-pressure gate; an 11-foot-diameter concrete conduit with a steel liner; a 72-inch-diameter steel outlet pipe, which bifurcates into two parallel branches just ahead of the control house for the river outlet; a river outlet control house with two 3.5-foot-square high-pressure gates for each branch; and a chute and stilling basin discharging to Lake Fork Creek. A short 72-inch-diameter steel branch outlet pipe, with a bulkhead, was provided upstream from the bifurcation for future use, and as an outlet to the Mt. Elbert Conduit. The capacity of the river outlet is 1,120 cubic feet per second, and the capacity of the outlet to the Mt. Elbert Conduit is 370 cubic feet per second.

A portion of the storage in Turquoise Reservoir is dedicated to non-Project uses as described in Section 7. As described later in this chapter, a significant raise of Sugarloaf Dam does not appear to be technically feasible due to seepage concerns. However, a 5-foot raise of the dam with a parapet wall may be a practical and cost-effective method to develop 9,000 af of storage capacity.

### 8.2.16 Twin Lakes

The "middle" reservoir of the East Slope Fry-Ark facilities is Twin Lakes located just west of the Arkansas River on the Lake Creek, approximately 13 miles south of Leadville, in Lake County. The primary source of water in Twin Lakes is transmountain imports conveyed from Turquoise Reservoir in the Mt. Elbert Conduit to Mt. Elbert Forebay.

Mt. Elbert Forebay occupies a saddle on a ridge above Twin Lakes Reservoir. The forebay is impounded by a dam on the north side and a dike on the south rim. An outlet channel from the southeast corner of the reservoir connects the inlet-outlet structure for the penstock leading to the Mt. Elbert Powerplant. The rolled earthfill forebay dam is about 2,600 feet long and 92 feet high. A 130-foot-long earth dike closes a low saddle at the southwest end of the reservoir. The forebay is lined with a 5-foot-thick, water-tight layer of impervious material. There is no spillway in the forebay dam. There is also no outlet works, other than the inlet-outlet structure for the powerplant. Natural flow into the reservoir is negligible due to the small drainage basin.

Twin Lakes Reservoir has a total capacity of 141,000 af. The dam is a zoned, rolled earthfill structure with a height above streambed of 53 feet. The crest of the dam is 30 feet wide and 3,150 feet long. The spillway is through left abutment of the dam, and has a capacity of 1,400 cubic feet per second. The spillway is an uncontrolled concrete morning-glory inlet structure with a 12-foot-diameter concrete conduit under the dam embankment and a concrete stilling basin. A channel downstream from the stilling basin conveys water to Lake Creek. The outlet works located in the right abutment can deliver 3,465 cfs to the river. It has an inlet structure with trashracks, twin 8-foot-diameter concrete conduits with steel liners, and a gate chamber housing two 6.5- by 8-foot-high-pressure gates. Twin 12.5-foot-diameter concrete conduits, each containing a 98-inch-diameter steel outlet pipe, convey water from the gate chamber to the river outlet control house with two 6.5- by 7.5-foot-high pressure gates. A chute, stilling basin, and a 400-foot-long outlet channel lead to Lake Creek.

The dam conceivably could be raised by 5 feet with the potential to gain 20,000 af of capacity. However, concerns exist relative to seepage and foundation conditions. As discussed later in this chapter, the dead storage capacity in Twin Lakes, which totals 55,000 af, may have significant value as "drought insurance" for entities within the District.

Twin Lakes is well located to provide enhanced water management for District water users. It already has space dedicated to non-Project water, as described in Section 7. Studies by Colorado Springs indicate that additional dedicated non-Project storage in the Upper Basin would be beneficial to their long range water interests.

### 8.2.17 Clear Creek

Clear Creek Reservoir is located on Clear Creek just upstream from the Arkansas River near Granite. The dam is a 75-foot-high embankment, with a crest length of 2,200 feet. Conservation storage is approximately 11,500 af. The project is owned and operated by the Pueblo Board of Water Works. Originally, Clear Creek Reservoir was to be an integral part of the Fry-Ark Project, serving as the afterbay for the Otero Powerplant. However, that element of the project was not constructed. Additional storage on Clear Creek could provide significant benefits to water users in the District. In addition to native flows, storage could be filled from nearby conveyance facilities of the Fry-Ark Project.

A 10-foot raise of the existing dam could provide approximately 3,000 af of added storage; however, significant seepage and dam safety issues would need to be addressed. Over the years, Pueblo has been dealing with seepage issues at the dam. Because of seepage and foundation concerns, as well as potential topographic constraints at the present site and its proximity to U.S. Highway 24, it appears that additional storage on Clear Creek would be best developed at an upstream site just above the existing reservoir. As described later in this section of the report, 100,000 af of storage capacity could be provided on Clear Creek with a new 255-foot high embankment dam.

### 8.2.18 Tennessee Creek Site

The Pueblo Board of Water Works has identified a storage site on Tennessee Creek about ½-mile northeast of Turquoise Reservoir and 6 miles northwest of Leadville. The reservoir would be located in a broad, flat valley drained by Tennessee Creek. A 50-foot-high dam with crest length of 2,200 feet would create a 28,000 af reservoir. The reservoir could be filled with West Slope water, via diversion from Turquoise Lake, and from native runoff from the 45-mi$^2$ Tennessee Creek drainage basin. The site appears suitable for an embankment dam, based on generally understood geologic conditions. Given the concerns with seepage of dams in the Upper Basin (Sugarloaf, Twin Lakes, and Clear Creek), extensive seepage control and collection measures would need to be incorporated into the dam design. Because of its location and ability to store West Slope and Project water, this storage option has been included in the list of options for further study.

### 8.2.19 Halfmoon Creek

This storage site is located 10 miles southwest of Leadville on Halfmoon Creek. The dam is about 1.5 miles downstream from Emerald Lake, which would be inundated by a larger size reservoir. The reservoir would be located near the Mount Massive Wilderness area and, therefore, intensive environmental scrutiny would be expected. A 100,000 af reservoir could be created at the Halfmoon Creek site. In addition to native runoff from a 23-mi$^2$ drainage basin, the reservoir could store West Slope water, assuming construction of an interconnecting pipeline from the Mt. Elbert Conduit to the new reservoir. The reservoir surface would be at Elevation 10,000 to 10,200 depending on the storage requirement. Pumping from the Mt. Elbert conduit would be required. This site also was carried forward for more detailed comparison with other storage options.

### 8.2.20 Upper Arkansas River Site

This site is on the mainstream of the Arkansas River near the Hayden Ranch, approximately 22 miles north of Buena Vista. A geologic reconnaissance of this site was performed in early 1998. No "fatal flaws" were discovered. The site is located approximately 2 miles upstream of the Lake Creek/Arkansas River confluence at a location where the narrow valley broadens into a much wider valley drained by the Arkansas River and Box Creek. The small town of Kobe and segments of U. S. Highway 24 and the Denver and Rio Grande Railroad would be inundated and would need to be relocated. The upstream drainage area is 290-mi$^2$ and the project could store native flows, as well as West Slope water. Storage potential at the site is approximately 50,000 af.

Given the controversy that developed over other proposals to dam the Upper Arkansas River, this storage option is likely to be subjected to intensive public and environmental scrutiny and be very challenging to permit, in comparison to other options. However, this site was carried forward for more detailed evaluation, based on inputs from the SSC.

### 8.2.21 Box Creek Site

This storage site is located on a small tributary of the Arkansas River called Box Creek, located just to the northwest of the Upper Arkansas (Hayden Ranch) site and approximately 2 miles northeast of the Mt. Elbert Forebay and Twin Lakes. The reservoir basin would be in an area that was intensively mined and is now covered with dredged tailings. Storage potential is 33,000 af.

The reservoir would regulate flows from a 12-mi$^2$ modest basin, however, storage space could be filled from the Mt. Elbert conduit, or a separate conduit from the Mt. Elbert Forebay to Box Creek Reservoir. Because of the potential for storing both native and transmountain water, this alternative was included among the alternatives for further, more-detailed evaluation.

### 8.2.22 Gravel Lakes Storage - Arkansas River/Fountain Creek

The technology of storing water in sand and gravel pits is developing rapidly. Along the South Platte in the Denver Metro area, literally dozens of such projects are built, under design, or in the advanced planning stages. The Colorado State Engineer has promulgated rules governing storage in gravel lakes facilities and has adopted strict criteria for leakage into the gravel pits from the alluvial aquifers adjacent to the gravel lakes. Compliance with these rules requires the use of seepage control measures, such as clay liners or slurry cutoff walls, to limit seepage into the gravel lakes when they are drawn down. These lining systems prevent injury to water users in the region that rely on alluvial wells and also prevent loss of streamflow from inflow into the lakes.

We understand that opportunities for development of gravel lakes along the Arkansas River in the vicinity of Pueblo are being explored by the Pueblo Board of Water Works. A preliminary assessment of gravel lakes storage potentials along the Arkansas was made using USGS 7.5-minute mapping. There are numerous old pits and no doubt many new pits are planned or have been mined since the USGS maps were issued. A detailed inventory based on a review of data at the Colorado Division of Minerals and Geology was beyond the scope of the present study.

Based on the map review, it appears that 13,000 af of storage could be developed along the Arkansas River in pits currently showing on USGS 7.5-minute maps. Typically, gravel pits in river alluvium along the Front Range are 20 to 30 feet deep. The selection of areas to mine usually is based on land ownership and use, depth of overburden, and depth and quality of sand and gravel materials.

Gravel lakes in the Denver area typically are used to facilitate water exchanges, whereby water is released from gravel lakes storage to compensate for diversion of higher quality water upstream. Because most of the storage is below ground and existing pits are used, gravel lakes storage is considered to be environmentally "benign." Recreational amenities can be incorporated; however, lake fluctuations can be significant during a given year.

Because of their potential to create economic storage space and relatively few environmentalist checks, gravel lakes storage opportunities were included in the list of options for further evaluation.

### 8.2.23 Elephant Rock Site

Over the years, a major storage dam and reservoir on the mainstream Arkansas River has been considered by entities within the District. One site, the Elephant Rock Reservoir, would be located 3 miles north of Buena Vista. As conceived in the 1996 Water Resource Plan of the Colorado Spring Utilities, Elephant Rock Reservoir would provide 19,000 af of storage for

Colorado Springs. A 1989 study identified a storage potential at the site of 70,000 af with a 135-foot-high dam having a crest length of 1,100 feet. An earthfill structure was assumed for earlier cost estimating; however, an RCC dam may be feasible at the site. The reservoir would inundate several miles of U. S. Highway 24 and the Denver and Rio Grande Railroad which would be relocated. Several residences also would need to be relocated.

The proposal to develop storage at the Elephant Rock site generated significant public concern and opposition. The City of Colorado Springs recognized the challenges associated with permitting the Elephant Rock Project. Pursuant to a stipulation in Case No. 90CW56, Water Division 2, the City of Colorado Springs may be dismissing the water court application associated with storage at the Elephant Rock Site.

Colorado Springs has explored other storage options, including storage in Fry-Ark Project facilities, in lieu of developing the Elephant Rock Project. If these options should not pan out, the City of Colorado Springs could possibly return its attention to developing a mainstream storage project.

### 8.2.24 Chalk Creek Site

The Chalk Creek damsite is located on the Upper Basin on a tributary of the Arkansas River. The site is 7 miles south of Buena Vista and 4 miles east of Nathrop. Storage on Chalk Creek was suggested in a SSC meeting by a District Board member representing the Upper Arkansas Water Conservatory District. A dam and reservoir downstream of Alpine and upstream of Cascade, two small towns in the Chalk Creek canyon, could provide 15,000 af of storage. The reservoir would control runoff from a 70-$mi^2$ basin which yields appreciable volumes of water. Larger storage volumes could be accommodated in the Chalk Creek canyon; however, significant relocations would be required.

By virtue of its location, opportunities to store Project or other transmountain water in a reservoir on Chalk Creek are limited. However, Chalk Creek yields sufficient water to permit storage by exchange in a reservoir in the 15,000 af capacity range. Geologic conditions suggest that a zoned embankment dam would be the preferred dam type; however, a RCC dam may be feasible. The Chalk Creek site was included in the list of alternatives for further evaluation.

### 8.2.25 Fooses Creek Site

Fooses Creek is a tributary of the South Arkansas River. A dam in the upper portion of the drainage near the Continental Divide could store up to 50,000 af. However, it is doubtful that Fooses Creek would yield sufficient water to permit storage of Project water by exchange. This storage option was not carried forward into the next level of evaluation.

### 8.2.26 Boss Lake Site

Boss Lake is located in the upper portion of the Lake Fork drainage. Up to 1,000 af of storage could be created with reconstruction or replacement of the old Ross Lake Dam. This amount of storage is too small to be of interest in terms of a storage project meeting regional water supply objectives. Additional storage at Turquoise Reservoir probably would be more cost-effective for regulation of Lake Fork flows than reconstruction of Boss Lake.

### 8.2.27 Aquifer/Storage Conjunctive Use

The conjunctive management of surface and ground water resources is practiced extensively in water short areas of the Western U. S. Notable projects include the City of Wichita's (Kansas) Aquifer Storage and Recharge (ASR) Project, the Edwards Aquifer Project in Texas, and the El Paso's (Texas) ASR Project. In Colorado, the City of Colorado Springs has explored options for recharging its aquifers using surface water supplies. A pilot project for deep-well injection of treated surface water has been undertaken by the Willow Water District south of Denver, in cooperation with Denver water and other entities.

In the Arkansas Basin, conjunctive use opportunities may exist in the alluvial aquifers of the Valley Fill, whereby "excess" surface water of Fry-Ark Project return flows could be temporarily stored below the ground to be withdrawn by wells at a later date or allowed to flow back to the river for later withdrawal. Generally, water levels in the alluvial aquifers are already quite high; therefore, space for storing water in a conjunctive use operation appears to be limited. In a similar setting in Colorado, a large-scale conjunctive use demonstration program is under way on the South Platte River northeast of Denver. As data from the Tamarack Project becomes available, study of conjunctive use opportunities in the Arkansas Basin may be warranted. Municipalities such as Colorado Springs are likely to continue exploring and developing local ASR projects to maximize use of their existing water supplies.

Institutional challenges for such projects may be substantial. Under Colorado water law, adjudication of conjunctive use projects in the Arkansas Basin is expected to be significantly more demanding than a conventional storage project. Water quality issues may also be difficult to address.

Based on these considerations, we believe the concept of aquifer storage/conjunctive use should be evaluated further as a water management tool. However, we do not believe that this option will be a replacement for additional surface water storage.

### 8.2.28 Fountain Reservoir Site

In 1970, the U. S. Army Corps of Engineers conducted a survey of flood control needs and flood storage/protection alternatives along Fountain Creek and the Arkansas River above John Martin Dam. A 247,000 af multipurpose project on lower Fountain Creek was configured at a site 6 miles north of Pueblo. In addition to flood storage, the project would have provided a permanent recreation/sediment pool of 60,000 af. Specific allocations for water supply storage were not identified in the Corps' report. As configured by the Corps, the zoned embankment dam would be nearly 13,000 feet long with a maximum height of 172 feet. A 60,000 af reservoir would require a dam approximately 9,000 feet long and over 60 feet high.

Storage at the downstream end of Fountain Creek may provide water management benefits primarily from regulation of municipal return flows generated by the FVA entities and storage of large flood flows occurring relatively infrequently. Project water conceivably could be stored by exchange or by conveyance from the Fountain Valley Conduit.

This project was not brought forward to the next level of review because other projects such as Williams Creek and the Lake Meredith Enlargement could provide similar water management benefits.

### 8.2.29 Granada Reservoir Site

In the 1950's, the Bureau of Reclamation examined a reservoir adjacent to the Arkansas River at the state line. This off-channel reservoir with capacity of 30,000 af would have provided regulation of winter return flows and provided for increased irrigation use by ditches below John Martin Dam. This downstream storage option could provide reregulation opportunities; however, storage at this location would not provide direct benefits to water users within the District. With development of the Fry-Ark Project and the Winter Water Storage Program, the need for regulation of winter water return flows has been significantly reduced or eliminated.

### 8.2.30 Amsley Reservoir Site

The Bureau in the 1950's also studied storage at the Amsley site on Horse Creek about 2 miles upstream from its confluence with the Arkansas River. The purpose of this project was to transfer some storage from the Great Plains Reservoir to a site subject to less evaporation losses. Flood flows on the Arkansas River would have been diverted to the Amsley site for storage and later use for irrigation. The Bureau report did not identify a specific project configuration or the storage potential; however, examination of USGS maps indicates that a relatively broad shallow reservoir could be constructed and may require extensive dike construction. A project such as this would primarily benefit downstream irrigators and provide relatively fewer opportunities for exchanges in comparison to storage at Lake Meredith or higher in the Basin.

### 8.2.31 Fry-Ark Project Reoperation

As described in Section 7, opportunities for "reoperation" of the Fry-Ark Project storage have been evaluated by the Bureau (1990) and most recently by Colorado Springs. The focus of these studies has been to identify whether or not storage space in Project facilities (Pueblo, Twin Lakes, and Turquoise reservoirs) could be dedicated for storing non-Project water without adversely affecting Project operations. Results of these studies, documented in Section 7, suggest that Fry-Ark reoperation may be a viable option for meeting at least a portion of the long-range water needs within the District.

## 8.3 Initial Screening of Alternatives

As described in Section 8.1, the screening and evaluation of potential alternatives is very preliminary in nature. Significant additional evaluations will be undertaken during subsequent phases of investigation and during eventual compliance with requirements of NEPA.

The 31 alternatives summarized in Table 8.1, and described in Sections 8.2.1 through 8.2.31, represent a fairly comprehensive list of potential water storage options for water users in the District. Obviously, the list is not "all-inclusive." There no doubt are literally dozens of potential sites with topography and geology suitable for construction of a dam and reservoir. In general, the storage alternatives include: (1) enlargements (or reoperation) of existing storage facilities that currently are meeting water management needs within the District; (2) new storage sites that have been identified by water managers within the District as having the potential to meet District-wide objectives; and (3) potential storage sites that are identified by Federal agencies during project planning studies conducted prior to implementation of the Fry-Ark Project.

Conducting even preliminary-levels studies on 31 alternatives would have over-taxed the resources available for conducting the Assessment Project studies. Therefore, an initial screening step was undertaken in cooperation with the SSC. This initial screening reduced the number of options to a more manageable level.

The initial screening was conducted using a qualitative approach based on the following criteria:

- Location of storage: Storage at or above Pueblo Reservoir is believed to be more attractive due to greater operational flexibility and normally deeper reservoirs.

- Service potential to entire district: Very cost efficient to convey water to any demand location in the SECWCD.

- Storage potential greater than 20,000 acre-feet: Lesser volumes of storage may be suitable for local needs. Storage in excess of 20,000 af is likely to be needed to meet needs on a regional basis.

- Enlargement versus new dam: Generally, enlargements of existing projects are easier to permit than new dams and reservoirs.

- Suitable for re-regulation of return flows: While upper basin storage is desirable from a water management perspective, sites lower in the basin, such as Lake Meredith, are attractive because of their potential to regulate municipal return flows.

- Anticipated few technical challenges: The geology at several alternative locations, and known difficulties related to seepage at certain existing dams, indicates that technical challenges for certain alternatives will be greater than for others.

- Storage efficiency is high: Upper basin reservoir sites generally have higher water supply storage efficiencies because of lower evaporation rates and smaller reservoir surface areas for equivalent volumes of storage. Lower basin sites can be efficient if storage is not in a broad, shallow reservoir.

- Few environmental concerns: Certain alternatives, by virtue of their location, are expected to have significant environmental impacts in comparison to others.

- No complex federal institutional issues: Certain projects will be inherently more challenging to implement due to federal ownership or involvement in the project.

- Recreation potential is high: Certain alternatives appear to have better recreational potential than others, based on their location and accessibility.

- Good public support is possible: Generally, alternatives that are not on the mainstem Arkansas River may be more acceptable to the public.

- Low potential impacts to fish and wildlife: Alternatives that do not inundate the mainstem Arkansas or its larger tributaries are likely to have fewer potential impacts than those that cause such inundation.

- Low potential for water quality issues: Certain alternatives may provide storage with few constituents and less opportunity to accumulate pollutants.

- Good potential for exchanges: Certain alternatives provide more opportunities for exchanges than other options.

The initial screening process involved comparing the alternatives against the above-noted, general criteria to see which alternatives had more positive attributes. Using this qualitative process, 12 of the 31 identified options emerged as candidates for further review and investigation. Based on inputs from the SSC, an additional project was added to the list. This is the Upper Arkansas River (Hayden Ranch) storage site. Twin Lakes option was added to the list because of its potential importance in terms of Fry-Ark operations, potential reoperation requirements, and the large volume of dead storage that may be an important drought management option for the District. Therefore, 14 alternatives were carried forward to the next level of review and evaluations. These alternatives are identified in Tables 8.2 and 8.3 and are summarized below in unranked fashion.

- **Reoperation of Fry-Ark Storage Facilities**

**Reservoir Enlargements**

- **Pueblo Reservoir**
- **Clear Creek Reservoir** (1)
- **Turquoise Lake** (2)
- **Twin Lakes Reservoir** (3)
- **Lake Meredith**

**New Reservoirs**

- **Halfmoon Creek**
- **Tennessee Creek**
- **Upper Arkansas (Hayden Ranch)**

- **Box Creek**
- **Chalk Creek**
- **Williams Creek**

- **Gravel Lakes**
- **Aquifer Storage/Conjunctive Use**

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(1) Would require a new upstream dam to gain appreciable new storage on Clear Creek.

(2) A major dam rise is not considered to be technically feasible.

(3) A major dam raise is not considered to be technically feasible. Use of large storage volume is proposed for consideration.

