ArkDSS Memorandum
Final

To: Bill Tyner and Kelley Thompson, Colorado Division of Water Resources

From: ParsonsWater Consulting

Subject: Task 2.1 – Pueblo Board of Water Works Operating Memorandum

Date: April 2019

INTRODUCTION

One of the Task 2 objectives is to:

> *Develop and document an understanding of the operations of key water use facilities in the basin in order to accurately represent the use and operations in the water rights allocation modeling. This understanding will be developed through interviews with DWR personnel, operators of large canal and reservoir systems, and representatives of federal facilities.*

A number of components in the Pueblo Board of Water Works (Pueblo Water) system have been identified as key structures for the Arkansas Decision Support System (ArkDSS) consumptive use and surface water modeling efforts. The purpose of this Task 2 memorandum is to document physical, legal, and operational aspects of those key structures.

The information provided in this memorandum was developed from publicly accessible sources provided by Pueblo Water and discussions with Alan Ward with Pueblo Water. Information was also provided by the District 14 and 15 Water Commissioner, Steve Stratman; the District 11 Water Commissioner, Brian Sutton; and the District 11 Deputy Water Commissioner, Gary Hanks. Information in this memorandum is believed to be accurate. However, this information should not be relied upon in any legal proceeding.

SYSTEM OVERVIEW

Pueblo Water supplies water to the City of Pueblo and surrounding areas and raw water for the Comanche Power Plant. The City is located along the Arkansas River below Pueblo Reservoir, both above and below the Fountain Creek confluence with the Arkansas River. Pueblo Water's water portfolio is very strong and typically provides excess supplies for lease to other users.

The first municipal system in Pueblo was established in 1874 and water rights for municipal uses were appropriated at that time. Some portions of Pueblo were served by private water

companies, but over time the various water providers consolidated into two municipal systems - one serving north of the Arkansas River and the other south. Pueblo's water supply has been supplemented with purchases of both native and transbasin irrigation water. In 1957 a new City Charter was adopted that, among other things, consolidated the two water utilities into the current single water utility - the Board of Water Works of Pueblo, Colorado. Pueblo Water has raw water storage in reservoirs it owns and reservoirs associated with the Fryingpan-Arkansas project, including Pueblo Reservoir, Turquoise Reservoir and Twin Lakes Reservoir. During the 1980s, Pueblo Water filed for exchange rights for the storage and reuse of its transbasin supplies and movement of water between reservoirs.

Since the 1970s, Pueblo Water has had sufficient water supplies to meet its demands. Pueblo Water's system has operational flexibility from the combination of its water right holdings, operation of multiple reservoirs, exchanges, and pro-rata interest in local irrigation companies; some of which have been changed in water court. Administration of the different municipal interests and agricultural interests on the Arkansas River is relatively complex. As such, in addition to the change cases and exchanges adjudicated in water court, Pueblo Water and other water users utilize a number of leases, trades, and other operating agreements to maximize the use of water within the basin.

Key structures identified in the Pueblo Water system include:

- Northside Intake, Southside Intake, and the South Outlet Works and Delivery Manifold from Pueblo Dam (aka South Outlet Works)
- Comanche Pump Station (owned and operated by Pueblo Water) used to deliver raw water to the Comanche Power Plant (owned and operated by Xcel Energy)
- Southern Colorado Power Company Diversion and the Historic Arkansas Riverwalk of Pueblo (HARP)
- Clear Creek Reservoir
- Transmountain Supplies
    - Warren E Wurts Ditch (aka Wurtz Ditch) and Wurtz Extension Ditch
    - Ewing Ditch
    - Twin Lakes Reservoir and Canal Company
    - Busk-Ivanhoe System
    - Fryingpan-Arkansas Project (Project)
- Arkansas River Mainstem Ditches
    - Old Pueblo Rights, including Ditch of the Trustees of Pueblo Water Works (Northside), Ditch of the Public Water Works No. 2 of Pueblo (Southside), Fields Ditch, Richie Ditch, and Brooks Ditch
    - West Pueblo Ditch
    - Booth Orchard Grove Ditch
    - Hobson Ditch
    - Bessemer Ditch

The location of the City of Pueblo and major elements of the Pueblo Water system are shown in **Figure 1**.