# TABLE 8.2
## WATER AND STORAGE NEEDS ASSESSMENT
## SCREENING OF POTENTIAL ALTERNATIVES

| Map Key Number | Potential Storage Option (Unranked) | Category | Storage at or Above Pueblo Reservoir | Service Potential to Entire District | Storage Potential Greater than 20,000 af | Enlargement versus New Dam | Suitable for Re-regulation of Return Flows | Anticipated Few Technical Challenges | Storage Efficiency is High | No Complex Federal Institutional Issues | Recreation Potential is High | Few Environmental Concerns | Good Public Support is Possible | Low Fish and Wildlife Habitat Impact | Low Potential for Water Quality Issues | Good Potential for Exchanges |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | John Martin Reservoir | | | | ✓ | ✓ | ✓ | ✓ | | | ✓ | ✓ | | ✓ | | |
| **2** | **Lake Meredith** | A | | | ✓ | ✓ | ✓ | ✓ | | | ✓ | ✓ | ✓ | ✓ | | ✓ |
| 3 | Lake Henry | | | | | ✓ | ✓ | ✓ | | ✓ | | ✓ | | ✓ | | |
| 4 | Horse Creek Reservoir | | | | | ✓ | ✓ | ✓ | | ✓ | | ✓ | | ✓ | | |
| 5 | Adobe Creek Reservoir | | | | ✓ | ✓ | ✓ | ✓ | | ✓ | | ✓ | ✓ | ✓ | | |
| 6 | Cheraw Lake | | | | | ✓ | ✓ | ✓ | | ✓ | | ✓ | ✓ | ✓ | | |
| 7 | Holbrook Reservoir | | | | | ✓ | ✓ | ✓ | | ✓ | | ✓ | ✓ | ✓ | | |
| **8** | **Williams Creek Reservoir** | A | | | ✓ | | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | | ✓ |
| **9** | **Pueblo Reservoir** | A | ✓ | | ✓ | ✓ | ✓ | ✓ | ✓ | | ✓ | ✓ | ✓ | ✓ | | ✓ |
| 10 | St. Charles Reservoirs #2, #3 | | | | | ✓ | ✓ | ✓ | | ✓ | | ✓ | ✓ | ✓ | | |
| 11 | Cucharas Reservoir | | | | ✓ | ✓ | | | | ✓ | ✓ | ✓ | ✓ | ✓ | | |
| 12 | DeWeese Reservoir | | ✓ | | ✓ | ✓ | | ✓ | | ✓ | ✓ | | ✓ | | | |
| 13 | Fourmile Creek | | ✓ | | | | | | | ✓ | ✓ | | | | ✓ | |
| 14 | Badger Creek | | ✓ | | | | | ✓ | ✓ | ✓ | | | | | ✓ | |
| **15** | **Turquoise Lake** | A | ✓ | ✓ | ✓ | ✓ | | | ✓ | | ✓ | | ✓ | ✓ | ✓ | ✓ |
| **16** | **Twin Lakes Reservoir** | B | ✓ | ✓ | ✓ | ✓ | | ✓ | ✓ | | | | | | ✓ | ✓ |
| **17** | **Clear Creek Reservoir** | A | ✓ | ✓ | ✓ | ✓ | | | ✓ | ✓ | ✓ | | ✓ | ✓ | ✓ | ✓ |
| **18** | **Tennessee Creek** | A | ✓ | ✓ | ✓ | | | ✓ | | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| **19** | **Halfmoon Creek** | A | ✓ | ✓ | ✓ | | ✓ | ✓ | | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | |
| **20** | **Upper Arkansas River** | B | ✓ | ✓ | ✓ | | | ✓ | ✓ | ✓ | ✓ | | | | | ✓ |
| **21** | **Box Creek Dam Site** | A | ✓ | ✓ | ✓ | | | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | | ✓ |
| **22** | **Gravel Lakes Storage** | A | ✓ | | ✓ | | ✓ | ✓ | ✓ | ✓ | | ✓ | ✓ | ✓ | | |
| 23 | Elephant Rock[1] | | ✓ | | ✓ | | | ✓ | ✓ | ✓ | ✓ | | | | ✓ | ✓ |
| **24** | **Chalk Creek** | A | ✓ | | ✓ | | ✓ | ✓ | ✓ | ✓ | ✓ | | | | ✓ | ✓ |
| 25 | Fooses Creek | | ✓ | | ✓ | | | ✓ | ✓ | ✓ | ✓ | | | | ✓ | |
| 26 | Boss Lake | | ✓ | ✓ | | ✓ | | ✓ | ✓ | ✓ | ✓ | | | | ✓ | |
| **27** | **Aquifer Storage/Conjunctive Use** | A | ✓ | | ✓ | ✓ | ✓ | | ✓ | ✓ | | ✓ | ✓ | ✓ | | |
| 28 | Fountain Reservoir | | | | ✓ | | ✓ | ✓ | | ✓ | ✓ | ✓ | | ✓ | | |
| 29 | Granada Reservoir | | | | ✓ | | | ✓ | | ✓ | ✓ | ✓ | | ✓ | | |
| 30 | Amsley Reservoir | | | | ✓ | | ✓ | ✓ | | ✓ | ✓ | ✓ | | ✓ | | |
| **31** | **Reoperation of Fry-Ark Facilities** | A | ✓ | ✓ | ✓ | | ✓ | ✓ | ✓ | | | ✓ | ✓ | ✓ | ✓ | ✓ |

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(1) Pursuant to a stipulation filed in Case No. 90CW56, Water Division 2, the City of Colorado Springs may be dismissing the water court application associated with storage at the Elephant Rock site.

| | |
|---|---|
| A | **Highest ranking alternatives.** |
| B | **Alternatives added based on input from the SSC.** |

## TABLE 8.3
## WATER AND STORAGE NEEDS ASSESSMENT
## SCREENING OF POTENTIAL ALTERNATIVES

| Map Key Number | Potential Storage Option (Unranked) | Category | Storage at or Above Pueblo Reservoir | Service Potential to Entire District | Storage Potential Greater than 20,000 af | Enlargement versus New Dam | Suitable for Re-regulation of Return Flows | Anticipated Few Technical Challenges | Storage Efficiency is High | No Complex Federal Institutional Issues | Recreation Potential is High | Few Environmental Concerns | Good Public Support is Possible | Low Fish and Wildlife Habitat Impact | Low Potential for Water Quality Issues | Good Potential for Exchanges |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **31** | **Reoperation of Fry-Ark Facilities** | **A** | ✓ | ✓ | ✓ |  | ✓ | ✓ | ✓ |  |  | ✓ | ✓ | ✓ | ✓ | ✓ |
| **9** | **Pueblo Reservoir** | **A** | ✓ |  | ✓ | ✓ | ✓ | ✓ | ✓ |  | ✓ | ✓ | ✓ | ✓ |  | ✓ |
| **19** | **Halfmoon Creek** | **A** | ✓ | ✓ | ✓ |  | ✓ | ✓ |  | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |  |
| **18** | **Tennessee Creek** | **A** | ✓ | ✓ | ✓ |  |  | ✓ |  | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| **17** | **Clear Creek Reservoir** | **A** | ✓ | ✓ | ✓ | ✓ |  |  | ✓ | ✓ | ✓ |  | ✓ | ✓ | ✓ | ✓ |
| **21** | **Box Creek Dam Site** | **A** | ✓ | ✓ | ✓ |  |  | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |  | ✓ |
| **8** | **Williams Creek Reservoir** | **A** |  |  | ✓ |  | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |  | ✓ |
| **15** | **Turquoise Lake** | **A** | ✓ | ✓ | ✓ | ✓ |  |  | ✓ |  | ✓ |  | ✓ | ✓ | ✓ | ✓ |
| **2** | **Lake Meredith** | **A** |  |  | ✓ | ✓ | ✓ | ✓ |  |  | ✓ | ✓ | ✓ | ✓ |  | ✓ |
| **22** | **Gravel Lakes Storage** | **A** | ✓ |  | ✓ |  | ✓ | ✓ | ✓ | ✓ |  | ✓ | ✓ | ✓ |  |  |
| **24** | **Chalk Creek** | **A** | ✓ |  | ✓ |  | ✓ | ✓ | ✓ | ✓ | ✓ |  |  |  | ✓ | ✓ |
| **27** | **Aquifer Storage/Conjunctive Use** | **A** | ✓ |  | ✓ | ✓ | ✓ |  | ✓ | ✓ |  | ✓ | ✓ | ✓ |  |  |
| **20** | **Upper Arkansas River** | **B** | ✓ | ✓ | ✓ |  |  | ✓ | ✓ | ✓ | ✓ |  |  |  |  | ✓ |
| **16** | **Twin Lakes Reservoir** | **B** | ✓ | ✓ | ✓ | ✓ |  | ✓ | ✓ |  |  |  |  |  | ✓ | ✓ |
| 23 | Elephant Rock[1] |  | ✓ |  | ✓ |  |  | ✓ | ✓ | ✓ | ✓ |  |  |  | ✓ | ✓ |
| 26 | Boss Lake |  | ✓ | ✓ |  | ✓ |  | ✓ | ✓ | ✓ | ✓ |  |  |  | ✓ |  |
| 5 | Adobe Creek Reservoir |  |  |  | ✓ | ✓ | ✓ | ✓ |  | ✓ |  | ✓ | ✓ | ✓ |  |  |
| 10 | St. Charles Reservoirs #2, #3 |  |  |  |  | ✓ | ✓ | ✓ |  | ✓ |  | ✓ | ✓ | ✓ |  |  |
| 1 | John Martin Reservoir |  |  |  | ✓ | ✓ | ✓ | ✓ |  |  | ✓ | ✓ |  | ✓ |  |  |
| 7 | Holbrook Reservoir |  |  |  |  | ✓ | ✓ | ✓ |  | ✓ |  | ✓ | ✓ | ✓ |  |  |
| 28 | Fountain Reservoir |  |  |  | ✓ |  | ✓ | ✓ |  | ✓ | ✓ | ✓ |  | ✓ |  |  |
| 25 | Fooses Creek |  | ✓ |  | ✓ |  |  | ✓ | ✓ | ✓ | ✓ |  |  |  | ✓ |  |
| 12 | DeWeese Reservoir |  | ✓ |  | ✓ | ✓ |  | ✓ |  | ✓ | ✓ |  | ✓ |  |  |  |
| 11 | Cucharas Reservoir |  |  |  | ✓ | ✓ |  |  |  | ✓ | ✓ | ✓ | ✓ | ✓ |  |  |
| 6 | Cheraw Lake |  |  |  |  | ✓ | ✓ | ✓ |  | ✓ |  | ✓ | ✓ | ✓ |  |  |
| 30 | Amsley Reservoir |  |  |  | ✓ |  | ✓ | ✓ |  | ✓ | ✓ | ✓ |  | ✓ |  |  |
| 3 | Lake Henry |  |  |  |  | ✓ | ✓ | ✓ |  | ✓ |  | ✓ |  | ✓ |  |  |
| 4 | Horse Creek Reservoir |  |  |  |  | ✓ | ✓ | ✓ |  | ✓ |  | ✓ |  | ✓ |  |  |
| 29 | Granada Reservoir |  |  |  | ✓ |  |  | ✓ |  | ✓ | ✓ | ✓ |  | ✓ |  |  |
| 14 | Badger Creek |  | ✓ |  |  |  |  | ✓ | ✓ | ✓ |  |  |  |  | ✓ |  |
| 13 | Fourmile Creek |  | ✓ |  |  |  |  |  |  | ✓ | ✓ |  |  |  | ✓ |  |

[1] Pursuant to a stipulation filed in Case No. 90CW56, Water Division 2, the City of Colorado Springs may be dismissing the water court application associated with storage at the Elephant Rock site.

| | |
|---|---|
| A | **Highest ranking alternatives.** |
| B | **Alternatives added based on input from the SSC.** |

## 8.4 Evaluation of Alternatives Passing the Initial Screening

The 14 alternatives for water storage were evaluated during a more rigorous process to identify a menu of options for meeting long-term water storage and management needs in the District. This more rigorous process proceeded in several steps, as follows:

1. Data on storage potential and development costs were obtained relative to each alternative as follows:

   For projects studied by others (e.g. Williams Creek, Lake Meredith Enlargement, etc.) contacts were made with the sponsoring entity to obtain information relative to technical issues and costs.

   For projects involving development of new reservoir enlargements, for which prior studies have not been conducted, GEI prepared conceptual project feature layouts and estimated costs to identify the probably costs per acre-foot of storage provided.

2. A decision analysis framework for the evaluation of alternatives was developed by GEI, presented to District staff and SSC members, refined based on inputs received, and finalized.

3. A meeting with the SSC was held on June 10, 1998, to present the decision analysis framework and to build consensus on the goals, objectives, and criteria for evaluating the alternatives.

4. A sub-group of the SSC met on June 30, 1998, to conduct the alternatives evaluation process based on the decision analysis framework and weighting factors established during the June 10, 1998 meeting with the full SSC.

### 8.4.1 Discussion of Alternatives

The following paragraphs provide additional information relative to the 14 alternatives. Basic information on each alternative was provided in Section 8.3 and references are made in the following paragraphs to the appropriate sub-sections in Section 8.3, as well as to Section 7 of the report, which deals with Fry-Ark Project's operations.

**Reoperation of Fry-Ark Project**

As discussed in Section 7, potentials appear to exist for operating the Fry-Ark Project in a manner that would permit storage of non-Project water in storage space currently dedicated to Project water. In 1992, studies by Gronning Engineering Company indicated that up to 90,000 af of space in Project reservoirs could be used for non-Project water storage, without impacting Project operations or yields. These findings generally seem to be consistent with earlier studies by the Bureau (1990). To facilitate better assessment of this option and to understand its limitations, additional operational analyses could be conducted by Montgomery-Watson using actual 1966-95 agricultural water use data developed by the Assessment Project and assuming that 40,000 af of storage space is dedicated in Pueblo Reservoir for winter water. The time frame for these analyses does not permit inclusion of results in this report.

### Pueblo Reservoir

The enlargement of east slope Fry-Ark Project storage reservoirs (Turquoise, Twin Lakes, and Pueblo) has been considered in the past. Most attention has been directed at enlarging Pueblo Reservoir, because a relatively small raise of the dam (5 to 10 feet) could provide additional storage of 29,300 to 69,500 af. Similar raises of Sugarloaf Dam (Turquoise Lake) or Twin Lakes Dam would provide less additional storage. Also, both of these dams have histories of seepage concerns, which could be exacerbated if the dams were raised.

In 1990, the USBR presented concepts for increasing storage at Pueblo Reservoir by 5-foot and 10-foot raises of the water surface elevation. Key data concerning these proposed raises of the dam and reservoir are summarized below:

**Summary of Data Relative to Raising Pueblo Dam**

| | Elevations in Feet (Above Mean Sea Level) | | |
|---|---|---|---|
| **Location** | **Current** | **With 5-foot Raise** | **With 10-foot Raise** |
| Dam Crest Elevation | 4925.0' | 4930.0' | 4935.0' |
| Maximum Water Surface Elevation | 4919.0' | 4924.0' | 4929.0' |
| Spillway Crest (Top of Exclusive Flood Pool) | 4898.7' | 4903.7' | 4908.7' |
| Top of Joint Use Pool | 4893.8' | 4899.1' | 4905.2' |
| Top of Active Conservation Pool | 4880.5' | 4886.7' | 4892.8' |
| Incremental Gain in Conservation Storage | --- | 29,300 af | 60,500 af |

For the 5-foot raise, the USBR selected a parapet wall on the embankment portion of the dam, a parapet wall on the non-overflow concrete section of the dam, and raising the ogee crest of the overflow section by 5 feet. (The option of adding gates to the crest was acknowledged by the USBR, but was not evaluated.) Based on GEI's understanding of the existing dam, the selected method of raising the dam appears to be reasonable and consistent with current technology. However, in July 1998, the USBR announced findings concerning the stability of the concrete spillway portion of the dam. Therefore, any change in operating and maximum pool elevations at Pueblo Reservoir will require careful integration with improvements that may be required to increase dam stability. These improvements for stability currently are being evaluated by the USBR. Obviously, the same considerations need to be recognized for the 10-foot raise. In 1990, the 10-foot raise involved raising the embankment using a combination of additional downstream fill and constructing a parapet wall. Raising of the non-overflow concrete section and the concrete overflow section would be accomplished in a similar manner to the 5-foot raise. Whether or not this method is suitable, given stability concerns at the dam, is the subject of additional study.

Currently, the USBR is re-examining dam raise options and associated costs under a separate study effort with the District. Results are expected to be made public in September 1998. Storage increases of 25,000 to 75,000 af are being considered by the USBR under contract to the District. That study will be considered, along with the alternatives in this report, when the District reviews options with respect to meeting identified storage needs for the District. Raising of Pueblo Reservoir will require modification of recreational facilities adjacent to the existing reservoir and would need to be addressed so that recreation benefits of the reservoir can be maintained or possibly enhanced.

### Clear Creek Reservoir

As discussed in Section 8.2.17, enlargement of storage on Clear Creek (Figure 8.2A) most likely will require construction of a new dam upstream of the existing Clear Creek Reservoir. Preliminary layouts were prepared by GEI for a dam approximately 255 feet high, with a central impervious core of clays and silts and shells of more free-draining clays, sands, and gravels. The upstream slope would be 3(H):1(V) and the downstream slope 2.5(H):1(V). A trench would be constructed to key the impervious core into the foundation and a grout curtain would be provided for seepage control. The dam would be similar in cross-section to the "typical" section shown on Figure 8.2.

The drainage basin above Clear Creek Reservoir is approximately 70 mi$^2$. Therefore, a significant spillway would be required to protect the dam against overtopping during the probable maximum flood. The spillway would be an excavated channel located through the right abutments of the dam. Material from the excavation could be used in constructing the dam. The dam would contain nearly 18 million cubic yards (cy) of fill. The minimum size for the outlet works conduit would be 5.5 feet.

The cost of developing 102,000 af of storage behind a new dam on Clear Creek is estimated to be $185 million, including allowances for contingencies (30% of direct cost), engineering and administration (15% of direct cost plus contingency), and permitting (5% of estimated direct cost. Note that these same allowances were applied to costs estimated by GEI for other storage options.) The unit cost of storage is estimated to be $1,800 per af.

### Turquoise Lake (Sugarloaf Dam)

The technical feasibility of raising Sugarloaf Dam (Turquoise Lake) would need to be very carefully explored. The benefits of having more storage higher in the Basin need to be weighed against the expected technical challenges and associated costs of raising the existing dam. A 5-foot raise could provide an additional 10,000 af of storage. To provide 20,000 af, the maximum normal pool and dam would need to be raised by approximately 11 feet.

The existing dam is a zoned embankment. Currently, the dam meets requirements for static stability factors of safety. Concerns exist about liquefaction potential of the foundation soils; however, a seismic event of reasonable probability is not expected to cause an overall failure of the dam after initial filling. (Certain types of soils below the water table can behave similar to a liquid when subjected to vibratory/seismic loadings. This can cause structures founded on these soils to move or deform.) Sinkholes were observed in the upstream left groin area when the reservoir exceeded Elevation 9850 (GEI, 1991).

Overall, seepage is considered to be within acceptable limits and is being safely controlled, collected, and measured. The primary challenge associated with raising Turquoise Dam is dealing with the variable foundation and potential increased seepage with higher reservoir levels. Given current land uses adjacent to the reservoir and current recreational uses, even a small increase in reservoir level is likely to receive some fairly strong opposition.

### Twin Lakes Reservoir

Raising of Twin Lakes Dam could provide significant additional storage. A 5-foot raise in the conservation pool would provide 14,360 af of additional storage capacity. Higher raises of the dam could provide much more storage, but may require major road relocations and involve impacts to operation of the Mount Elbert Pumped-Storage Project, which uses Twin Lakes as the lower reservoir. A 12-foot raise of the normal pool would provide additional storage of approximately 40,000 af. As with Turquoise Dam, raising Twin Lakes Dam would require addressing various technical challenges associated with the foundation. Twin Lakes Dam is a zoned embankment with a deep core trench for seepage control. During initial filling (1980-81), seepage increased dramatically, and a sinkhole was observed in the reservoir floor. Sand and silt boils were observed downstream. As a result of high seepage, a remediation project was undertaken, and we understand that the dam has performed satisfactorily since completion of the remediation.

The dam is founded on a glacial moraine. With its prior seepage history and permeable foundation, any raise in the normal reservoir pool would require careful evaluation of potential seepage issues. Small raises of the dam probably could be implemented relatively easily. However, the use of a parapet wall may not be feasible because of the relatively small freeboard between the normal pool (Elev. 9200) and dam crest (Elev. 9210). The damsite can topographically accommodate a much higher dam; however, a significant dam raise in the 20-foot range could be very technically challenging. Also, major modification of the Mount Elbert Pumped-Storage Project could be required due to higher tailwater on the pump/turbine units and reduced operating head.

Twin Lakes was once two natural lakes that were formed by glaciation. In the 1930s, the original Twin Lakes Dam was completed, inundating the natural lakes. In 1978-81, the reservoir was enlarged by constructing a new downstream dam, which is the present dam. Storage in the original natural lakes cannot be accessed and is considered to be dead storage. We have carefully reviewed this under-utilized resource and conclude that roughly 55,000 af are located below the outlet works of the dam within the glacial depression. Converting this dead storage to active storage could play a major role in providing cost-effective drought insurance to the water users.

The Twin Lakes outlet works invert is at Elevation 9157, while the bottom of the natural lake is about Elevation 9107 (See Figures 1 and 2). It is likely that the extensive seepage cutoff, constructed as part of the Twin lakes Dam foundation preparation, may have created a surface/ground water reservoir that is not, in a major way, connected hydrogeologically to the alluvium of the Arkansas River Valley downstream of the dam. If drawdown of the natural lakes impacts existing upstream alluvial wells, these water rights would have to be protected from injury. However, this system may only be called upon as the water supply increment of last resort, i.e., under emergency conditions (severe drought or other system outage), perhaps every 20 to 50 years. This may avoid the need for adjudicating a complex augmentation plan.

Approximately 32 feet of storage may be available for emergency use, assuming a minimum drawdown water surface of Elevation 9125. This volume of water totals roughly 50,000 af, considering the potential, both in the west and east Twin Lakes reservoirs. In addition to surface water volumes, a very preliminary analysis suggests that up to 20,000 af of ground water may gradually flow toward the lowered reservoir from the surrounding soils as water is pumped from the original natural lakes. Considering the surface water would be supplemented with ground water accretion, up to 70,000 af of water may be physically available as firm yield. Options by which to develop this water supply include: 1) pump water directly from the reservoir, to a pipeline discharging to Lake Creek, downstream of the dam; 2) install tube wells on the upstream side of the dam and pump the water over the dam crest into Lake Creek; or 3) a combination of the preceding two options. In the event of a drought or other emergency supply interruption, there are many possible scenarios for accessing the dead storage through these options. A probable negative impact on this drought period operation would be a loss of generating potential for the Mount Elbert power plant. During a severe drought, the Mount Elbert pumped storage units may be inoperable because of lowered reservoir levels. If this is the case, concerns about power interference charges may be less significant. Further investigation into issues, such as water rights, environmental impacts, ground water levels and recharge rates, and specific developmental options, would be needed as part of additional studies of this option.

### Lake Meredith

The enlargement of Lake Meredith is currently being investigated by Colorado Springs Utilities. Lake Meredith is part of the Colorado Canal system. Originally, enlargement of this project was considered to be a possible alternative to the Williams Creek Reservoir for storing reusable return flows from Colorado Springs (Montgomery-Watson, [M-W] 1998-Draft). However, this use of enlarged Lake Meredith storage does not appear to be practical, based on the M-W studies. Enlargement of Lake Meredith storage, however, may have benefits to Colorado Springs in terms of exchanging Lake Meredith storage for space in the Fry-Ark system. This should include consultation with the Holbrook Canal and Fort Lyon Canal companies who over the past 26 years have stored an average of 21,600 af in Fry-Ark facilities. These agricultural entities are currently the only two canal companies downstream of the Colorado Canal that use Fry-Ark Project water.

Colorado Springs also is examining, as part of the enlargement studies, the feasibility and operational benefits of reconfiguring the outlet from Lake Meredith to increase exchange potentials to the Arkansas River. This modification could be accomplished independently of the reservoir enlargement.

While the reservoir operations studies were available in draft form (URS Greiner, 1998), final cost estimates for raising the dam have not yet been released. The operations studies examined storage capacity increases from 39,000 to 294,000 af. The cost information made available by Colorado Springs for the enlargement is based enlargements of 55,900, 117,800, and 172,100 af. Studies are underway to develop costs for enlargements of 15,000, 25,000, 40,000, and 75,000 af. Based on the preliminary cost estimates (URS, 1998), the unit cost of additional storage stays relatively constant ($350 to $450/af) in the capacity enlargement range of 55,900 to 172,100 af. Based on these figures, the Lake Meredith enlargement is assumed to cost $400 per af of additional storage capacity. The largest capacity increase currently being considered by Colorado Springs is 80,000 af. The associated cost would be $32 million. The minimum capacity increase being considered is 15,000 af ($6 million).

### Halfmoon Creek

As described in Section 8.2.19, a 100,000 af storage reservoir on Halfmoon Creek (Figure 8.2B) was investigated. The dam would be approximately 300 feet high with a crest length of 3,600 feet. Most likely, the dam would be a zoned earthfill structure with a central impervious core and shells of clays, sands and gravels. The upstream slope would be 3(H):1(V) and the downstream slope at 2.5(H):1(V) as indicated on the "typical" section in Figure 8.2. A spillway would be required to handle the probable maximum flood from the 23 $mi^2$ drainage basin above the dam. The minimum size outlet conduit would be 6.5 feet in diameter. The embankment is estimated to have a total volume of 22 million cy. Based on USGS mapping, the reservoir would inundate large areas of riverline wetlands and Emerald Lake. A 100,000 af reservoir would have a pool af elevation 10,200, which is higher than the pool elevation in Turquoise Lake and the Mt. Elbert Forebay. Therefore, storage of Project water in a reservoir on Halfmoon Creek will require pumping, unless storage can be accomplished by exchange.

Construction cost, including contingencies, engineering and administration, and permitting is estimated by GEI to be $227 million, which is equivalent to approximately $2,300 per af of storage.

### Tennessee Creek

This potential storage site is located on Tennessee Creek (Figure 8.2C) about one mile northeast of Turquoise Lake, in an area called Tennessee Park. A relatively long (2,200 feet), low (50 feet) dam would create a 28,000 af reservoir. The upstream drainage area is approximately 45 $mi^2$. The dam would be similar in cross-section to that shown on Figure 8.2. The minimum outlet works conduit size would be 6-foot diameter. A spillway would be provided to prevent overtopping of the dam during the probable maximum flood. Approximately 360,000 cy of fill material would be required to construct the dam, which has an estimated construction cost of $23.3 million ($800 per af storage).

USGS mapping identifies extensive wetlands in the reservoir basin. This obviously would be of importance in project permitting and mitigation planning, in addition to other environmental issues.

The maximum normal pool in a 28,000 af reservoir on Tennessee Creek would be at Elevation 9,850 in comparison to the normal pool in Turquoise Lake at Elevation 9,869. Therefore, storage of Fry-Ark Project water by gravity flow from Turquoise Reservoir to Tennessee Creek

Reservoir appears to be feasible. The minimum pool in Turquoise Reservoir (top of dead storage) is approximately Elevation 9,766. Therefore, gravity conveyance from Turquoise Reservoir to a reservoir on Tennessee Creek will not be possible over the full range of potential reservoir levels in Turquoise Reservoir. However, a pipeline from the downstream portal of the Boustead Tunnel to a reservoir on Tennessee Creek could, if necessary, overcome this operational constraint.

### Upper Arkansas River (Hayden Ranch)

As discussed in Section 8.2.20, this site is on the Arkansas River (Figure 8.2D). It is approximately 1.5 miles northeast of Twin Lakes. With a pool at Elevation 9,195, the reservoir could store approximately 49,000 af. The top of active conservation storage in Twin Lakes is at Elevation 9,200. Therefore, an interconnection between Twin Lakes and the Upper Arkansas (Hayden Ranch) Reservoir would allow the latter reservoir to "float" on the water levels in Twin Lakes. Also, a connection from the Mt. Elbert Forebay (or Mt. Elbert Conduit) to the Upper Arkansas Reservoir would enable direct filling with Fry-Ark water. However, by virtue of its location on the mainstem Arkansas River, Fry-Ark Project water also could be stored by exchange. The dam would control 290 $mi^2$ of the Upper Arkansas Basin and provide additional regulation of native flows.

A dam at the Hayden Ranch site would be configured similarly to the "typical" section shown in Figure 8.2. The earthfill dam would be 114 feet high with a crest length of 800 feet. Fill volume is estimated to be 743,000 cy. A large spillway through the left abutment would be required. Materials excavated for the spillway channel could be used for dam construction. The minimum size outlet conduit would be 6-foot diameter. A higher dam and larger reservoir appear to be feasible at this site. In February 1998, GEI completed a "geotechnical fatal flaw" analysis of this damsite for a non-District entity. Nothing was found in that review to preclude consideration of constructing a dam at the site.

The project has an estimated construction of $82 million, of which nearly $55 million is the estimated cost of relocating U.S. Highway 24 and the Denver and Rio Grande Railroad. These relocations were budgeted at $3.5 million per mile. Buildings in the small town of Kobe would need to be acquired or replaced in kind at another location.

Estimated cost of storage at the Upper Arkansas (Hayden Ranch) site is $1,700 per af (of which $1,150 per af is attributable to highway and railroad relocations). In addition to the significant relocations issues and costs, this storage alternative would meet with significant opposition similar to that which developed over the proposal for construction of a reservoir at the Elephant Rock site.

## Box Creek

This potential damsite (Figure 8.2E) also was reviewed by GEI for a non-District entity in February 1998. Again, no fatal geologic or geotechnical flaws were found that would preclude consideration of constructing a dam at this site. The Box Creek site is located just northeast of the Mt. Elbert Forebay and just west of the potential reservoir that would be created by a dam at the Upper Arkansas (Hayden Ranch) site. A 160-foot-high zoned earthfill dam, generally configured as shown on Figure 8.2, would have a crest length of 3,310 feet and fill volume of 6.6 million cy. A dam of this size would create a 33,000 af reservoir. A higher dam and larger reservoir appear to be feasible. The depth of and composition of alluvial deposits indicate that seepage control issues may be significant and that measures to safely control and handle seepage may be significant elements of overall project cost.

The drainage basin above the Box Creek site is 12 $mi^2$. A spillway on the left abutment would be required to accommodate the probable maximum flood. The minimum size outlet conduit would have a diameter of 4 feet.

The reservoir could store Fry-Ark Project water via diversion from the Mt. Elbert Forebay. This would be possible by gravity. The normal maximum pool in the Mt. Elbert Forebay is Elevation 9,646. The maximum pool in Box Creek Reservoir (for 33,000 af of storage) would be Elevation 9,400. Box Creek also could be filled with Project water via a pipeline from the Mt. Elbert Conduit.

Estimated cost to develop 33,000 af of storage of the Box Creek site is $73.9 million, equivalent to $2,200 per af of storage. The reservoir would inundate tailings from prior dredging operations along Box Creek and Corske Creek.

## Chalk Creek

As described in Section 8.2.24, storage on Chalk Creek (Figure 8.2F) may be limited by existing property development in the canyon in addition to the relatively steep slopes and narrow width of the Chalk Creek Canyon itself. Storage of Project water at this site would require exchanges using the native runoff in the Chalk Creek Basin, which yields significant volumes of water each year. The basin is approximately 70 $mi^2$, along the Continental Divide.

Storage of 15,000 af on Chalk Creek at a site between the Mt. Princeton Campground at the Town of Alpine would require a dam nearly 200 feet high with a crest length of 1,240 feet. Estimated cost is $42.1 million ($2,800 per af). A zoned embankment dam would have a fill volume of 3 million cy, if configured similarly to the section shown on Figure 8.2. Depending on foundation conditions, depth of overburden, and aggregate availability and quality a roller-compacted concrete (RCC) dam may be feasible at this site. If so, the costs for dam construction may be reduced, because the required spillway could then be accommodated as an integral feature of the dam itself.

### Williams Creek

Storage on Williams Creek, a tributary of Fountain Creek that joins Fountain Creek midway between Fountain and Pueblo, is an integral part of the Southern Supply Project proposed by Colorado Springs Utilities. Storage at the Williams Creek site is planned by Colorado Springs for completion in the year 2034 as the last stage of the Southern Supply Project. Williams Creek Reservoir will be used to regulate the release of reusable return flows and maximize river exchange potentials. Recent operations studies by Montgomery-Watson (1998) indicate that the optimal size for Williams Creek Reservoir to meet the needs of Colorado Springs is 12,000 af.

Earlier planning studies (Black and Veatch, 1996) were based on a 90-foot high embankment dam on Williams Creek creating a 31,000 af reservoir. Estimated cost was $33.6 million, equivalent to $1,200 per af of storage capacity.

According to modeling studies, Williams Creek Reservoir can provide 12,000 af of annual firm yield with 9,000 af of active storage (Montgomery-Watson, 1998) and is better suited for regulation of reusable return flows than an enlarged Lake Meredith. Williams Creek Reservoir appears to have potential as an "exchange reservoir" for entities other than Colorado Springs within the Fountain Valley Authority. In discussions related to the Water Needs Assessment, Colorado Springs has expressed possible interest in moving up the timeline for Williams Creek and considering a "joint project" with larger storage capacity. However, as discussed in Section 8.2.8., the storage efficiency of the site declines with volumes in excess of 31,000 af.

### Gravel Lakes

The development/conversion of sand and gravel pits for water storage is becoming increasingly common among municipal water providers in Colorado, particularly in the Denver area. In the Denver area, lined sand and gravel pits are used to facilitate exchanges and to replace out-of-priority diversions of water higher in the drainage basin. Typically, water that is diverted from the upper South Platte and its tributaries is replaced by releases from gravel lakes to meet downstream agricultural demands. The State of Colorado has adopted strict standards relative to leakage into these storage vessels from surrounding alluvial aquifers. In order to meet leakage criteria, these sand and gravel pits must be lined. Two types of liners are typically used. One type is a compacted clay liner constructed of shale bedrock materials if they are present below the sand and gravel deposits. The second is a slurry trench constructed around the perimeter of the pit. The clay liner prevents water from the surrounding aquifer from seeping into the pit when the water level is lowered. The slurry trench is keyed into relatively impermeable bedrock materials and consists of soils mixed with cement/bentonite or bentonite slurry. This creates a "wall" around the pit that controls seepage of water from the surrounding aquifer into the pit when the water level is drawn down.

As described in Section 8.2.22, a total storage volume of 13,000 af has been readily identified along the Arkansas River downstream of Pueblo, using USGS maps. The actual potential is no doubt much higher. Typically, gravel deposits extend to depths of 20 to 30 feet below ground. Assuming an average depth of 25 feet, 100,000 af of gravel lakes storage would require a surface area of 4,000 acres (over 6 $mi^2$). This storage would need to be located fairly close to the river to facilitate filling and emptying the usable storage volume.

GEI is undertaking numerous gravel lakes storage projects in the Denver area. We are finding that the costs for meeting State leakage criteria, coupled with development of inlet/outlet facilities, site drainage and access roads, range from $1,500 to $3,000 per af of storage depending on site conditions. For planning, we propose that $3,000 per af be used for the Water Needs Assessment.

The suitability of gravel lakes storage as an alternative to conventional surface storage will need to be carefully evaluated. While these types of projects are easier to permit than conventional dam/reservoir projects, they normally require pumping for evacuation of storage. Unless there are valuable mineral deposits to support the costs of excavation, "below ground" storage is not cost-effective. Therefore, the facilities tend to be "strung out" along the river with locations fixed by economically minable sand and gravel deposits.

In our opinion, gravel lakes storage may be a viable option for meeting regional water and storage needs as an element of a larger conventional storage project or reoperation of Fry-Ark facilities.

### Aquifer Storage/Conjunctive Use

As discussed in Section 8.2.27, this option should be investigated as a future tool for managing water within the District's service area. Available data from pilot projects in the Denver and Colorado Springs areas and elsewhere in the Western U.S. indicate that costs will be in the range of $3,000 to $4,000 per af. Significant and challenging water quantity, water quality, and water rights issues will need to be addressed before this technology could be applied on a large scale. Data from the ongoing Tamarack Project on the South Platte River northeast of Denver will be valuable for assessing this option in the Arkansas Basin.

### 8.4.2 Evaluation of Alternatives

The 14 alternatives described in Section 8.4.1 were systematically evaluated and ranked using a decision analysis process that has been used successfully by GEI on similar water resources planning projects.

The decision analysis framework is depicted on Figure 8.3, showing the structure of project goals, subgoals, and criteria for assessing the relative performance of each alternative. The base structure for the decision framework, presented on Figure 8.3, was adopted in consultation with the District staff and with the concurrence of the SSC.

Weighting factors were assigned to the goals and subgoals at the June 10, 1998 SSC meeting using a group-based polling process. The weighting factors are identified on Figure 8.3.

The key factors in the decision framework are the weighting factors for the four project goals. These weighting factors, which can be thought of as the relative importance of each goal in the "collective June 10, 1998 opinion" of the SSC, are:

| Goal | Weighting (Percent) |
|---|---|
| Minimize Environmental Impacts | 23 |
| Minimize Social Impacts | 17 |
| Maximize Operational Effectiveness | 32 |
| Minimize Overall Project Costs | 28 |
| Total | 100 |

Minimum cost and maximum operational effectiveness were deemed most important by the SSC at the June 10, 1998 meeting. However, a different group with greater representation by citizens and environmental groups, could have weighted the four goals much differently. Therefore, the evaluation of alternatives was subjected to a "sensitivity-test" in which the goal weighting for environmental and social considerations were increased and the cost and operational effectiveness were decreased. This analysis is described in Section 8.4.3.

The basic data used in the decision analysis is summarized in Table 8.4. This table indicates storage volume, cost, and other technical factors for each alternative.

Preference relationships were developed for each of the subgoals, based on qualitative considerations. These preference relationships are depicted in Figures 8.4 through 8.6 for the

11 subgoals. These relationships were used in the June 30, 1998 SSC subgroup meeting to score each alternative in each subgoal category. The 6-hour meeting resulted in the point scoring of the alternatives which is summarized in Table 8.5. The subgroup included a representative from the District staff, Colorado Springs Utilities, Catlin Canal Company, Bureau of Reclamation, and the Pueblo Board of Water Works, and two from the consultant team.

The raw scores for the alternatives (Table 8.5) were input to a spreadsheet to calculate the total scores for each alternative, which are depicted graphically on Figure 8.7. As of September 22, 1998, cost estimates for raising Pueblo Dam had not yet been published by the Bureau. Therefore, the cost score for that alternative may change, depending on the final preliminary cost estimate developed by the Bureau.

Figure 8.8 shows the alternatives ranked in sequence from high score to low score, as well as the results of a sensitivity test. Review of the base case scores summarized in Figure 8.8 indicates that there are three groups of alternatives, as summarized below:

| Scores Greater than 57 | Scores Greater than 50 But Less than 57 | Scores Less than 50 |
|---|---|---|
| Lake Meredith | Tennessee Creek | Halfmoon Creek |
| Fry-Ark Reoperation | Pueblo Reservoir | Conjunctive Use |
| Turquoise Reservoir | Williams Creek | Box Creek |
| Clear Creek Reservoir | Gravel Lakes | Upper Arkansas (Hayden) |
| | | Twin Lakes (Dead Storage) |
| | | Chalk Creek |

# TABLE 8.4
SECWCD/ARKANSAS BASIN ASSESSMENT PROJECT
## ALTERNATIVES FOR SCREENING

| Map ID Number | Alternative (Unranked) | Storage Volume (1000 AF) | New Dam (N) or Raise (R) | Dam Height (feet) | Raise Height (feet) | Embankment Volume (Million CY) | Outlet Length (feet) | Outlet Diameter (inches) | Planning -Level Const. Cost ($Million) | Planning Level Cost ($/AF) |
|---|---|---|---|---|---|---|---|---|---|---|
| 31 | Reoperation of Fry-Ark Facilities | 92.5 | - | - | - | - | - | - | TBD | TBD |
| 9 | Pueblo Reservoir Enlargement | 25-75 | R | - | TBD | TBD | - | - | TBD | TBD |
| 19 | Halfmoon Creek Reservoir | 100 | N | 300 | - | 22.1 | 3600 | 78 | $227.3 | $2,300 |
| 18 | Tennessee Creek Reservoir | 28 | N | 50 | - | 0.4 | 150 | 72 | $23.3 | $900 |
| 17 | Clear Creek Reservoir (New) | 102 | N | 255 | - | 17.8 | 1500 | 78 | $184.8 | $1,800 |
| 21 | Box Creek Reservoir | 33 | N | 160 | - | 6.6 | 900 | 48 | $73.9 | $2,200 |
| 8 | Williams Creek Reservoir | 28 | N | 90 | - |  |  |  | $33.6 | $1,200 |
| 15 | Turquoise Lake Enlargement | 9 | R | - | 5 | - | - | - | $1.4 | $150 |
| 2 | Lake Meredith Enlargement | 15-80 | R | - |  | - | - | - | $9-$48 | $600 |
| 22 | Gravel Lakes Storage | 13 | - | - | - | - | - | - | $39.0 | $3,000 |
| 24 | Chalk Creek Reservoir | 15 | N | 190 | - | 3.0 | 1100 | 30 | $42.1 | $2,800 |
| 27 | Aquifer Storage/Conjunctive Use |  | - | - | - | - | - | - |  | $3,500 |
| 20 | Upper Arkansas Reservoir (Hayden Ranch) | 49 | N | 114 | - | 0.7 | 750 | 72 | $81.6 | $1,700 |
| 16 | Twin Lakes Reservoir (Dead Storage) | 70 | - | - | - | - | 15,000 | 96 | $77.0 | $1,100 |

N - New Reservoir
R- Raise of Existing Reservoir.

## TABLE 8.5
SECWCD/ARKANSAS BASIN ASSESSMENT PROJECT
## SCORES FOR ALTERNATIVES

| Map ID Number | Alternative (Unranked) | Environmental | | Social | | | Operational Effectiveness | | | | Cost | | Weighted Total Score |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 1. Permitting/Regulatory Challenges | 2. Environmental Impacts | 3. Public Concerns | 4. Community Impacts | 5. Maintain/Enhance Recreation | 6. Storage Potential (1000 AF) | 7. Water Quality Impacts | 8. Exchange Potentials | 9. District-Wide Benefits | 10. Capital Cost ($/AF) | 11. Total Cost ($/AF) | |
| 31 | Reoperation of Fry-Ark Facilities | 30 | 40 | 60 | 70 | 80 | 80 | 50 | 80 | 90 | 100 | | 57.9 |
| 9 | Pueblo Reservoir Enlargement | 20 | 40 | 30 | 70 | 80 | 80 | 70 | 80 | 90 | 70 | | 52.1 |
| 19 | Halfmoon Creek Reservoir | 20 | 20 | 20 | 70 | 70 | 100 | 60 | 50 | 60 | 40 | | 40.7 |
| 18 | Tennessee Creek Reservoir | 60 | 60 | 50 | 70 | 80 | 50 | 60 | 30 | 40 | 100 | | 53.3 |
| 17 | Clear Creek Reservoir (New) | 50 | 50 | 40 | 70 | 70 | 100 | 70 | 70 | 70 | 70 | | 56.3 |
| 21 | Box Creek Reservoir | 30 | 50 | 50 | 50 | 60 | 50 | 60 | 40 | 40 | 40 | | 38.8 |
| 8 | Williams Creek Reservoir | 60 | 70 | 70 | 50 | 40 | 50 | 50 | 80 | 40 | 70 | | 51.3 |
| 15 | Turquoise Lake Enlargement | 50 | 70 | 60 | 70 | 60 | 30 | 80 | 50 | 70 | 100 | | 56.6 |
| 2 | Lake Meredith Enlargement | 70 | 70 | 60 | 70 | 60 | 80 | 50 | 70 | 70 | 100 | | 62.8 |
| 22 | Gravel Lakes Storage | 90 | 100 | 70 | 50 | 40 | 30 | 50 | 70 | 30 | 40 | | 50.9 |
| 24 | Chalk Creek Reservoir | 10 | 20 | 20 | 30 | 60 | 30 | 60 | 60 | 50 | 40 | | 30.5 |
| 27 | Aquifer Storage/Conjunctive Use | 30 | 90 | 60 | 50 | 10 | 30 | 50 | 60 | 30 | 40 | | 39.8 |
| 20 | Upper Arkansas Reservoir (Hayden Ranch) | 10 | 10 | 10 | 30 | 50 | 50 | 50 | 80 | 80 | 70 | | 37.6 |
| 16 | Twin Lakes Reservoir (Dead Storage) | 20 | 30 | 20 | 20 | 10 | 80 | 40 | 20 | 60 | 70 | | 35.3 |

To test the sensitivity of the scoring to changes in goal weights, the goal weights were adjusted as follows to place higher importance on environmental and social objectives:

| | Base Case (Percent) | Sensitivity Case (Percent) |
|---|---|---|
| Environmental | 23 | 32 |
| Social | 17 | 28 |
| Operational | 32 | 17 |
| Cost | 28 | 23 |
| Total | 100 | 100 |

As shown in Figure 8.8, the numerical scores change and the rankings shift somewhat. However, the top eight alternatives are the same for both the base case and sensitivity case.

Based on the alternative rankings from the decision analysis process, we recommend that the top eight alternatives be carried forward into subsequent stages of planning and implementation. These alternatives are summarized in Table 8.6.

## Table 8.6
## Summary of Highest Ranking Alternatives

| Alternative | Storage Potential | Estimated Cost ($/af) | Discussion |
|---|---|---|---|
| Lake Meredith Enlargement | 15,000 to 75,000 af | $400 | Regulation of return flows from FVA entities. Additional storage space for Project water and other imported supplies. |
| Fry-Ark Project Reoperation | Up to 90,000 af | Undetermined | Additional storage of non-Project water in Project space. Reduction of Winter Water spills. |
| Turquoise Reservoir Enlargement | 9,000 af | $150 | Supplemental Upper Basin storage for native water, Fry-Ark water, and other imported supplies. |
| Clear Creek Reservoir (New Site) | 100,000 af | $1,800 | Major addition to Upper Basin storage for native water, Fry-Ark water, and other imported supplies. |
| Tennessee Creek | 28,000 af | $900 | Similar to Clear Creek, but smaller storage potential. |
| Pueblo Reservoir Enlargement | 25,000 to 75,000 af | Not Yet Available | Maintains existing Project functions and allocations, while providing added space for non-Project water |
| Williams Creek Reservoir | 12,000 to 28,000 af | $1,200 | Regulation of return flows from FVA entities. Additional storage space for Project water. |
| Gravel Lakes | 13,000 af | $3,000 | Regulation of return flows and management of native and imported water supplies. |

The top-ranking storage options listed in Table 8.6 have a total combined storage potential of 423,000 af, in comparison to the identified storage need of 65,000 to 159,000 af (as documented in Section 6 of this report). Various combinations of storage options should be considered for meeting the identified storage needs. Also, the storage volumes associated with individual options may be adjusted to maximize District-wide benefits.

## 8.5 The Valley Pipeline

The Valley Pipeline was a part of the original concept for the Fryingpan-Arkansas Project; however, its construction was never authorized. The main pipeline from a pumping station near Pueblo Reservoir to Lamar, with "spur" pipelines to Ordway, Cheraw, Eads, and several other end users. Based on the Project water demands described in Section 5 for the entities East of Pueblo and the pipeline alignments identified in earlier pipeline planning studies (Black and Veatch, 1972), GEI prepared an update of project costs. The main pipeline would have a total length of approximately 123 miles (18- to 48-inch diameter) with "spur" pipelines totaling 71.5 miles in length (6 to 12-inch diameter). The general alignment of the Valley Pipeline is shown on Figure 8.9.