PHYSICAL INFORMATION

The major structural elements in Pueblo Water's system include storage sites (Pueblo Reservoir, Clear Creek Reservoir, Twin Lakes Reservoir, and Turquoise Reservoir); supply ditches and pipelines to its water treatment plant (Northside Intake, Southside Intake, and South Outlet Works Pipeline); transbasin diversions owned by Pueblo Water (Wurtz Ditch and Ewing Ditch); larger transbasin projects shared by multiple entities (Busk-Ivanhoe System, Fry-Ark, Independence Pass Transmountain Diversion System); and direct flow water rights (Old Pueblo Rights, Bessemer Ditch, Booth Ditch, Hamp-Bell Ditch, Hobson Ditch, and West Pueblo Ditch).

Other supplies and operations that form part of Pueblo Water's system include an agreement with the City of Aurora for an annual delivery to Pueblo Water of 2,500 acre-feet from the Homestake Project or other transmountain water; providing supplies to multiple lessees; integrated operations with local energy suppliers (Xcel Energy and Black Hills Energy) and HARP. Reuse of changed and transbasin water rights and exchanges of those supplies to various storage units are also used in the operation of Pueblo Water's water supplies. Additional information related to a number of the transbasin projects and their direct flow rights and storage reservoirs is listed in the *Where to find more information* section at the end of this memorandum.

The history, operations, and current specifications of elements of Pueblo Water's water resources infrastructure are summarized below.

1. Northside Intake (Structure ID 1400589), Southside Intake (Structure ID 1400590), and Pueblo Dam Outlet (1400639)

Pueblo Water owns and operates multiple intakes from the Arkansas River to its water treatment plant. The Northside and Southside Intakes were constructed in the 1880s when the City of Pueblo was served by two separate water utilities; one serving areas north of the Arkansas River and the other serving areas south of the river. The intakes originally diverted water through ditches into settling basins from which water was then piped to residents and for other uses. A pipeline out of Pueblo Reservoir was constructed in 2001 through 2002. The new pipeline is the primary feed to the system, but the old river intakes are still used to supplement and provide redundancy to the pipeline. The City is supplied by the Whitlock Water Treatment Plant (WTP).

Specifics regarding the Pueblo Water WTP are as follows:

- The maximum capacities of the diversions to the WTP are currently 82 cfs (Northside), 54 cfs (Southside), and 278.5 cfs (South Outlet Works)
- The maximum capacity of the Whitlock WTP is 84 million gallons per day (MGD)