Total direct cost of the Valley Pipeline is estimated to be $166 million, as summarized below:

**Direct Cost of Valley Pipeline**

| | Total Length (Miles) | Estimated Cost ($Million) |
|---|---|---|
| Main Pipeline (Pueblo to Lamar) | 123.3 | 114.95 |
| Ordway Spur | 20.5 | 4.28 |
| Cheraw Spur | 10.8 | 2.45 |
| Eads Spur | 27.5 | 5.82 |
| Misc. Spurs | 12.7 | 1.78 |
| **Total** | **194.8** | |
| Line Storage Tanks(2) | | 36.00 |
| Pueblo Northside Pumping Plant | | 1.19 |
| | **Direct Cost** | **166.47** |

---

(1) Excludes contingencies and engineering/administrative costs.
(2) 2-30 million gallon (MG) tanks; 4-70 MG tanks; 4-50 MG tanks.

With contingencies (20 percent) plus engineering and administrative costs (15 percent) added, the total cost is estimated to be $230 million. (Right-of-way costs are not included). The year 2040 average annual delivery to entities served by the Valley Pipeline is 19,000 af. If total annual cost for the pipeline, including operation and maintenance and debt service, is taken as 10 percent of the construction cost ($23 million), the unit cost of water delivered in 2040 is $1,210 per af. This is equivalent to $3.71 per 1,000 gallons. This cost does not include water treatment, which would be provided at a regional treatment facility or by individual municipal water supply entities.

This unit cost is significantly higher than current commodity charges for municipal water anywhere in the District. Funding of the Valley Pipeline with user charges would be extremely challenging. Given the declining water quality in the Lower Basin, however, there may be State or Federal assistance available to help finance such a project. The investment for the Valley Pipeline as configured herein obviously is significant and may be beyond the ability of the District and its water supply entities to finance and construct. However, it may be possible to reconfigure the alignment and size of the pipeline in order to optimize the project to meet particular needs of participating entities. Further study of this option is warranted.

## 8.6 Non-Structural Water Management Alternatives

The District's water management challenges are characterized by uncertainty in meeting the needs of agricultural and municipal water users in the Arkansas Basin's drought-prone climate. One of the greatest uncertainties in attempting to develop new storage projects is the enormous amount of vocal local opposition coupled with challenges associated with the federal permitting process under the National Environmental Policy Act.

One of the key components of this study is a thorough investigation of alternative water storage and supply alternatives. A menu of primarily structural alternatives is documented in Section 8.2. Non-structural measures also may play a key role in meeting future water management objectives. Examples of non-structural measures are conservation measures, reoperation of storage facilities, water exchanges, agricultural-municipal drought leasing, and drought insurance. Conservation is addressed in Section 5, and reoperation of Project facilities is discussed in Section 7. The drought leasing option is similar to a concept currently being evaluated by the State of Colorado for repayment to Kansas.

### 8.6.1 Exchanges

Water exchanges are common in over-appropriated river basins in Colorado. For example, the City of Colorado Springs Arkansas River Exchange Plan was formulated to permit the City to fully utilize its transmountain return flows. This was effected through a water court decree, which permits identification of the use, re-use, and successive use to extinction of non-native water supplies. This program has been successfully operating since 1981. Each acre-foot of non-native water can be stretched to two to three acre-feet or more by such water resource management strategies. Additionally, return flows from uses of Fry-Ark water deliveries can be used, at least on an interim basis, for replacement of stream depletions caused by irrigation wells.

### 8.6.2 Drought Leasing

#### Overview

A significant aspect of the history of water use along the Front Range in Colorado, and the Arkansas Basin in particular, has been the slow but steady transference of agricultural water rights to municipal use. Municipalities buy, or acquire through trade, enough senior agricultural water rights to meet their needs on an average annual basis, and then build reservoirs for carry-over to provide water supplies during drought periods. During many years, the reservoirs remain nearly full. The large municipal reservoirs are necessary, in part, because of the lack of water during the drought, but also because senior agricultural water right holders control most of the available supplies of surface water.

The joint use of available water supplies (and water rights) by both agricultural and municipal users during drought periods could help to reduce the amount of storage needed by municipal users. This turn, would help keep more land in agriculture, and reduce the size of the reservoirs necessary to provide dependable water supply to the municipal users. The essence of the "joint use" is an agreement of some type, the form being yet unidentified, which would allow the municipal users to pay the agricultural water rights holders a fee (perhaps annual, perhaps lump-sum) in return for the right to use senior agricultural water during drought periods.

The Arkansas Basin is characterized by limited additional native flow available for development without large carryover storage requirements. Thus, to develop a firm yield for municipal supply from native water can be costly. If the municipal users continue to pursue the outright purchase of senior water rights, it will exacerbate the current competitive environment, resulting in rising water prices and diminishing the agricultural base of the District. However, a leasing concept may actually aid the agricultural economy.

#### Description of the Concept

This "leasing concept" involves obtaining agricultural water during a drought and making this water available for municipal use. An analogy in the electricity market is the technique of interruptible power where electrical customer experience a lower power charge, if they agree to reduce usage during peak power demand periods. Leased water would supplement that developed from storable native flows, thereby reducing the storage volume required for the same amount of yield from a new reservoir. The leasing concept provides for paying an annual "insurance fee" for the right to divert senior agricultural water to satisfy municipal demands. This "insurance fee" is used to compensate irrigators for their foregone profit from a crop when the irrigation water is diverted to municipal uses during a drought. This concept would augment the traditional conservative, but costly, approach of providing high volumes of reservoir carryover volume to provide sufficient storage for critical drought conditions. It must be stressed that this approach would require some storage for regulation, but the volume needed would be less than required for carryover storage and drought reserves.

A variation of this drought leasing concept would be for the municipal user to purchase the water rights and lease water back to the irrigators, with the provision that they would only be partially called out once in every ten years or so.

A key issue to be addressed in a drought leasing plan would be the timing of flows and potential impact on intervening users between the point of diversion and point of return flows. However, appropriate augmentation plans could be structured to address this issue.

### Importance of Water Supply Data

The Colorado satellite-linked water resources monitoring program, funded by the Colorado Water Resources and Power Development Authority, would have a major role in implementing this concept in the Arkansas Basin. Snow surveys and snow pillows in the Basin, linked to the satellite, could be effectively used to monitor water in storage, permitting one to predict early in the runoff season if water shortages are likely to occur later in the irrigation season.

Real-time, accurate hydrologic data acquisition is very important, particularly to the Arkansas Basin, since it is over-appropriated. With a highly instrumented basin, a junior water right may be able to divert earlier, since the senior water rights holders would know that there is enough water in the snow pack to meet their needs. Through this early warning tool, the irrigators in the basin who have agreed to lease their water would know if adequate water will be available to meet their irrigation requirements. Based on this knowledge, some of the annual crops may not be planted in periods of water shortage, but the perennial crops would continue to receive irrigation water.

### 8.6.3 Drought Insurance

Drought insurance is a concept wherein the municipal user would have access to certain senior agricultural water during periods of drought or other water emergency conditions. The municipal user would accumulate funds in a special account during wet or average years to pay out to participating agricultural users in critical dry years. The advantages of such an arrangement are that high-cost water storage facilities may be deferred. It is apparent that the municipal user could only deal with agricultural users having water rights of sufficient seniority to insure the availability of a defined minimum quantity of water under a pre-determined drought condition. Drought insurance is a practical method of protecting the highest value use of water during dry years, while enhancing income to the agricultural community.

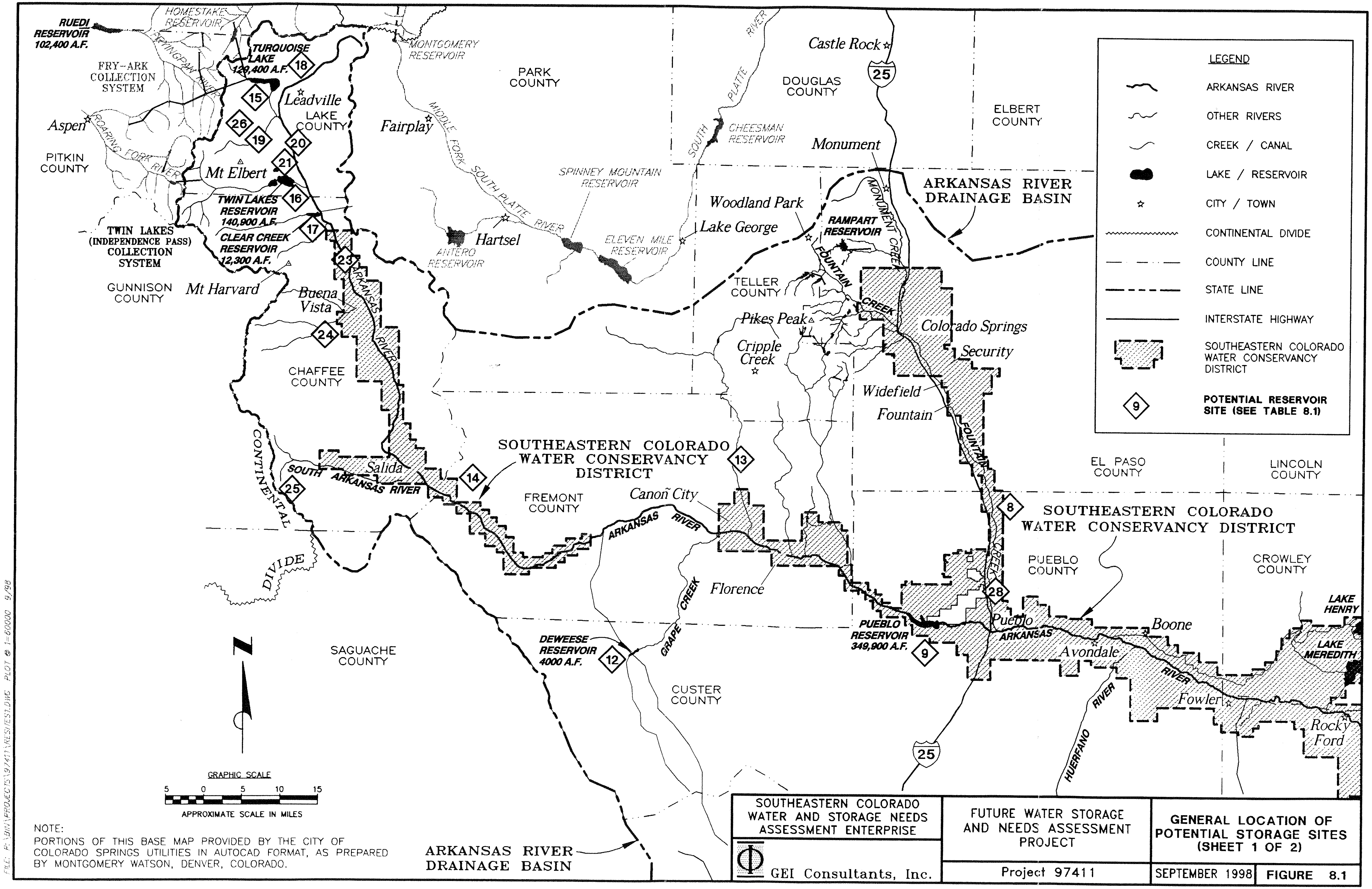
### 8.6.4 Legal Implications

There likely are significant water law constraints that could affect a program of dry-year leasing of irrigation water to municipal use. As a legal matter, it is a "change of water right," for which judicial approval is required. An application must be filed, notice given to others whose water rights might be injured, hearings follow, and then the referee or court says either yea or nay, or imposes additional conditions. This is the formal process; however, practical considerations often prevail during drought emergencies. In the drought of the 1950s, it was fairly common for agricultural users in mutual ditch companies to lease water for a year at a time to municipalities. This typically occurred when cities and farmers shared the same reservoir or ditch facilities. The challenges can become much greater if the municipal user has to obtain water through a different ditch or reservoir than that used by the irrigator making the lease.

It is clear that if the yield to be obtained in a drought were to be in any sense reliable, and any substantial sums of money were to pass between parties, then a municipality would be wise to obtain formal agreements and judicial confirmation. An undecreed or unauthorized use is always at risk.

In change of use proceedings themselves, there are real opportunities for issues and conflicts to arise, particularly if return flow patterns are disrupted when water is switched back and forth between the historical irrigation practice and a new municipal use. Other water users are adept at identifying ways in which proposed changes of use may injuriously change the regimen of a stream system. Any leasing plan would have to avoid that kind of injury. The engineering and legal costs of proving no injury under a drought-year leasing program may be substantial.

Usually, municipal users that invest millions of dollars on developing reliable water supplies shy away from deals in which the other party may have the opportunity to breach a contract and frustrate the bargain, or to take unfair financial advantage in an emergency situation. There are obviously many legal challenges to address. However, dealing with these issues directly may produce a level of municipal/agricultural cooperation that could not be achieved with the other more conventional options.



NOTE:
PORTIONS OF THIS BASE MAP PROVIDED BY THE CITY OF COLORADO SPRINGS UTILITIES IN AUTOCAD FORMAT, AS PREPARED BY MONTGOMERY WATSON, DENVER, COLORADO.

SOUTHEASTERN COLORADO
WATER AND STORAGE NEEDS
ASSESSMENT ENTERPRISE

Φ GEI Consultants, Inc.

FUTURE WATER STORAGE
AND NEEDS ASSESSMENT
PROJECT

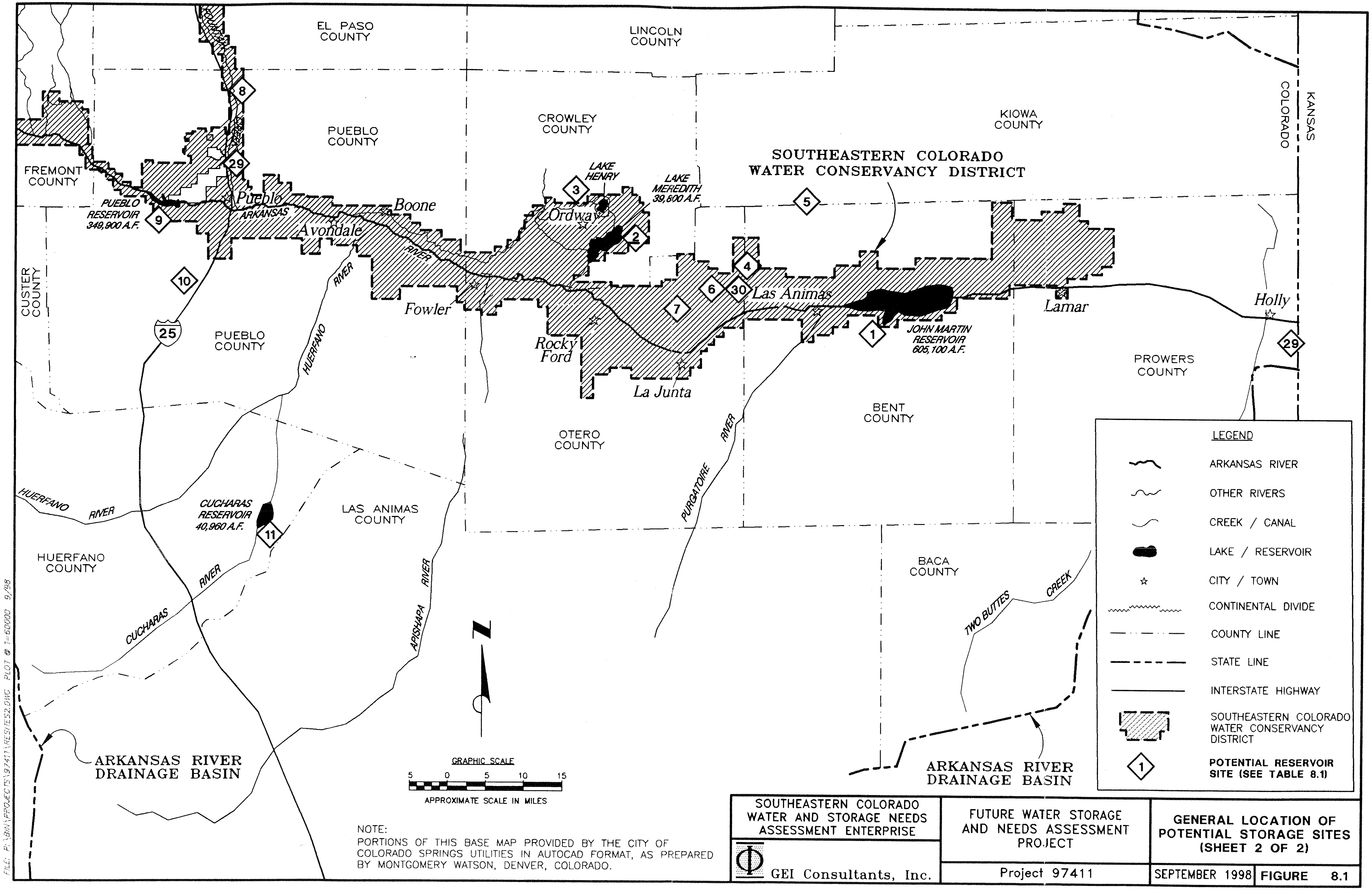
Project 97411

GENERAL LOCATION OF
POTENTIAL STORAGE SITES
(SHEET 1 OF 2)

SEPTEMBER 1998

FIGURE 8.1

FILE: P:\BIN\PROJECTS\97411\RESITES\SITES1.DWG PLOT @ 1=60000 9/98



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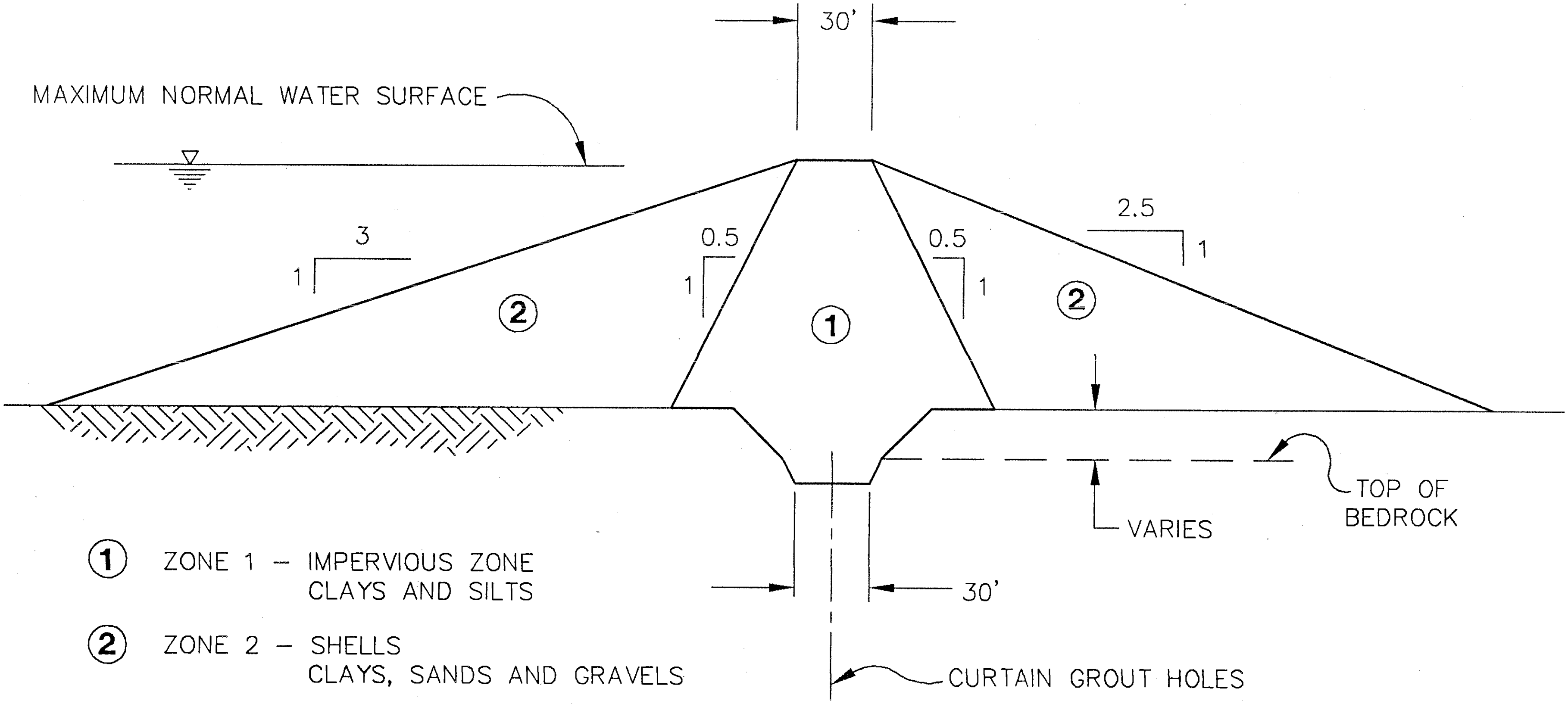
PROJECT

Project 97411

GENERAL LOCATION OF
POTENTIAL STORAGE SITES
(SHEET 2 OF 2)

SEPTEMBER 1998 **FIGURE 8.1**



**NOTE:**

TYPICAL SECTION USED TO ESTIMATE FILL VOLUME BASED ON LAYOUTS USING USGS 7 1/2' QUADRANGLE MAPS

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**TYPICAL SECTION OF EARTHFILL DAM**

SEPTEMBER 1998

**FIGURE 8.2**

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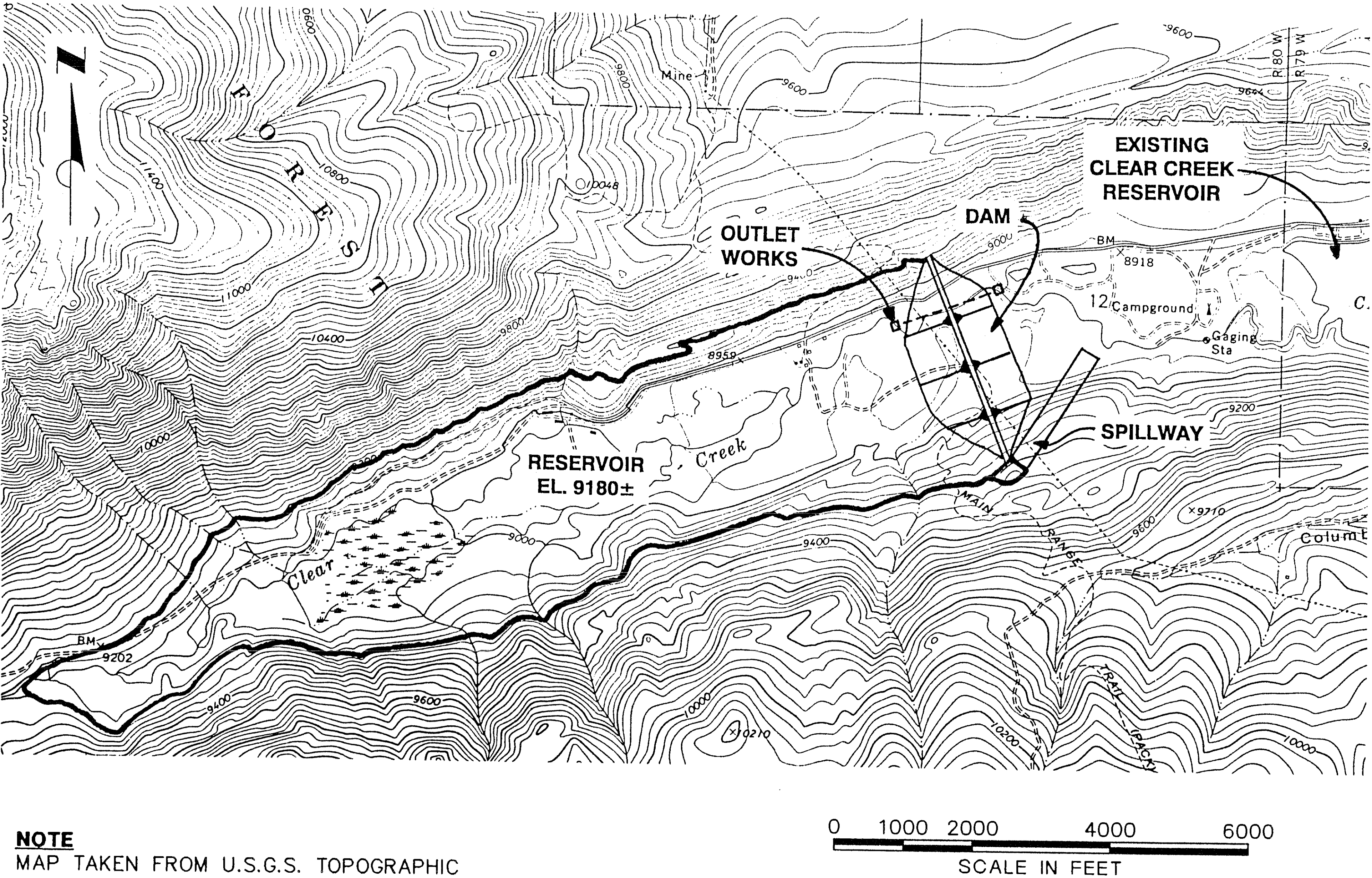
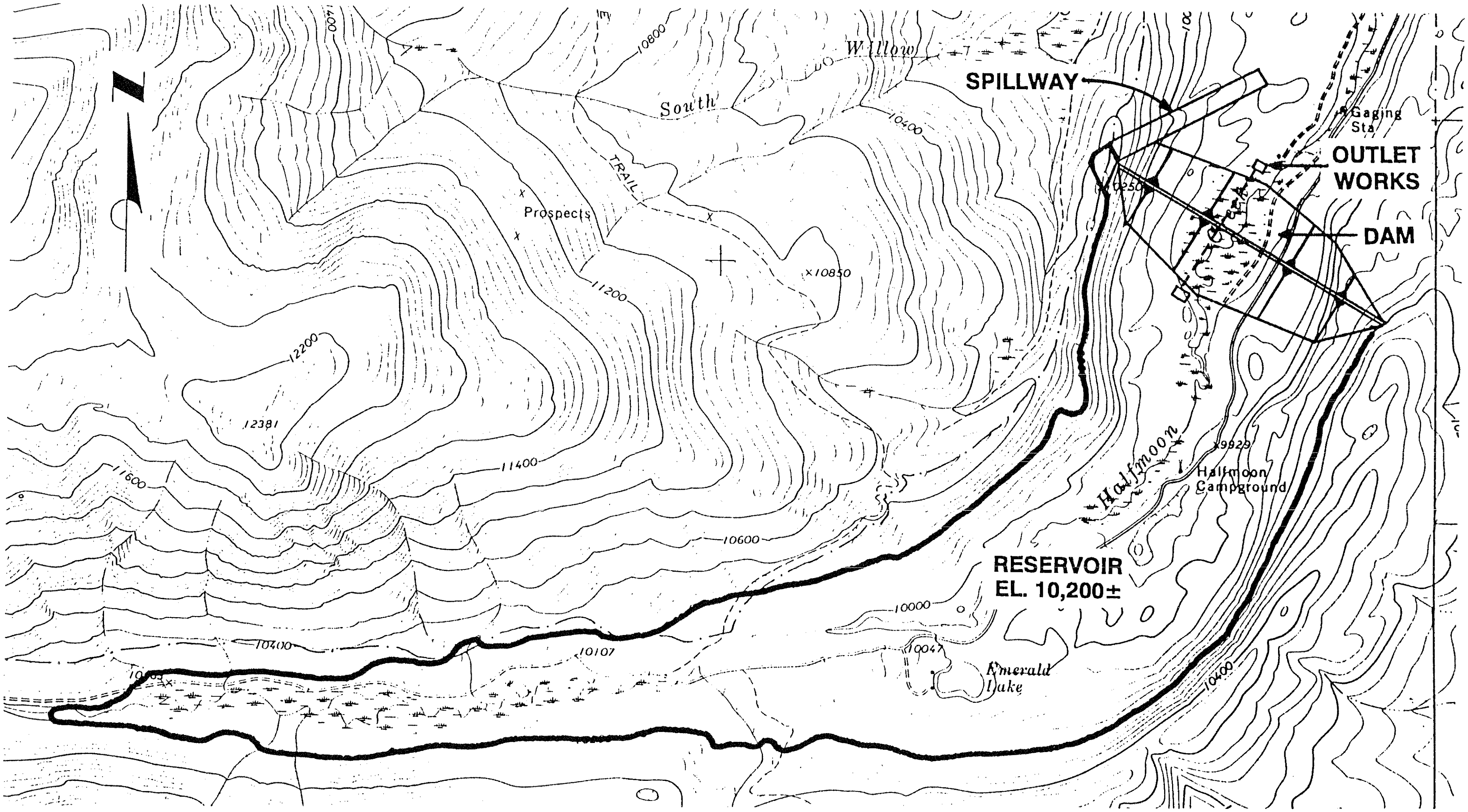


**NOTE**
MAP TAKEN FROM U.S.G.S. TOPOGRAPHIC
7.5 MINUTE SERIES

| | | |
|---|---|---|
| SOUTHEASTERN COLORADO WATER AND STORAGE NEEDS ASSESSMENT ENTERPRISE | FUTURE WATER AND STORAGE NEEDS ASSESSMENT PROJECT | GENERAL PLAN<br>CLEAR CREEK SITE |
| GEI Consultants, Inc. | PROJECT NO. 97411 | SEPTEMBER 1998 FIGURE 8.2A |

FILE: P:\BIN\PROJECTS\97411\BASETB.DWG 1=1 9/98



**NOTE**
MAP TAKEN FROM U.S.G.S. TOPOGRAPHIC
7.5 MINUTE SERIES

| | | |
|---|---|---|
| SOUTHEASTERN COLORADO WATER AND STORAGE NEEDS ASSESSMENT ENTERPRISE | FUTURE WATER AND STORAGE NEEDS ASSESSMENT PROJECT | **GENERAL PLAN HALFMOON CREEK SITE** |
| GEI Consultants, Inc. | PROJECT NO. 97411 | SEPTEMBER 1998 **FIGURE 8.2B** |

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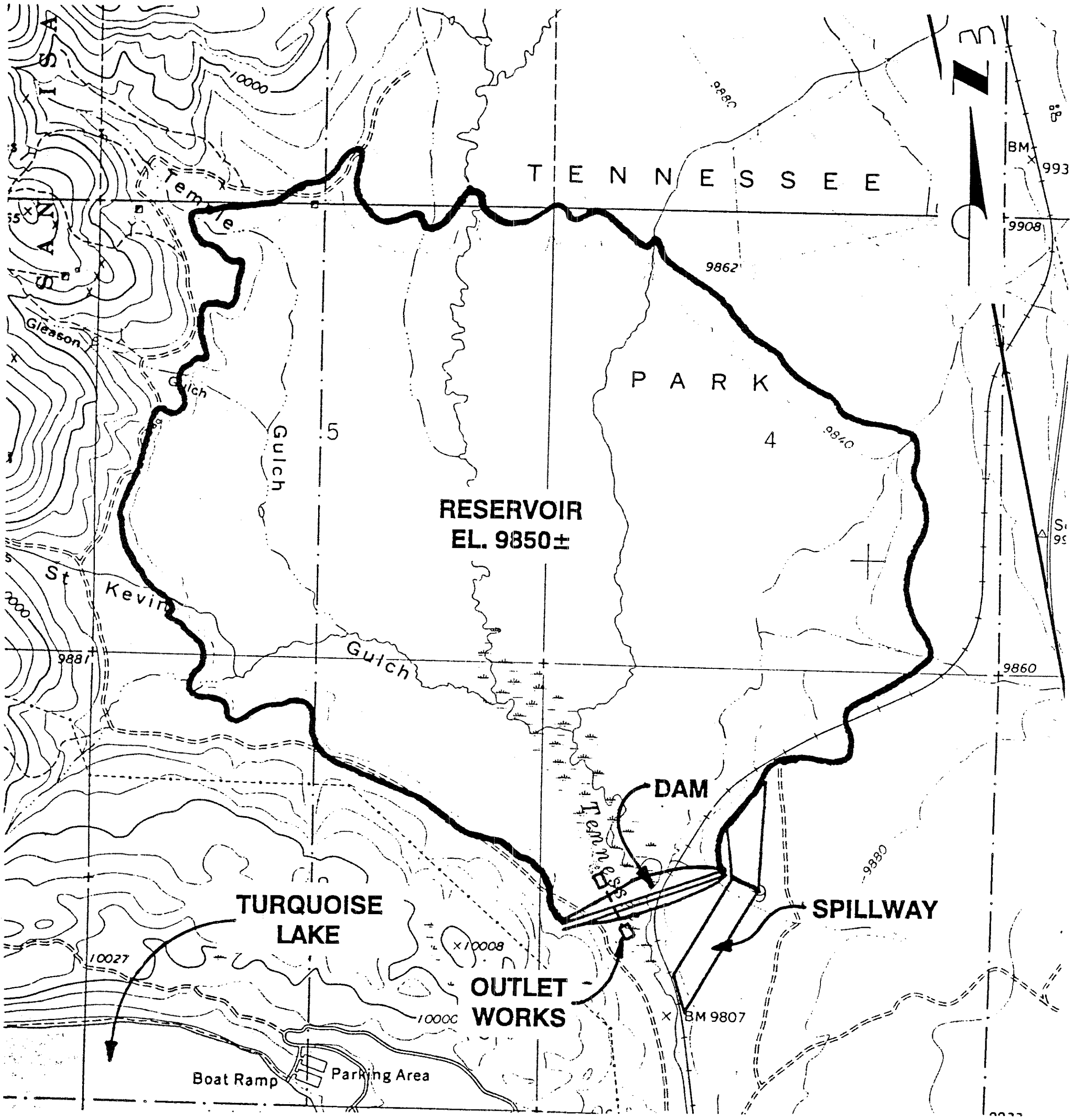

**NOTE**

MAP TAKEN FROM U.S.G.S. TOPOGRAPHIC
7.5 MINUTE SERIES

0 1000 2000 4000 6000
SCALE IN FEET

SOUTHEASTERN COLORADO
WATER AND STORAGE NEEDS
ASSESSMENT ENTERPRISE

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FUTURE WATER AND
STORAGE NEEDS
ASSESSMENT PROJECT

PROJECT NO. 97411

GENERAL PLAN
TENNESSEE CREEK

SEPTEMBER 1998

FIGURE 8.2C

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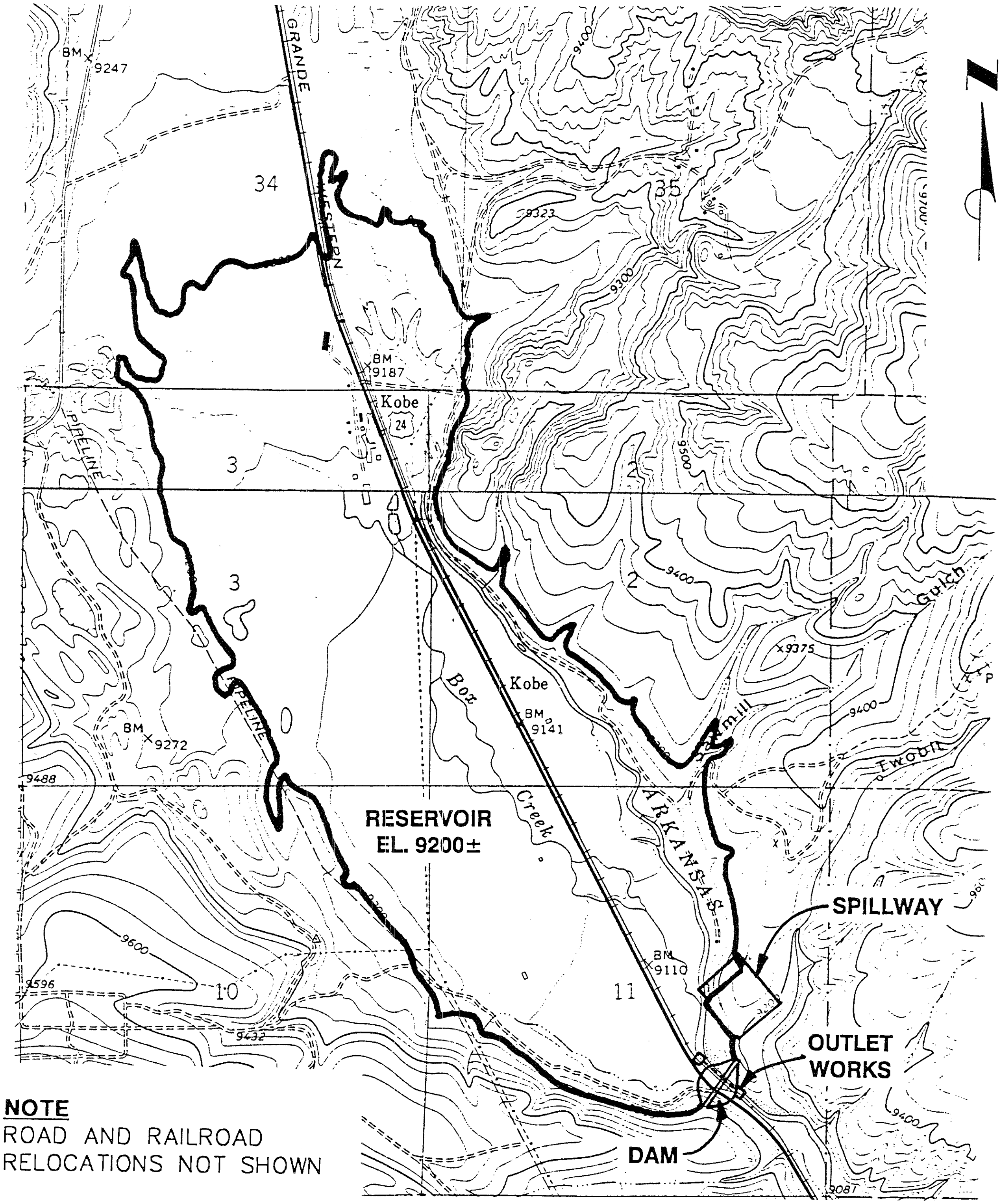

**NOTE**

ROAD AND RAILROAD RELOCATIONS NOT SHOWN

**NOTE**

MAP TAKEN FROM U.S.G.S. TOPOGRAPHIC 7.5 MINUTE SERIES

0 1000 2000 4000 6000
SCALE IN FEET

SOUTHEASTERN COLORADO WATER AND STORAGE NEEDS ASSESSMENT ENTERPRISE

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FUTURE WATER AND STORAGE NEEDS ASSESSMENT PROJECT

PROJECT NO. 97411

GENERAL PLAN
UPPER ARKANSAS
(HAYDEN RANCH)

SEPTEMBER 1998

FIGURE 8.2D

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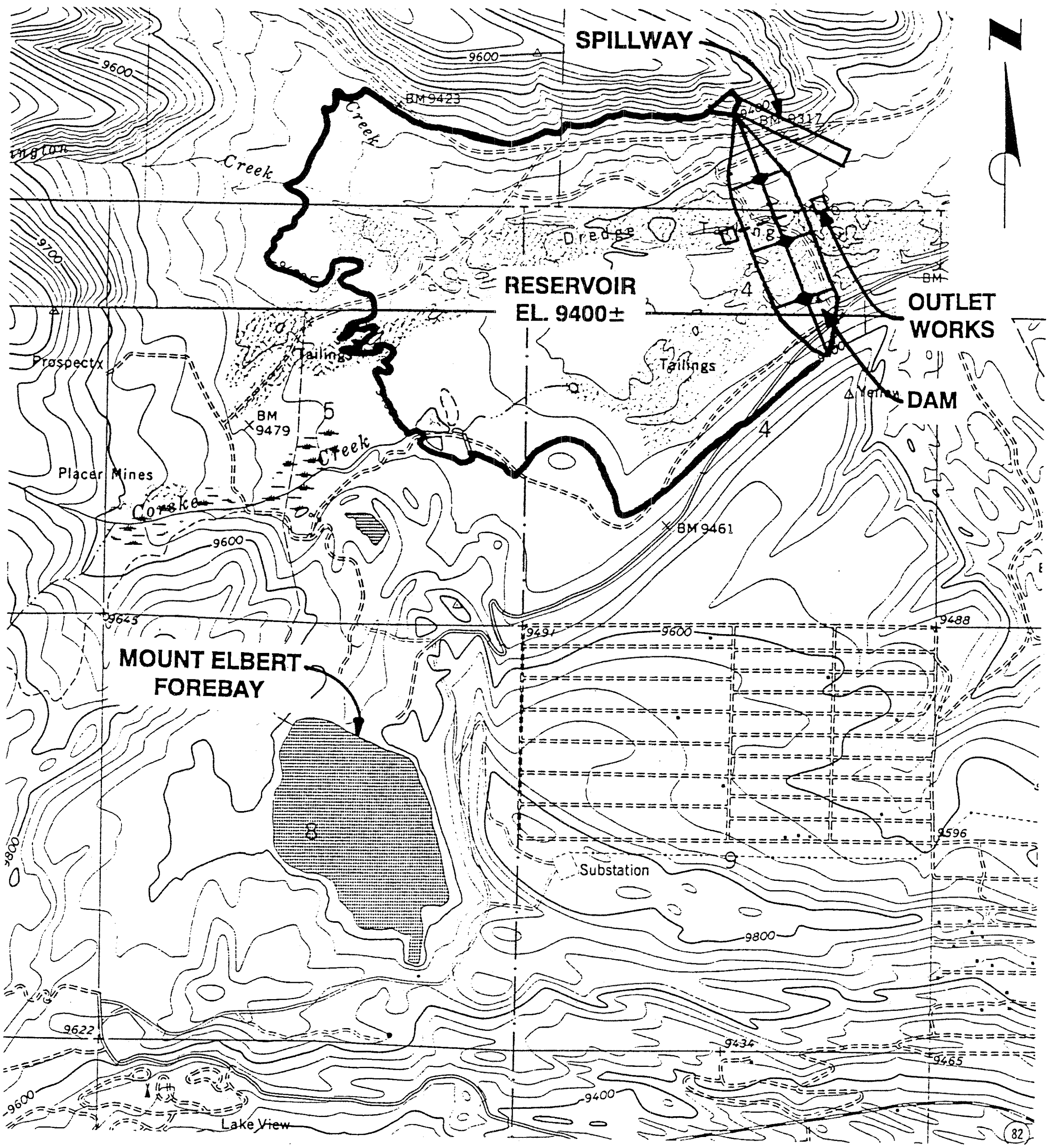

**NOTE**

MAP TAKEN FROM U.S.G.S. TOPOGRAPHIC
7.5 MINUTE SERIES

0 1000 2000 4000 6000
SCALE IN FEET

| | | |
|---|---|---|
| SOUTHEASTERN COLORADO WATER AND STORAGE NEEDS ASSESSMENT ENTERPRISE<br>GEI Consultants, Inc. | FUTURE WATER AND STORAGE NEEDS ASSESSMENT PROJECT<br>PROJECT NO. 97411 | **GENERAL PLAN BOX CREEK SITE**<br>SEPTEMBER 1998 **FIGURE 8.2E** |

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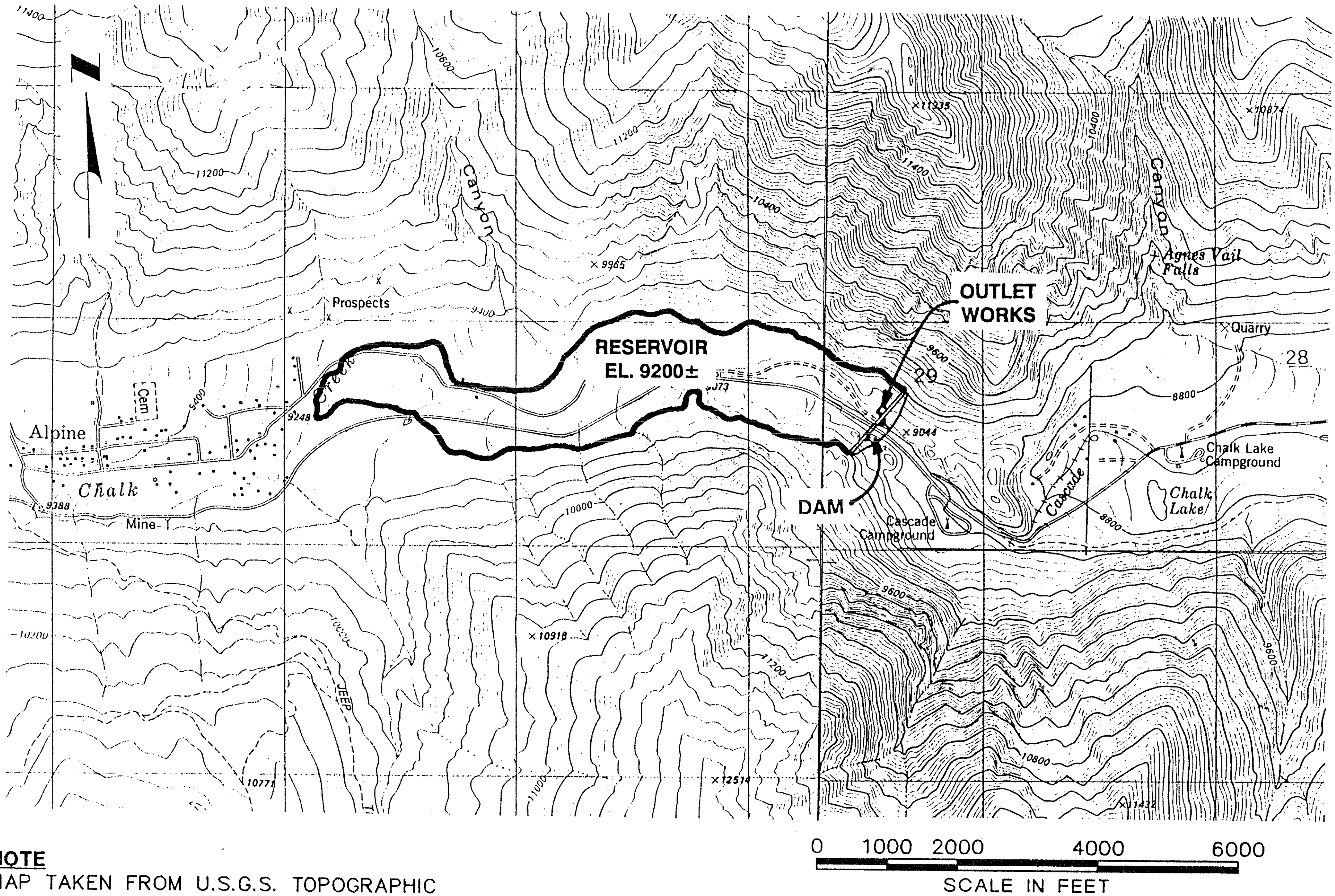

**NOTE**
MAP TAKEN FROM U.S.G.S. TOPOGRAPHIC
7.5 MINUTE SERIES

SOUTHEASTERN COLORADO
WATER AND STORAGE NEEDS
ASSESSMENT ENTERPRISE

GEI Consultants, Inc.