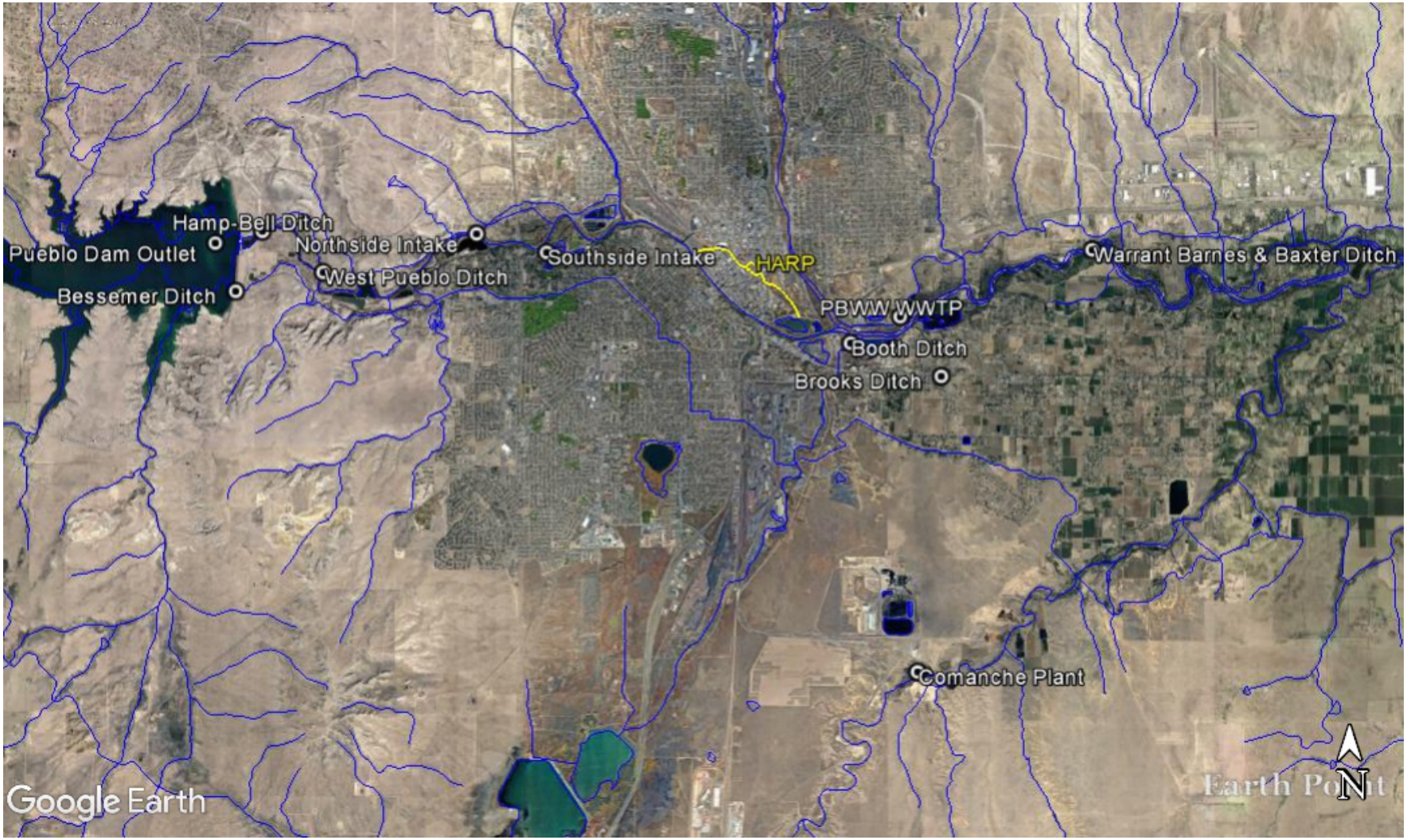

Figure 1: Board of Water Works of Pueblo, Colorado Water Resources System

Municipal water rights were appropriated on April 1, 1874 by Pueblo Water's predecessors and were decreed in 1932 in the original adjudication of water rights for purposes other than irrigation in Water District No. 14. These rights were supplemented by the transfer of senior irrigation rights, which include the Fields Ditch (1400781), Richie Ditch (1400583), and Brooks Ditch (1400780). The irrigation rights were transferred to Pueblo Water in 1927 (Civil Actions 20076 and 20077). Collectively, these water rights are referred to as the "Old Pueblo Rights". Pueblo Water is entitled to divert the Old Pueblo Rights year-round.

HydroBase Data

Monthly data is available over the 1950-current period for the two river intakes and the South Outlet Works Pipeline (aka Pueblo Dam Outlet) as follows. **Figure 2** combines the historical monthly diversions.

- Total River Diversions. Complete record during period it was active 2002 to current (annual diversion of approximately 27,000 acre-feet)
- Southside Intake. Complete record during period it was active 1950-1986; sporadic use thereafter
- Northside Intake. Complete record through 2002; sporadic record thereafter (missing data in 2003, 2004, 2006, 2007, 2008, and 2014 should be set to zeroes for modeling purposes)