FUTURE WATER AND
STORAGE NEEDS
ASSESSMENT PROJECT

PROJECT NO. 97411

GENERAL PLAN
CHALK CREEK SITE

SEPTEMBER 1998

FIGURE 8.2F

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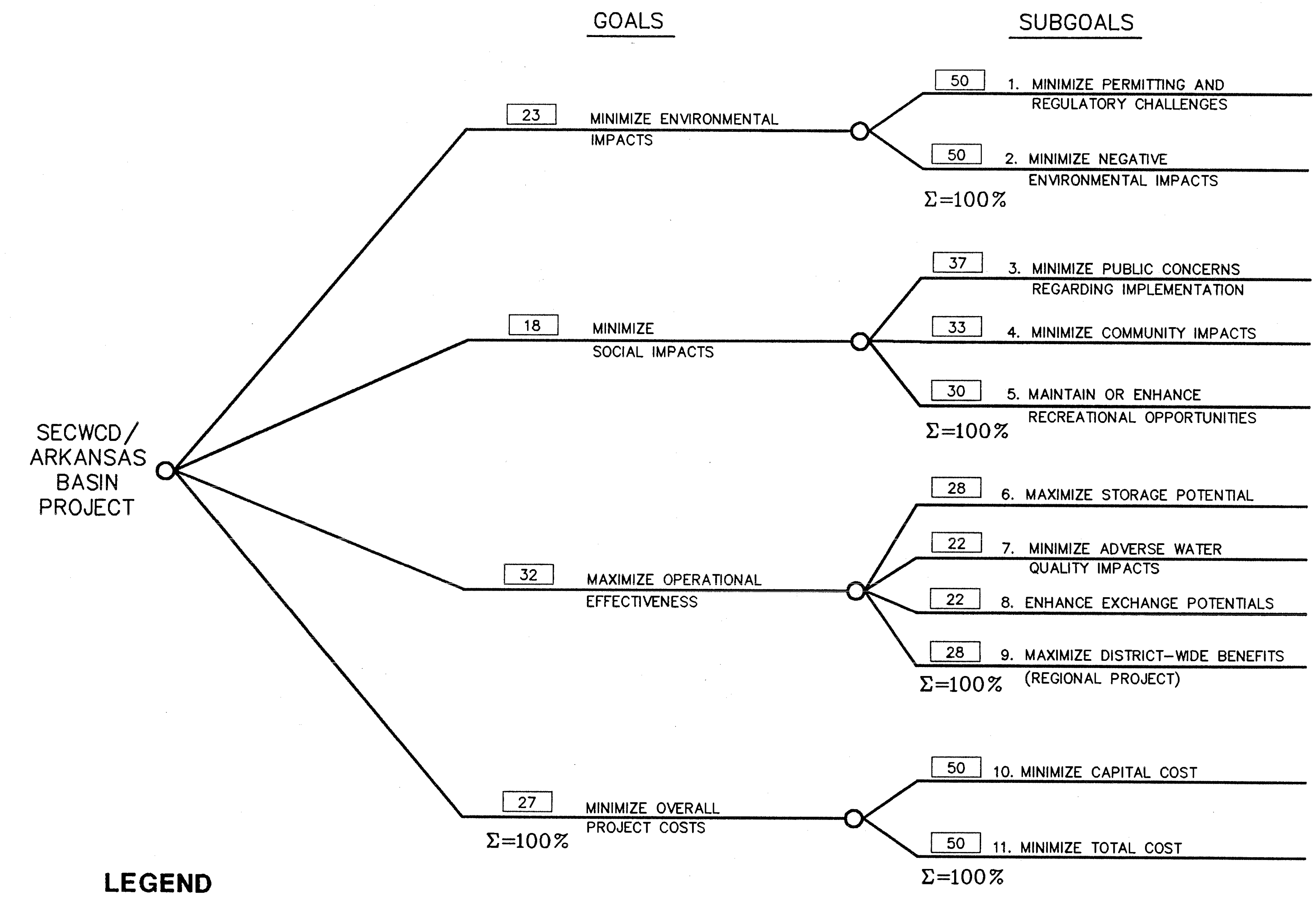

**LEGEND**

○ - INDICATES NODAL POINT WHERE SCORES ARE COMPUTED

☐ - INDICATES LOCATION WHERE WEIGHT IS REQUIRED FOR MODEL COMPUTATION

SOUTHEASTERN COLORADO
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DISTRICT

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FUTURE WATER AND STORAGE
NEEDS ASSESSMENT PROJECT

PROJECT NO. 97411

**PRELIMINARY
FUNCTIONAL HIERARCHY
FOR DECISION
ANALYSIS**

SEPT. 1998

**FIGURE 8.3**

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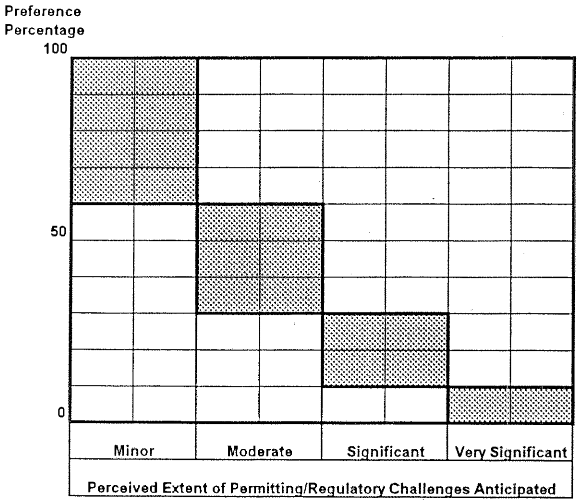
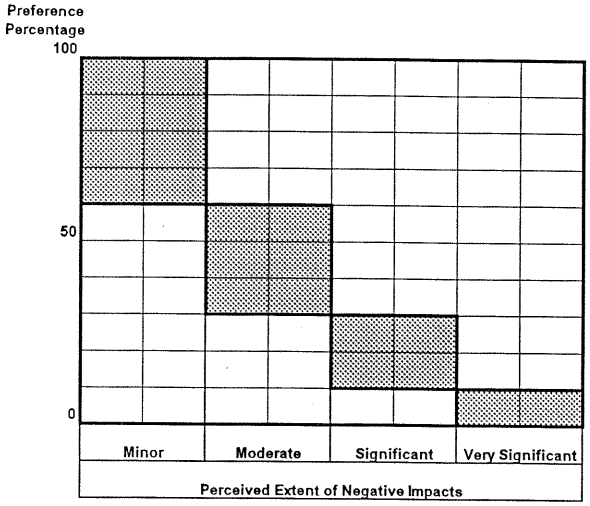
### SUBGOAL NO. 1 – ANTICIPATED PERMITTING CHALLENGES



Considerations:

NEPA Compliance (EA, EIS)
Dealings with USBR
Change in Legislation
Change in Operating Principles
Change in Allocation Principles
East Slope/West Slope Issues

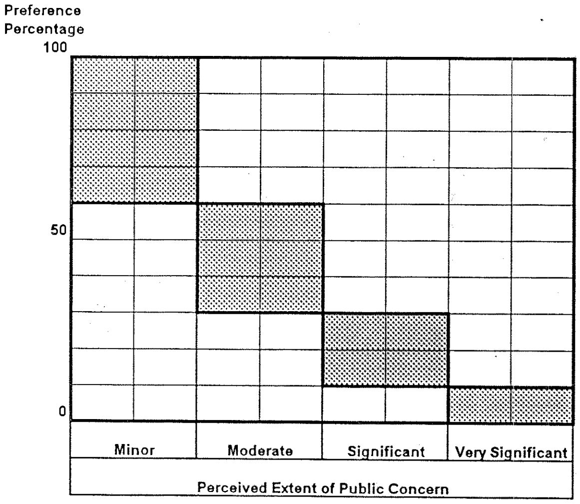
### SUBGOAL NO. 2 – NEGATIVE ENVIRONMENTAL IMPACTS



Considerations:

Wetlands
T&E Species
Streamflow Modifications
Fisheries
Cultural Resources

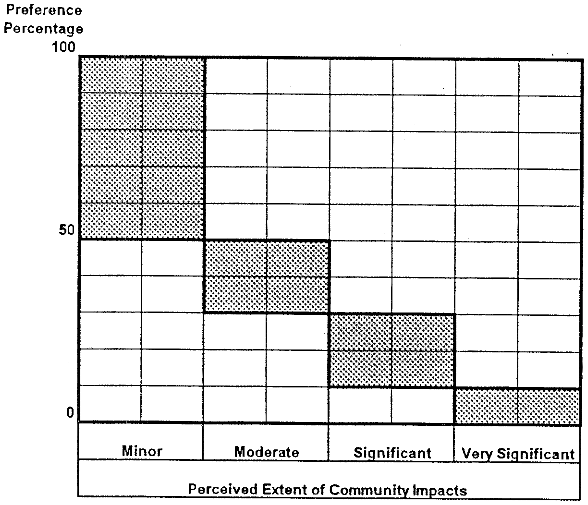
### SUBGOAL NO. 3 – PUBLIC CONCERNS



Considerations:

Dam Safety
Public Safety
Not in My Backyard

### SUBGOAL NO. 4 – COMMUNITY IMPACTS



Considerations:

Local Economic Effects
Increased Tourism
Traffic/Roads

Note: Consider that a balance of positive and negative impacts results in score of 50. If the impacts are mor negativea lower score should be assigned.

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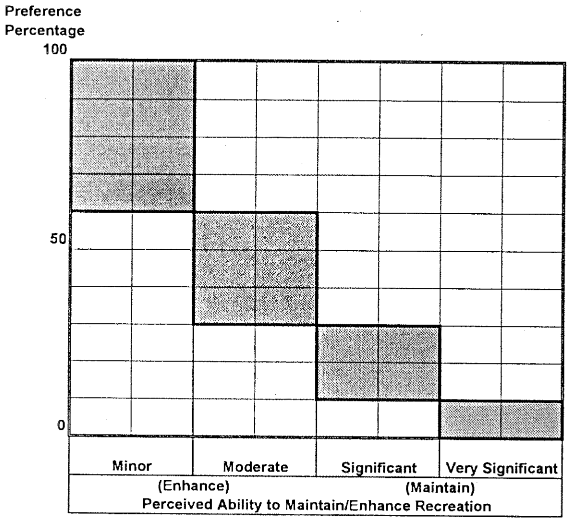
Critdsm2.xls
9/21/98/Project 97411

FIGURE 8.4
PREFERENCE RELATIONSHIPSS FOR DECISION ANALYSIS

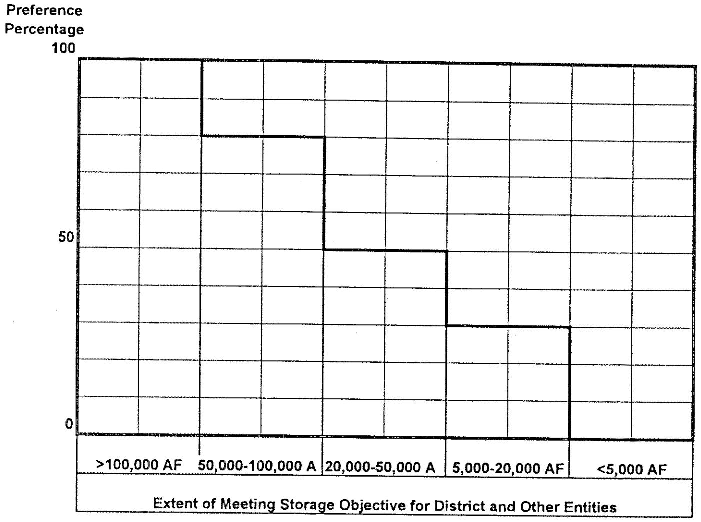
SUBGOAL NO. 5 -- MAINTAIN OR ENHANCE RECREATION



Considerations:

River Rafting/Boating
Stream Fishing
Lake Recreation

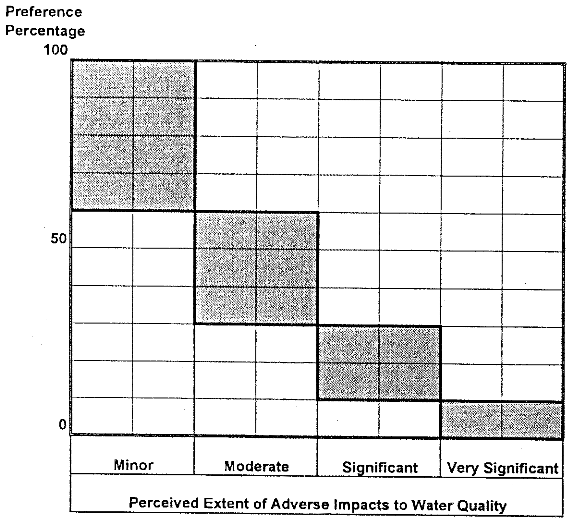
SUBGOAL NO. 6 -- STORAGE POTENTIAL



Considerations:

Volume of Storage Provided

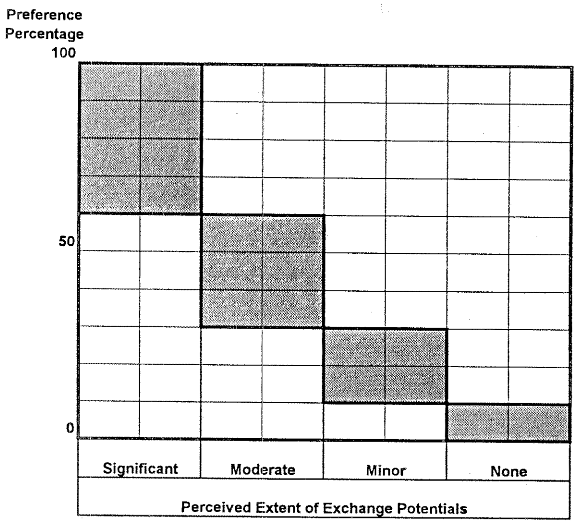
SUBGOAL NO. 7 -- WATER QUALITY IMPACTS



Considerations:

Reservoir Water Quality
Stream Water Quality

SUBGOAL NO. 8 -- EXCHANGE POTENTIALS



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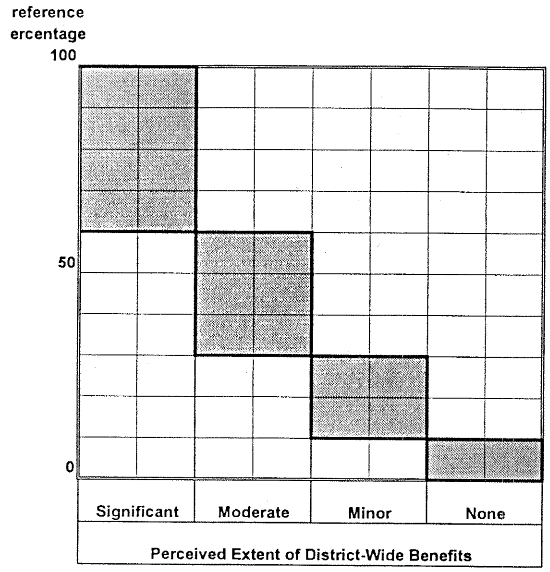
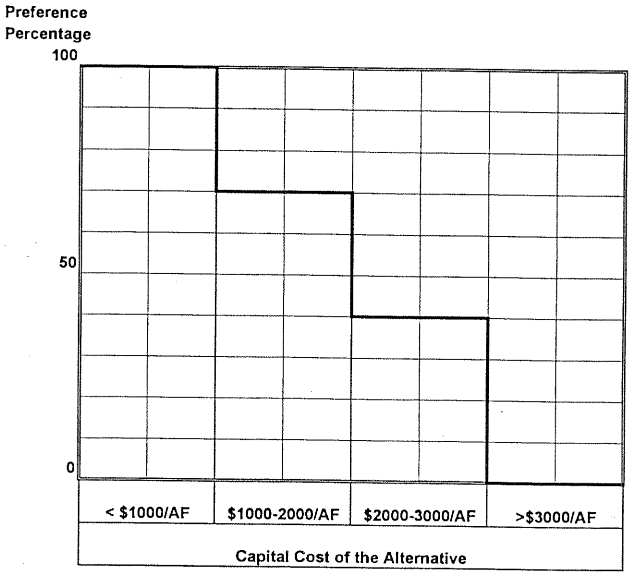
Critdsm2.xls
9/21/98/Project 97411

FIGURE 8.5
PREFERENCE RELATIONSHIPS FOR DECISION ANALYSIS

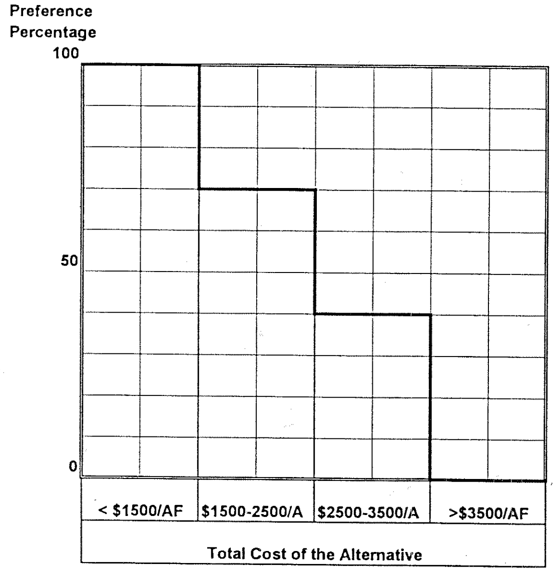
SUBGOAL NO. 9 -- DISTRICT-WIDE BENEFITS



SUBGOAL NO. 10 -- CAPITAL COST



SUBGOAL NO. 11 -- TOTAL COST



**Considerations:**

**O&M Cost**
**Present Worth of All Costs**

**FIGURE 8.6**
**PREFERENCE RELATIONSHIPS FOR DECISION ANALYSIS**

SECWCD/ARKANSAS BASIN ASSESSMENT PROJECT

**COMPARISON OF ALTERNATIVES**

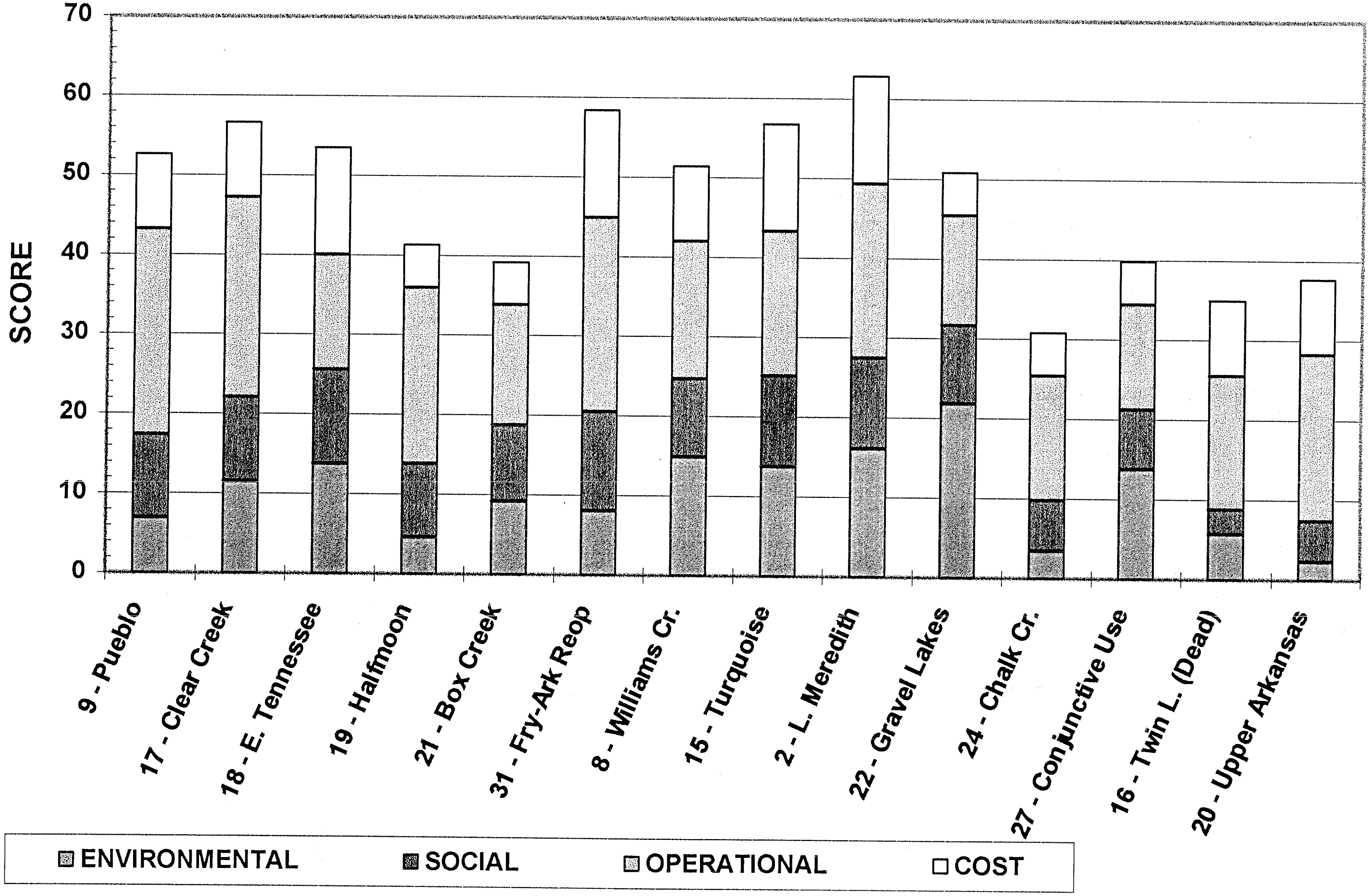


**FIGURE 8.7**

**SCORES FOR ALTERNATIVES**

(BASE CASE)

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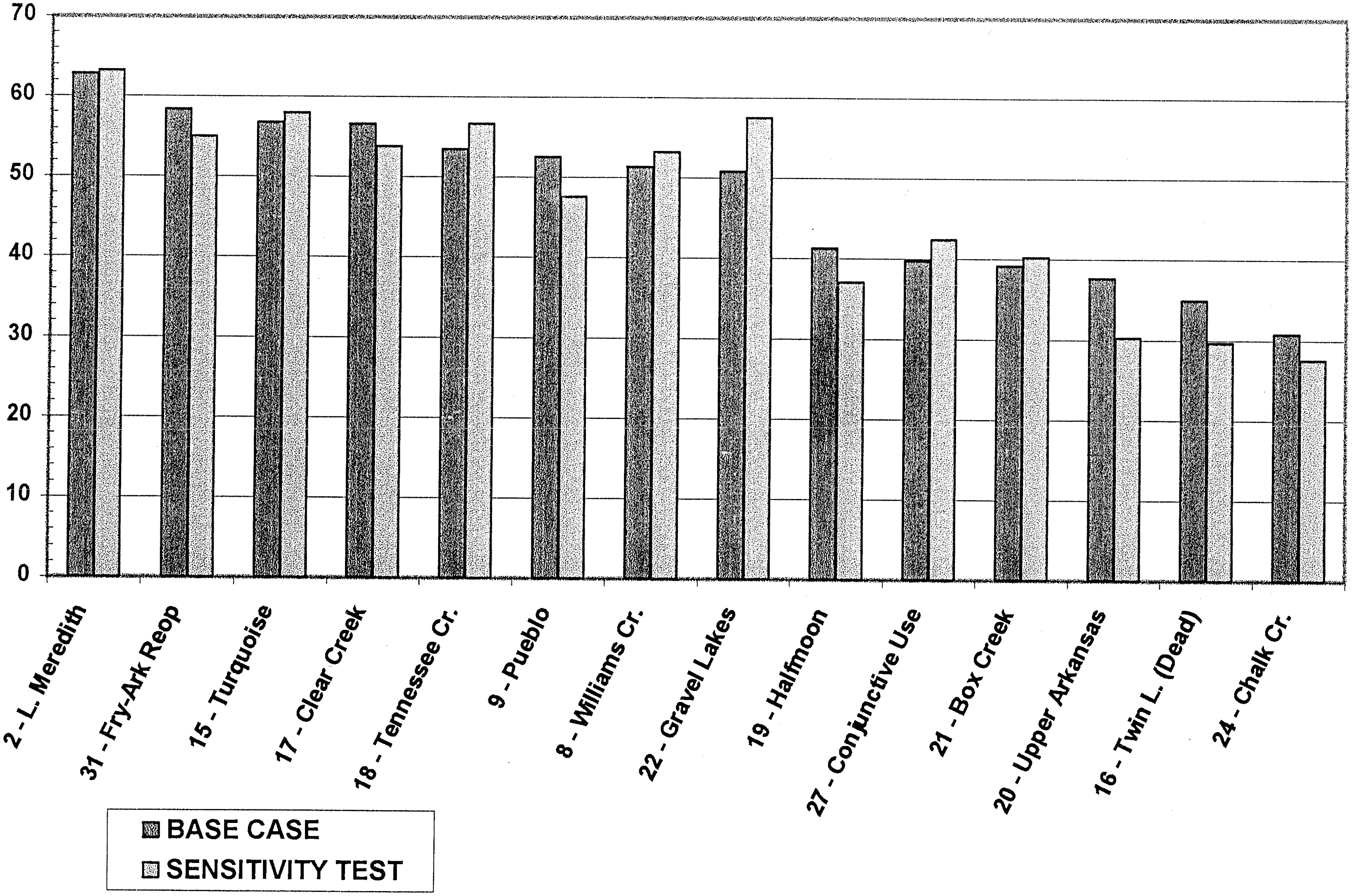
Score_a.xls
Base Case

SECWCD/ARKANSAS BASIN ASSESSMENT PROJECT

## ORDERED RANKING OF ALTERNATIVES



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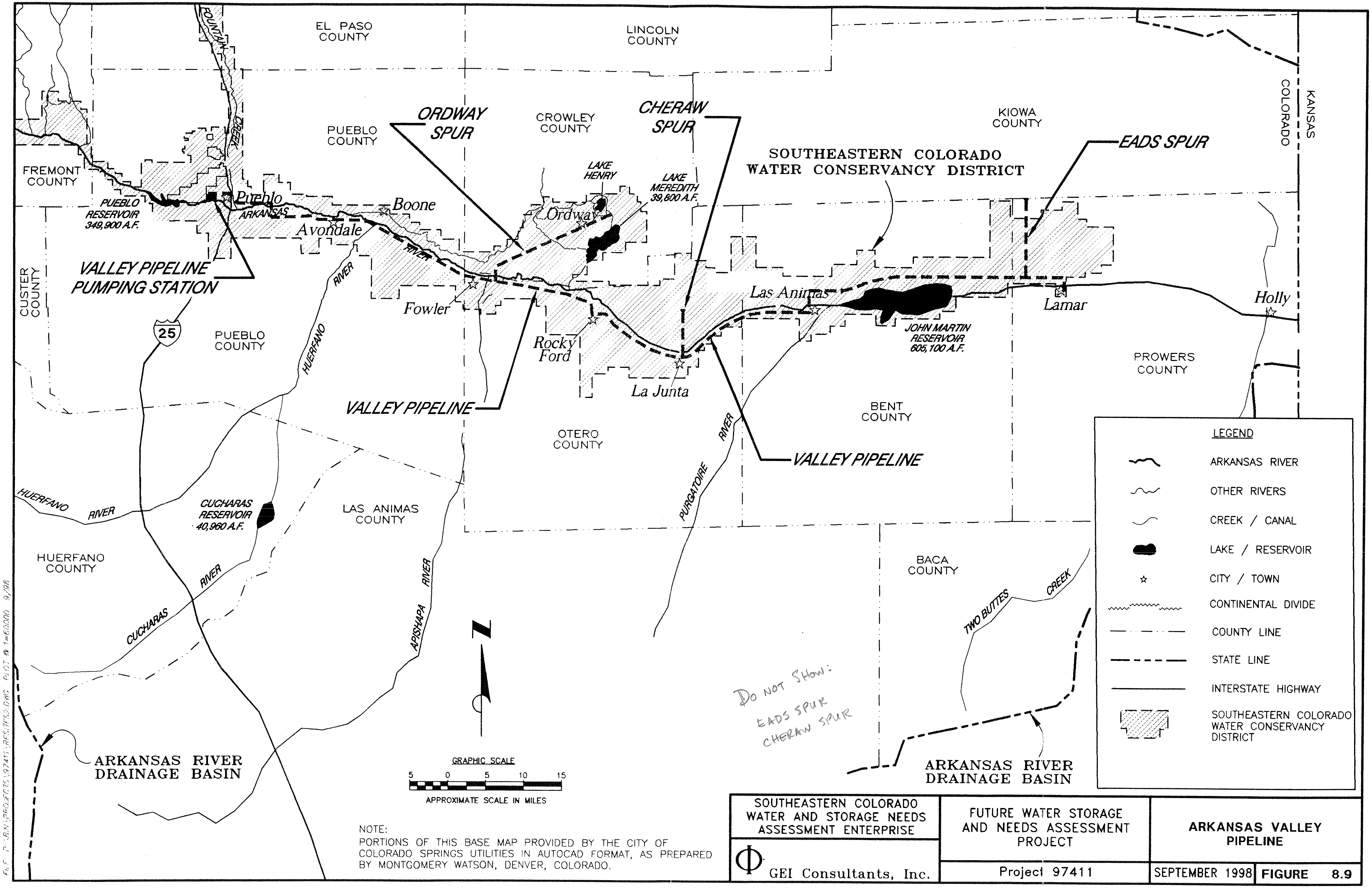
PROJECT 97411
12/8/98

SCORE_FIN.XLS
Ordered Ranking

FIGURE 8.8
COMPARISON OF SCORES
FOR ALTERNATIVES
BASE VS. SENSITIVITY TEST



Do NOT SHOW:
EADS SPUR
CHERAW SPUR

NOTE:
PORTIONS OF THIS BASE MAP PROVIDED BY THE CITY OF COLORADO SPRINGS UTILITIES IN AUTOCAD FORMAT, AS PREPARED BY MONTGOMERY WATSON, DENVER, COLORADO.

SOUTHEASTERN COLORADO
WATER AND STORAGE NEEDS
ASSESSMENT ENTERPRISE

Φ GEI Consultants, Inc.

FUTURE WATER STORAGE
AND NEEDS ASSESSMENT
PROJECT

Project 97411

**ARKANSAS VALLEY PIPELINE**

SEPTEMBER 1998

**FIGURE 8.9**

FILE: P:\BIN\PROJECTS\97411\RESITES2.DWG PLOT @ 1=60000 9/98

Section 9

# 9. CONCLUSIONS

## 9.1 General

Water resources in the Arkansas Basin are managed to meet the needs of municipal and agricultural water users through complex systems of diversions, ditches and canals, and pipelines that develop water in the Arkansas Basin and on the Western Slope in the Upper Colorado River Basin. In 1958, the Southeastern Colorado Water Conservancy District (District) was created to help bring the Fryingpan-Arkansas Project (Fry-Ark) into existence. Since 1972, the Fry-Ark Project has been providing water to municipal users and supplemental irrigation water to agricultural users within the District boundaries.

Like other regions along the East Range, and other urbanized or urbanizing areas in Colorado, the growth in population and resulting demands for water in the municipal sector within the District has created competition for scarce water resources in the Arkansas Basin. The agricultural sector has seen municipal entities from within the District and outside the District acquire agricultural water rights and transfer the water to municipal use. District water supply entities have endorsed the concept of trying to maintain the agricultural economy of the District and the Basin as a whole, by continuing to provide irrigation water supplies at historical levels, while identifying ways to meet the needs of the municipal entities through the 40-year planning horizon.

## 9.2 Population Growth and Municipal Water Demands in the District

The District's population is projected to increase from 620,000 persons to 1.2 million persons by the year 2040 under the "base case" growth scenario described in Section 3. (Recent state demographer figures [August, 1998] show somewhat higher growth rates for the base case.) A higher growth scenario would result in year 2040 District population of 1.6 million persons. This "high growth" case represents an annual growth rate of approximately 2.3 percent, which is not considered to be high, based on recent trends in Colorado. It certainly is not an overly optimistic or overly conservative figure. Much of the population growth under either the "base case" or "high growth" scenario is forecast to occur in the Fountain Valley area (Colorado Springs, Security, Widefield, Stratmoor Hills, and Fountain) and in the Pueblo area (Pueblo, Pueblo West, St. Charles Mesa). Together, these entities will account for 89 percent of the year 2040 population, in comparison to 85 percent at present.

Water demand in the municipal sector is projected to increase from the current 148,000 af to 244,000 af under the base scenario and 335,000 af under the high growth scenario by the year 2040. The forecast demands assume that reasonably effective conservation measures will be implemented. Conservation is expected to provide at least a 10 percent reduction in water demand in comparison to simply extrapolating current per capita usage within each entity into the future.

For the high growth scenario, year 2040 municipal water demand in the District (with conservation) is forecast to be 335,000 af of which 62 percent will occur in the Fountain Valley area and 24 percent in Pueblo, Pueblo West, and St. Charles Mesa. Approximately 84 percent of the increase in water demand is forecast to occur in the Fountain Valley and Pueblo areas.

## 9.3 Agricultural Water Use in the District

During the 1986-95 period of record, agricultural surface water diversions in the District averaged 754,000 af per year. Of the total, 594,000 af (71%) was direct flow water, 32,000 af (4%) was Fry Ark Project water, 22,000 af (3%) was other transmountain water, and 74,000 af (10%) was water from non-Project storage. During the same period, approximately 79,000 af of ground water was pumped for irrigation uses, including both sole-source wells and augmentation wells. Total annual irrigation water use averaged 833,000 af and ranged from a high of 997,000 to a low of 703,000 af during the 10-year period. During dry years, "the supplemental sources" (i.e., non-direct flow water) become increasingly important and represent 35 percent of the total agricultural water use versus 15 percent in a wet year, as discussed in Chapter 5.

For the purposes of this Assessment, agricultural water use is being treated as the "demand" for agricultural water. The water supply to meet the full theoretical consumptive use of crops on the irrigated lands within the District certainly exceeds the historic usage. Irrigators have adapted their cropping patterns and water applications to the current water supply realities in the Basin. Expenditures to develop additional water for agricultural use most likely cannot be supported by the agricultural economy. However, irrigators do require Project storage space to better manage their existing supplies and guaranteed sources of supply to provide replacement water that offsets stream depletions caused by well pumping.

## 9.4 Available Water Supplies and Potential Deficits

### 9.4.1 Municipal Sector

As described in Section 6, Pueblo and Pueblo West appear to have adequate water supplies to meet their long-range needs.

Most of the additional water supply is required in the Colorado Springs and other FVA entities as indicated below:

| Entity | Additional Water Supply Required (acre-feet)[1] | | | |
|---|---|---|---|---|
| | Base Forecast | | High Forecast | |
| | Year 2020 | Year 2040 | Year 2020 | Year 2040 |
| West of Pueblo | 0 | 910 | 0 | 2,063 |
| Fountain Valley | | | | |
| Colorado Springs | 3,589 | 13,096 | 22,837 | 72,371 |
| Fountain | 139 | 3,973 | 139 | 3,973 |
| Security | 1,046 | 790 | 1,046 | 790 |
| Widefield | 706 | 2,447 | 706 | 2,447 |
| Stratmoor Hills | 0 | 12 | 0 | 12 |
| El Paso County | 61 | 103 | 61 | 103 |
| | 5,541 | 20,421 | 24,789 | 79,696 |
| Total | 5,541 | 21,331 | 24,789 | 81,759 |

(1) See Section 6, Tables 6.1 through 6.9.

Planning for future municipal water needs in the District should recognize that significant additional water needs will develop in the FVA entities service areas where nearly 90 percent of the additional population growth water demand is forecast to occur.

Colorado Springs Utilities has published its Long-Range Water Resources Plan. That plan proposes that 70 to 75 percent of the additional water needed by Colorado Springs should be developed in a "Southern Supply Project." Based on the water supply-demand comparison made for the Assessment Project, which shows a total Colorado Springs need of 72,000 af, this equates to approximately 50,000 af of water to be delivered by the Southern Supply Project. Colorado Springs is proposing that 45,000 af of storage be dedicated in Fry-Ark Project facilities to regulate its undeveloped water rights and that a pipeline be constructed from Pueblo Dam to a terminal reservoir on Jimmy Creek in the western part of the Colorado Springs' service area. (The new pipeline would parallel the existing Fountain Valley Conduit for a portion of its length). If the base forecast is considered, Colorado Springs would require less storage to meet its 2040 water needs. Under either the base or the high forecast, the other FVA entities would require approximately 7,300 af of additional water supply. Storage of 22,000 af is estimated to be needed to provide this supply. Allocation or reallocation of Project water supplies is beyond the scope of the present study. Our study also did not presume to allocate apparently "surplus" firm yield from one entity to another. However, unallocated Project water could be made available through the allocation process, on an annual basis, to meet shortfalls. A relatively small portion of the future water supply requirements of the other FVA entities will be obtained from construction of additional wells. These entities have indicated their desire to participate on a regional basis with Colorado Springs in a second Fountain Valley Conduit and in being appropriately considered in any planning for dedication of storage space in Project reservoirs for non-Project water, including storage in Pueblo Reservoir. For planning purposes, we assumed, as described in Section 6, that storage in the amount of 22,000 af would be needed by the other FVA entities in addition to the 45,000 af requested in the Project by Colorado Springs.

### 9.4.2 Agricultural Sector

The primary goal of agricultural entities within this District is to maintain their present levels of crop production by maintaining irrigation water supplies at their present levels. Of particular concern is the Winter Water Storage Program, which relies, in large part, on effectively using available storage space in Project facilities, primarily Pueblo Reservoir. The WWSP was envisioned as an integral part of the Fry-Ark Project and it has been operating successfully since the Project began full operations. As discussed in Section 7, stored Winter Water is subject to spill from Project reservoirs to meet the necessities of flood control, power generation, storing transmountain water, storing East Slope Project water, and Project operational requirements. the amount of Winter Water spills may be reduced over time as municipal users begin to use more Project water. However, modeling studies by the Bureau described in Section 7 indicate that dedication of 40,000 af of storage in Pueblo Reservoir would reduce the frequency of Winter Water spills as the authorized amount of Project storage is provided to municipal entities.

Another agricultural water need is replacement water for well depletions. As indicated in Section 6, Project water return flows from agriculture can only meet a portion of the depletion. Between 17,000 and 21,000 af per year of additional water is needed to offset well depletions. There will be demand for municipal Fry-Ark Project return flows to offset depletions from well pumping. Storage to regulate water rights obtained to offset well depletion is estimated to be 26,000 af, based on an approximate storage-to-supply factor of 1.5.

A third need that will develop in the future within the agricultural sector is replacement of the transmountain water that is currently being purchased by irrigation entities from municipal users. During 1986-95, this "other transmountain" water averaged 22,000 af.

In summary, potential future water supply deficits in the agricultural sector total 59,000 af, as indicated below:

| Component | Acre-Feet |
|---|---|
| Reduced availability of Fry-Ark Project water | 20,000 |
| Additional replacement water to offset well pumping | 17,000 |
| Reduced availability of water currently purchased from municipal entities | 22,000 |
| **Total** | 59,000 |

These deficits will begin to materialize in the 2010 - 2015 time frame, as demands for water in the municipal sector begin to increase above currently developed water supplies. Storage also may be needed to regulate water for replacement of well depletions.

## 9.5 Water and Storage Needs

The needs for additional water supplies and storage for District entities are described in Section 6 of the report, with additional information on storage options provided in Section 7. For the base case forecast, additional storage capacity of 114,000 af appears to be required. For the high growth scenario, storage of 139,000 af appears to be required. Storage is needed to regulate currently undeveloped supplies for which water rights have been adjudicated and to better manage the water supplies of both municipal and agricultural users within the District.

The need for storage to meet growing demands for water will materialize by the year 2010 and continue to increase during the 40-year planning horizon. To respond to this need, planning for additional storage development needs to begin immediately, particularly in light of the long lead times for NEPA compliance.

As part of the studies for this report, District entities identified other storage needs totaling approximately 34,000 af. Much of this storage would be in already identified projects. However, the storage also could be provided in a "regional" project, which would result in cost savings. With this volume included, 173,000 af of storage need has been identified for District entities, as indicated below:

| Entity | Required Storage (af) | |
|---|---|---|
| | High Forecast | Base Forecast |
| Studied Needs | | |
| Colorado Springs Utilities | 45,000 | 21,000 |
| Other FVA entities | 22,000 | 22,000 |
| Entities West of Pueblo | 3,700 | 5,000 |
| Florence | 2,300 | 0 |
| Winter Water Program | 40,000 | 40,000 |
| Storage to Regulate Replacement Water for Well Pumping | 26,000 | 26,000 |
| Subtotal | 139,000 | 114,000 |
| Other Reported Needs | | |
| Pueblo Water Works | 20,000 | 20,000 |
| Public Service Company | 5,000 | 5,000 |
| Pueblo West MD | 5,500 | 5,500 |
| St. Charles Mesa | 3,600 | 3,600 |
| Subtotal | 34,100 | 34,100 |
| Total | 173,100 | 148,100 |

A non-District entity, the City of Aurora, has indicated its desire for up to 10,000 af of storage within The Arkansas Basin and its willingness to consider participation in a "joint" project with District entities. This type of partnering would help to reduce costs for all involved.

## 9.6 Potential Alternatives

As described in Section 8, 31 candidate storage alternatives were reviewed and subjected to initial evaluations to assess their suitability and practicality for implementation. Based on that review, 14 storage options were developed and evaluated further using a decision analysis framework and procedure. The SSC was involved in configuring this framework and in the evaluation of alternatives.

The more-detailed analysis of 14 alternatives resulted in retaining 8 alternative storage options for further consideration. As described in Section 8, these alternatives can provide varying amounts of storage at costs ranging from $150 to $3,000 per af of storage. No single storage option, as they are currently configured in terms of size, can meet the identified storage need for the high growth scenario. Therefore, various combinations of alternatives should be considered. As described in Section 8, the 8 storage options with the highest rankings from the alternatives analysis exhibit good performance in the identified project goals of minimizing cost and maximizing operational effectiveness. Even when environmental and social goals were raised in importance, these 8 alternatives remained the highest ranking of the 14.

Section 7 presents discussions on "reoperation" of Fry-Ark Project facilities. Studies performed for Colorado Springs to support their long-range water planning indicate that up to 90,000 af of the storage space in Project reservoirs could be dedicated to non-Project water without adversely affecting Project operations. Additional operations studies are needed to verify the characterization of agricultural demands, and Winter Water storage and East Slope Project water storage in this prior work. Such studies will probably be completed during the next 6 to 12 months, based on reports from the District. Results from the earlier evaluation seem to be supported by earlier studies performed by the Bureau of Reclamation, which examined dedication of 70,000 af of space for non-Project and Winter Water.

Given the relative low-cost of storage "reoperation," this option should be given high priority in subsequent phases of Project development. Reoperation would provide benefits to Colorado Springs, other FVA entities, and Pueblo, who have expressed interest in this alternative.

Based on identified storage needs and the options discussed in Section 8 of the report, several example storage plans were identified:

### Reoperation Plus New Storage Capacity at Project Facilities
### Plan A

| | Storage (acre-feet) | Cost ($ million) |
|---|---|---|
| Pueblo Reservoir - dedicate storage for non-Project water (35,000 for Colorado Springs; 40,000 for Winter Water) | 75,000 | TBD |
| Twin Lakes/Turquoise - dedicate storage for non-Project water | 10,000 | TBD |
| Raise Turquoise Dam with parapet wall | 9,000 | 1.4 |
| Enlarge Pueblo Dam and Reservoir | 45,000 | 22.5(1) |
| Subtotal | 139,000 | 23.9 |
| Add storage for other District entity needs (Pueblo and Lake Meredith Enlargements) (2) | 34,000 | 17.0(1) |
| Total | 173,000 | 40.9 |

Note: TBD = To be determined.

(1) Awaiting finalization of studies by the U.S. Bureau of Reclamation. Cost based on assumed $500 per af.

(2) Assumes that other needs can be met by storage at Pueblo.

## Additional Storage at Project Facilities Plus Upper Basin Storage (No Reoperation)
## Plan B

| | Storage (acre-feet) | Cost ($ million) |
|---|---|---|
| Enlarge Pueblo Dam and Reservoir | 75,000 | 37.5(1) |
| Raise Turquoise Dam with parapet wall | 9,000 | 1.4 |
| New Clear Creek Dam and Reservoir | 55,000 | 99.0 |
| Subtotal | 139,000 | 137.9 |
| Add storage for other District entity needs (Clear Creek) | 34,000 | 61.2 |
| Total | 173,000 | 199.1 |

(1) Awaiting finalization of studies by the U.S. Bureau of Reclamation. Cost based on assumed $500 per af.

## Reoperation Plus New Storage at Non-Project Facilities in Upper Basin
## Plan C

| | Storage (acre-feet) | Cost ($ million) |
|---|---|---|
| Pueblo Reservoir - dedicate storage for non-Project water | 75,000 | TBD |
| New Clear Creek Dam and Reservoir | 64,000 | 115.5 |
| Subtotal | 139,000 | 115.5 |
| Add storage for other District entity needs (Tennessee Creek) | 34,000 | 30.6 |
| Total | 173,000 | 146.1 |

Note: TBD = To be determined.

## Reoperation Plus New Storage at Project Facilities in Upper and Lower Basin
## Plan D

| | Storage (acre-feet) | Cost ($ million) |
|---|---|---|
| Pueblo Reservoir - dedicate storage for non-Project water | 75,000 | TBD |
| Tennessee Creek Dam and Reservoir | 28,000 | 25.2 |
| Raise Turquoise Dam with parapet wall | 9,000 | 1.4 |
| Enlarge Lake Meredith | 61,000 | 24.4 |
| Total | 173,000 | 51.0 |

Note: TBD = To be determined.

Based on preliminary cost figures, providing the needed storage capacity for District entities is anticipated to cost from $32 to 167 million. (Cost figures from the Bureau for the Pueblo enlargement are not yet available and will change these figures when they are known.)

Plans involving reoperation of Project facilities for non-Project storage, and raising existing Project dams to enlarge reservoirs, will involve intensive study and many institutional challenges, as documented in Section 7. Changes in Project operations must be consistent with the Project's authorizing legislation and Operating Principles; some plans may require a new Act of Congress. A change in the Allocation Principles may also be needed, subject to approval by the District's Board and possibly the District Court. Protection of existing entitlements may involve significant additional costs; these costs have not yet been studied. Any project, whether involving reoperation, building new storage capacity or both, will involve compliance with the National Environmental Policy Act (NEPA) and extensive studies to support an Environmental Assessment or Environmental Impact Statement.

## 9.7 Public Comment Process

### 9.7.1 Overview of Public Process

The Water and Storage Needs Assessment Project study was commissioned by the Southeastern Colorado Water and Storage Needs Assessment Enterprise (an "enterprise" of the Southeastern Colorado Water Conservancy District). The purpose of the study is to determine the District-wide need for water supply and storage into the year 2040. This section of the report documents the level of public involvement in the study process and summarizes public inputs received during the study process and presentation of the draft report at several public meetings.

Twenty-eight water user entities from throughout the nine-county service area of the Southeastern Colorado Water Conservancy District, and the Colorado Water Conservation Board, contributed as local sponsors of the Study and provided input on the direction of the Study. Those entities represent most of the major agricultural and municipal water use in the District; they include: Bessemer Ditch Co.; City of Las Animas; Arkansas Groundwater Users Association; City of Lamar; Holbrook Mutual Irrigating Co.; City of Canon City; City of Fountain; Widefield Water and Sanitation District; Colorado Canal Co.; St Charles Mesa Water District; Pueblo Board of Water Works; City of Florence; City of Rocky Ford; City of Colorado Springs Utilities--Water Resources Department; Security Water and Sanitation District; Catlin Canal Co.; Public Service Company; Stratmoor Hills Water and Sanitation District; Colorado Water Protective and Development Association; City of Aurora; City of La Junta; City of Salida; Lower Arkansas Water Management Association; Pueblo West Metro District, Penrose Water District, Fort Lyon Canal, and the Colorado Water Conservation Board.

The water-user participants met as the Enterprise's Storage Study Committee (SSC), following the creation of the Needs Assessment Enterprise, on January 16, 1997. There were approximately eight SSC meetings throughout the 20 months of the study process. All meetings were open to the public and minutes were taken. Meeting notices were posted at the District's designated public-notice posting location, and notices were mailed to the SSC mailing list. Upon request, all interested parties were included in the SSC mailings.

In addition to the SSC public-involvement process, the Enterprise held a series of public meetings, and published notices throughout the nine-county service area of the District notifying their constituents that the draft Water and Storage Needs Assessment Report (draft Report) was available for public review. An Executive Summary of the draft Report was distributed at the public meetings, and a complete copy of the draft Report was made available upon request. The SSC meetings and the public meetings were not intended to be a formal scoping process. They served as additional input to the planning efforts of the Enterprise.

The Report does not propose a preferred alternative or recommend a final decision on how best to meet the year 2040 needs for water and storage. It documents the potential need for additional water and storage development and lists a set of possible alternatives to meet the projected demand. The potential storage alternatives were subjected to a superficial evaluation as a part of this Study process. Further consideration of any of the storage alternatives would require more detailed analysis of the possible environmental, economic, recreation, and social impacts, as well as the actual costs of construction and maintenance. A more formal NEPA (National Environmental Policy Act) type evaluation and scoping process would need to be conducted if the alternatives and study findings warrant further consideration. The primary objective of the participants in the Water and Storage Needs Assessment was to document the future demand for water and storage within the District.

### 9.7.2 Summary of Comments Received

During the public meetings, people in attendance were invited to make comments and ask questions concerning the study and the draft Report. The District received written comments on the draft Report from several individuals, interest groups, and State and Federal agencies. Written comments are on file at the District's office in Pueblo. The following discussion attempts to faithfully summarize both the verbal and written comments and inputs received. Comments tended to be focused on four main issues: growth and concern about the effects of growth; needs for water storage and the issues related to water supply operations; recreation and environmental issues; economic and social issues; and inputs on the public comment process itself.

Growth Concerns

- Front Range cities are growing rapidly, putting pressure on water resources in other regions of the State
- Water conservation measures should be considered well before development of new water projects
- Several public comments stated that the report underestimates the impact that water conservation can have on reducing future demand
- Growth in municipal demand for water makes the Winter Water Storage Program even more important to help meet the needs of agriculture in the future
- The report includes valuable information for use in future water supply planning
- Municipal entities should be responsible to finance the storage alternatives..."Their growth is causing the problem"
- Agricultural entities must stay at the table, in order to make sure that storage alternatives, which may be implemented, meet their needs as well

Storage Projections/Operation Issues

- Projections for water storage should include the storage needs related to replacement water for well augmentation
- The stipulation with Colorado Springs and Pueblo relative to Project water should be re-visited... the storage of Project Water return flows would help meet future replacement water shortfalls
- Because of water quality and the high cost of water treatment, the "Valley Pipeline" concept should be studied further
- The municipal carryover privilege in Fry-Ark Project facilities should be reviewed in relation to future municipal storage demand
- Carryover of Project Water in Pueblo Reservoir should be limited to 1.5 times annual demand...perhaps a storage charge should be imposed for carryover

- Project operations in Lake County (Turquoise Lake) should be more closely monitored…the impacts of current Fry-Ark Project operations should be assessed

- The water quality impacts of any Fry-Ark Project "re-operation" should be fully analyzed

- The old Schaffer Reservoir site should be reviewed

- Storage options on tributaries of Fountain Creek should be investigated…the Chico Basin site should be reviewed

- The "re-operation" alternative needs to be fully detailed…so that all water users understand the impacts it may have on their Project entitlements

- The storage of East-Slope Project Water drives the need for entities to seek dedicated storage space

- Physical limitations on the availability of additional groundwater and water quality issues make it necessary for the FVA entities to seek other solutions to meeting future demands

- Pueblo Reservoir represents the best option to help address the storage needs of the other FVA entities (Fountain, Security, Widefield, and Stratmoor Hills)…they seek to participate with Colorado Springs in the "expansion" of the FVA pipeline

- The other FVA entities should be treated equally with Colorado Springs with respect to Project Water allocations or reallocations

- Projects or re-operation plans designed to meet large municipal demands should not be implemented at the expense of other entities

- The use of the Arkansas River and tributary channels for delivery of municipal water, as compared to pipelines, is inefficient

### Recreation and Environmental Issues

- Existing storage facilities will be subject to greater annual fluctuations in storage levels as municipal demands increase in the future…this will adversely impact recreation

- The enlargement of existing facilities will impact currently established recreation facilities...the cost of re-establishing recreation facilities should be factored into estimates of project cost

- Further evaluation of the storage alternatives should include the effects on river-related tourism in the Arkansas Basin

- A more-thorough evaluation of the Clear Creek Reservoir site is needed...there are potential impacts to wildlife habitat, historic sites, and recreation that have not been effectively considered in the evaluation contained in the draft report

- Any water project will have some impacts to wildlife...the level of impact would be dependent upon a number of factors...without significant detail on each project, these factors cannot be projected...that analysis would be completed as a part of NEPA for any alternative

- Raising Pueblo Dam will have impacts to existing recreation facilities and wildlife areas

- An environmental impact statement should precede any planning and /or construction for raising Pueblo Dam

- The report does not appear to provide adequate scoping...according to the National Environmental Policy Act

- The ranking of storage alternatives was based upon insufficient knowledge of the storage sites and the potential impacts to the environment and recreation interests

Economic and Social Issues

- Any project that will harm the economy in Lake County is unacceptable

- When altering the flow regime of the Arkansas River or its tributaries, damage to private property must be avoided

- Lake County wished to express, within the comment period, that it is interested in pursuing with the District the water storage options in Lake County that could be mutually beneficial to Lake County and the District

- The assumption that agricultural water use will remain constant is contrary to reality

- The State's water repayment plan in the Kansas versus Colorado litigation should be factored into the Report...it would lead to the dry up of agricultural lands, which may reduce the need for storage

- The District should work with Lake County officials in their effort to reclaim a section of the upper Arkansas...so that the potential impacts of new development can be considered up front

Public Comment Process

- Your overall "partnership planning process" is valuable in determining future needs

- There was inadequate time for the public to respond to the draft Report

- We believe your process is prudent to evaluate the obvious recreational potential of the storage reservoirs themselves

- The public review process provided only an Executive Summary...and there was little time to review the entire draft Report (Note: the full draft Report was made available upon request)

- With more time for public review, other public groups would be involved in the process

- The willingness of the District to provide the meeting in Leadville and hear the concerns of the community is appreciated

- The public comment period should be extended

- The structure of your Storage Study Committee process was a good means to pull together interested parties

### 9.7.3 Conclusions Relative to Public Comments

The public comments received during the course of the study, following issuing of the draft Report, and at the public meetings are constructive. They provide valuable insights and direction for the scoping of subsequent investigations related to development of additional water storage and in subsequent NEPA compliance.

Φ

Section 10

# 10. RECOMMENDATIONS

Completion of studies for the water and storage needs assessment project, which are described herein, is one step in a process involving significant investments of time and money in engineering, legal, institutional, and environmental studies. Under the high growth forecast, needs for additional water development within the District are evident in the year 2010 for municipal entities. Given the long lead times for project permitting, the next steps in the process need to be initiated expeditiously. It appears likely that efforts by the District to plan and permit a regional water supply project may move, at least for awhile, in parallel with similar efforts by Colorado Springs Utilities and other water users. Given the fact that Colorado Springs accounts for the majority of the future municipal water needs in the District, their interest in keeping the process moving is understandable. The District and Colorado Springs may wish to execute a Memorandum of Agreement (MOA) to define roles and responsibilities and to avoid duplication of efforts. Other municipal and agricultural entities, as well as the Bureau, may wish to be parties to the MOA.

Based on the study findings and inputs from the District, we recommend that the following actions be undertaken over the near-term:

1. The District should limit its initial deliberations on the following storage alternatives:

    a. Lake Meredith Enlargement
    b. Fry-Ark Project Re-operation
    c. Turquoise Lake Enlargement
    d. Pueblo Reservoir Enlargement
    e. Gravel Lakes Storage
    f. Non-structural alternatives

    These alternatives involve Project facilities or are options that work conjunctively with the enlargement or re-operation of Project facilities. The Storage Study Committee should have discussions on the best possible alternatives available to meet District-wide storage needs. This discussion should be used to guide the District/Enterprise in limiting or expanding future investigations of storage alternatives.

2. Execute an MOA with Colorado Springs Utilities, which would allow for Storage Study Committee/District oversight and input into their Technical Review/NEPA compliance engineering study. Enterprise-hired engineers should work with CSU

engineers in their work, and supplement those investigations as needed to meet the District/Enterprise's needs.

3. Thoroughly investigate the options and limitations for Fry-Ark Project "re-operations" –including the evaluation of the MODSIM modeling work of Colorado Springs Utilities. Particular attention should be directed to East Slope storage rights, Winter Water Storage, "if and when" storage, existing carryover storage entitlements, water quality impacts and concerns, and delivery limitations. The Enterprise/District should run the model incorporating these factors for their in-house analysis. This analysis should involve Bureau personnel and would assist in the development of a consensus re-operation/storage plan.

4. Meetings should be held with the Bureau of Reclamation to discuss the "reoperation" proposals, Project facility enlargements, results of operations studies, and the range of options to meet long-term water and storage needs in the District. The goals of these discussions should be to define the institutional and permitting challenges associated with modifying Project operations and to identify procedures and timetables for addressing these challenges. However, any policy-level talks and legislation regarding the authorization of re-operation of Project facilities should be put on hold, until the complete impacts of a re-operations plan can be studied and documented, including a Bureau evaluation.

5. A meeting with Storage Study Committee members should be held to review the Financing Options Report and further evaluate the possibility of joint financing, focusing the major financial responsibility on those entities that have the greatest demand and therefore the greatest potential benefit.

6. The District and the SSC should work with the East-of-Pueblo entities and Pueblo on the further evaluation of the "Valley Pipeline" concept.

7. Follow-up public information meetings should be conducted to update constituent groups on the District/Enterprise's Phase II work.

8. The Storage Study Committee process should be maintained to develop a consensus storage/re-operations plan to address future storage needs. The most constructive means for public participation in the process by the general public should be reviewed.

9. As discussed in Section 9, the various storage options may be implemented in combination to meet District-wide objectives. Operations studies should be prepared

to evaluate how these options would integrate with overall Fry-Ark Project operations to meet District needs. These operations studies should be limited to the storage options identified in Item 1, above. Impacts on water quality should be assessed.

10. In addition to engineering and water system operation studies, preliminary environmental studies should be carried out to make sure that individual storage options do not have "fatal flaws" that could preclude their implementation. These environmental studies should be limited to the storage options identified in Item 1, above.

11. Review should be made of the various non-structural options identified in the report to see how these could be integrated into a preferred plan of water development to meet long-range District needs.

12. Legal and institutional reviews should be undertaken so that the District is well-positioned to address all of the legal issues related to the storage and reoperation alternatives.

The above-noted recommendations, if implemented, will continue to build the engineering, environmental, and legal foundations for the NEPA compliance process (Environmental Assessment or Environmental Impact Statement). We recommend that the decision analysis framework presented in the report be expanded and refined to incorporate additional evaluation factors and quantitative assessment of the performance of individual alternative plans for meeting long-range water and storage needs. Following completion of the preliminary engineering, institutional and environmental studies outlined above, the more-intensive efforts required for NEPA compliance can be scoped in detail and budgeted.

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Appendix A

# APPENDIX A

## Water Supply Information and Survey Results

Limited copies of the appendix are available with the SECWCD. This appendix is not included with most copies of the Main Report.

Appendix B

# APPENDIX B

## Agricultural Water Use in the District

Limited copies of the appendix are available with the SECWCD. This appendix is not included with most copies of the Main Report.

Appendix C

# APPENDIX C

## Fry-Ark Project Allocation Principles

SOUTHEASTERN COLORADO WATER CONSERVANCY DISTRICT
905 HIGHWAY 50 WEST
PUEBLO, COLORADO 81008

## ALLOCATION PRINCIPLES

## FINDINGS, DETERMINATIONS AND RESOLUTIONS

The Board of Directors of the Southeastern Colorado Water Conservancy District in regular meeting assembled hereby finds and determines:

1. The total Project water supply of the Fryingpan-Arkansas Project available for allocation as estimated by the Bureau of Reclamation's Computer Operation Study No. 40051, including an estimated evaporation charge prorated equally to all storage rights, is 80,400 acre-feet, of which 56,900 acre-feet are waters imported from the Colorado River and its tributaries, and 23,500 acre-feet are storable flood flows of the Arkansas River and its tributaries. None of the Winter Water Storage Project waters are considered Project waters.

2. The quantities in Finding 1 above are premised upon the completion of the Fryingpan-Arkansas Project as now authorized by Congress and under average ordinary operating conditions. The Board recognizes that there is no floor under importations from the Colorado River, and there is a ceiling of 120,000 acre-feet from which there must be deducted internal Project uses, evaporation and transit losses. The storable flood flows on the Arkansas River may vary from 0 acre-feet to a full Pueblo Reservoir in any one year.

3. The Fryingpan-Arkansas Project must be operated and its waters must be allocated consistent with the requirements of the Statutes of the United States, the State of Colorado, the Repayment Contracts between the United States and the Southeastern Colorado Water Conservancy District, and the Operating Principles, all as amended in the past or future. The Fryingpan-Arkansas Project was authorized by Public Law 87-590, 87th Congress, J.R. 2206, August 16, 1962, and Section 3(a) thereof requires the Project to be operated in accordance with the Operating Principles adopted by the State of Colorado on December 9, 1960, and reproduced in House Document 130, 87th Congress. Section 13 of said Operating Principles specifies:

> 13. The Project will be operated in such a manner that those in Eastern Colorado using Project water imported from the Colorado River Basin for domestic purposes shall have preference over those claiming or using water for any other purpose.

4. The Board find that within the limits of said requirements, the basis of

equitable allocation of Project waters is premised upon need for such waters and the availability thereof, with consideration being given to population, taxable property, irrigated acreage and economy, and to that end has allocated such waters on an annual basis ever since waters have been available to said District under the Interim Contract. Said Fryingpan-Arkansas Project was designed to furnish supplemental water. All entities served by said Project and within the boundaries of said District, whether political subdivisions, irrigation entities or others, should in the future continue to endeavor to procure all possible additional water supplies

5. Municipal entities must construct pipelines, treatment plants and other facilities requiring expenditures of large sums. In order to finance and construct the same, it is essential that such facilities be designed to definite capacity, and it must be known by the entities to be served thereby what proportion of Fryingpan-Arkansas Project water will be available for use in such facilities.

6. All political subdivisions within the boundaries of the District, including all cities, towns, water districts private water companies, water associations and entities not served by the Fountain Valley Pipeline have the fundamental right to be treated in the same manner in Fryingpan-Arkansas Project municipal water allocations.

7. The preference clause in said Operating Principles preferring "domestic" over other uses of waters imported from the Colorado River does not mean that all municipal uses are domestic. Domestic use on a farm ranks equally with domestic use in a city or town.

8. This Board has given consideration to the Black and Veatch reports on the Fountain Valley Pipeline captioned "Report on Fountain Valley Pipeline" and "Report on Arkansas Valley Conduit", and has also given appropriate weight to the potential needs of all cities and towns, as well as the needs of irrigation in the Arkansas Valley within the boundaries of said Southeastern Colorado Water Conservancy District.

9. The Board finds that no Fryingpan-Arkansas Project water is available for industry, or other non-agricultural uses, except via municipal service, until the requirements of domestic and irrigation uses have been satisfied. Any and all industrial requirements must be satisfied out of municipal allocations.

10. It is impossible to foresee or to fulfill the ultimate requirements of any or all entities, be they cities, towns, water districts or whatever form, for all time.

11. Return flows from Project water allocations to entities served thereby should be made available, where physically possible, on the first right of refusal basis (but not for resale outside the entity) to the respective cities and towns so served on the basis of water which they acquire from the Project.

12. It is imperative that this District now allocate municipal waters.

13. Municipal growth is certain to continue and the demands of cities and towns for waters will continuously increase.

14. Municipal and domestic facilities require enormous investments, and the municipalities which will derive their water by said means are entitled to the same assurance that the Fryingpan-Arkansas Project had when it initiated the Fryingpan-Arkansas Project; namely, once the facility is built, its minimum proportionate supply of water is assured, subject only to annual variations in Project water supply. Any allocation for municipal or irrigation uses must be based on a percentage of the total annual Fryingpan-Arkansas Project water supply.

WHEREFORE, IT IS HEREBY RESOLVED:

A. There is hereby allocated for the useful life of the Project a minimum of 51% of the annual Project water supply to municipal and domestic use.

B. The minimum of 51% allocated to municipal and domestic use is hereby divided as follows:

1. Fountain Valley Pipeline: no less than 25% of the annual Project water supply, estimated to be an average of 20,100 acre-feet;

2. Arkansas Valley cities, towns and entities lying east of Pueblo; no less than 12% of the annual Project water supply, estimated to be an average annual of 9,643 acre-feet;

3. Pueblo: no less than 10% of the annual Project water supply, estimated to be an average annual of 8,040 acre-feet;

Arkansas Valley cities, towns and entities lying west of Pueblo, no less than 4% of the annual Project water supply, estimated to be an average annual of 3,200 acre-feet.

C. In making these allocations, the Board acknowledges that it is unlikely that any entity receiving municipal and domestic water will require its minimum allocation for a number of years; their demand will gradually increase, and in the interim each of such municipal and domestic water users shall annually, on or before April 1 of each year, advise the Board of its anticipated demand; if such full demand is not asserted for many years, such will not constitute an abandonment of this allocation and such undemanded water may, during such time be allocated first to municipal and domestic users by the Board consistent with Paragraph B. 1, B. 2, B. 3, and B. 4 hereof. Entities named in any one of said paragraphs shall have the first option to purchase such unused portion allocated in that year. If not so purchased, allocated water remaining unsold may thereafter be offered to any other user on such basis as the Board of Directors may then determine. There shall be no credit for water not demanded.

D. Said allocations are premised upon the utilization of carryover storage space in Project reservoirs, in an amount not less than a total of 159, 000 acre-feet capacity, of which the Fountain Valley Pipeline may use not less than 78, 000 acre-feet; Arkansas Valley cities, town, and entities lying east of Pueblo, not less than 37, 400 acre-feet; Pueblo, not less than 31, 200 acre-feet; Arkansas Valley cities, towns and entities lying west of Pueblo, not less than 12, 400 acre-feet.

E. Carryover storage space for all municipal and domestic purposes shall not be less than 159, 000 acre-feet in any one year. This storage limitation may periodically be revised by the Board of Directors of the District; provided that any revision shall never reduce municipal and domestic carryover storage space to less than the amount as then determined by the Bureau of Reclamation required for annual delivery of the allotted volumes of water to which municipal and domestic users are entitled by reason of this resolution. Carryover storage for municipal and domestic purposes shall be subject to appropriate evaporation and transportation charges and water stored in carryover space shall not be subject to reallocation.

F. Irrigation waters will, subject to the pleasure of the Board of Directors of the District, be allocated on an annual basis of need.

G. This allocation of water for municipal and domestic purposes is made on the express condition that there will not be any decrease in the 51% allocated to municipal and domestic use and any increase in municipal and domestic allocations shall only occur if agricultural irrigated acreage on which Project water has been used, is removed from irrigation in which event the amount of Project water previously allocated to such acreage shall be allocated to other non-irrigation uses. The Southeastern Colorado Water Conservancy District Board shall consider the requests of all non-agricultural users in any reallocation of this supply. That no entity shall be prevented from requesting annual adjustment in its allocation of water from the Project within the parameters referred to in Introductory paragraphs 3 and 4.

H. Allocation at 51% of Project water to municipal and domestic use at this time represents a fair division of water, taking into account the social and economic value of agriculture. However, it is recognized that the Fryingpan-Arkansas Project is intended to provide a supplemental, not a primary, supply of irrigation water. Therefore, as irrigation water which is a primary source of water is converted to a non-agricultural use, the amount of Project water allocated to irrigation should be proportionately reduced and allocated to non-agricultural use.

I. These Principles will be implemented by appropriate contracts between the District and the entities under said facility desiring Project waters.

J. Catastrophies, public emergencies, force majeure events unforseeable, shall be delt with as an exception to these Principles of Allocation as long as such emergency need exists, and the District and all contracting entities will pledge themselves to mutually cooperate in resolving such a crisis if and when it occurs.

K. These Principles and any contract to implement the same shall be confirmed by final judgment in a declaratory judgment proceeding to be initiated by the District as promptly as possible.

ADOPTED AT A REGULARLY SCHEDULED MEETING, NOVEMBER 29, 1979.