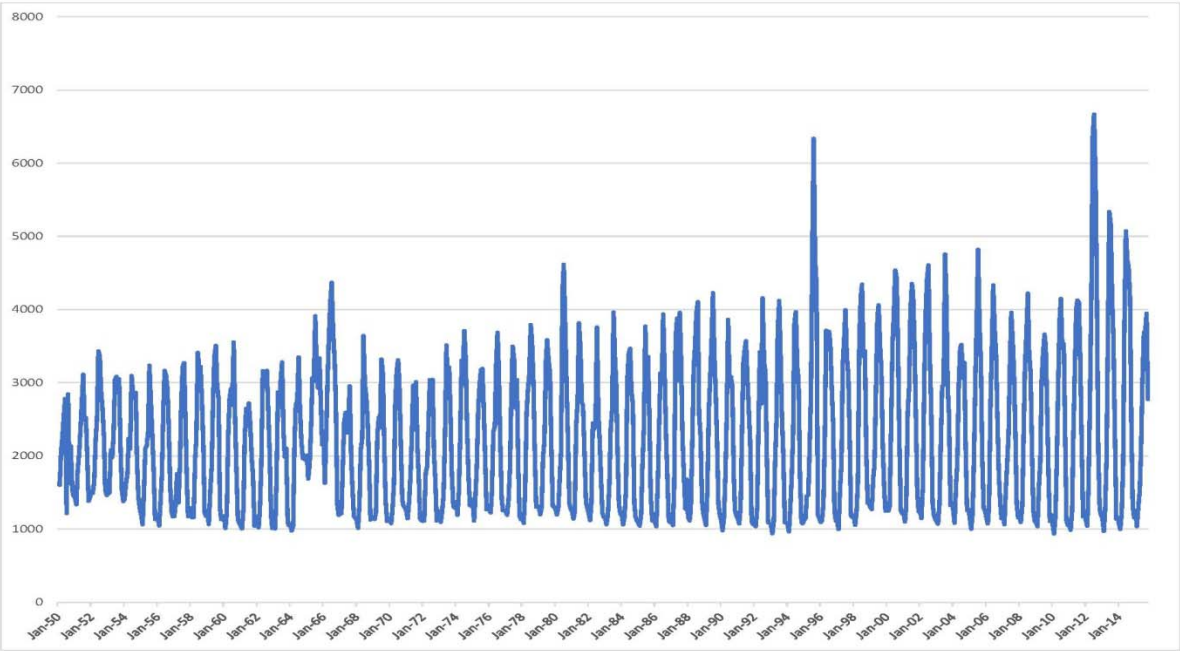

Figure 2: Pueblo Board of Water Works Monthly Diversions

Return Flow Location

The City of Pueblo owns and operates one municipal wastewater treatment plant (WWTP). The WWTP is located on the north side of the Arkansas River in the Northeast Quarter of Section 5, Township 21 South, Range 64 West of the 6th Principal Meridian. The WWTP has been located at this site since 1938. The plant has a maximum capacity of 19 MGD and currently discharges an average of about 11.25 MGD to the Arkansas River, approximately two-thirds of a mile below the confluence with Fountain Creek.

Pueblo Water can reuse return flows from diversion of transmountain supplies, including the return flows associated with its use of Homestake water purchased from Aurora. Pueblo Water does not currently have a reuse plant on-line and any reuse of water is operated by exchange to upstream locations, including Pueblo Reservoir.

2. Comanche Pump Station (Structure ID 1400618)

Xcel Energy owns and operates an electricity generating station located south of the Arkansas River, between Salt Creek and St. Charles River. The station includes three coal-burning plants. Cooling water is supplied by the Comanche Pump Station (1400618), located on the south side of the Arkansas River approximately one mile downstream from the Pueblo Reservoir dam.

Specifics regarding the Comanche Pump Station are as follows:

- Three separate pumps at the river supply water to the electricity generating station via a 30-inch steel pipeline
- The maximum capacity of the pump station is currently 33 million gallons per day (MGD)
- Diversions are measured at the pump station using Venturi meters

The Comanche Power Plant came on-line in the mid-1970s with two cooling units. A third unit became operational in 2009. Water demand at the plant includes cooling water, condensation makeup, service water, fire protection and potable water use. The Comanche Pump Station was decreed as an alternate point of diversion for the Old Pueblo Rights in the mid-1970s (Case Nos. W-4155 and W-4156). Since its inception, pursuant to a contractual agreement, Pueblo Water has supplied water to the Comanche Power Plant. In addition to the Old Pueblo Rights, Pueblo Water can provide water to the Comanche plant from its other supplies, including storage water in Pueblo Reservoir. Xcel Energy also has some of its own water rights that can be conveyed to the plant through the pump station.

HydroBase Data

The monthly data over the 1950-current period of record pertaining to the Comanche Pump Station is available as follows:

Total River Diversions (see **Figure 3**)

- Complete record during the period it was active 1976-current, diversions increase in 2009 as a consequence of a third unit coming online

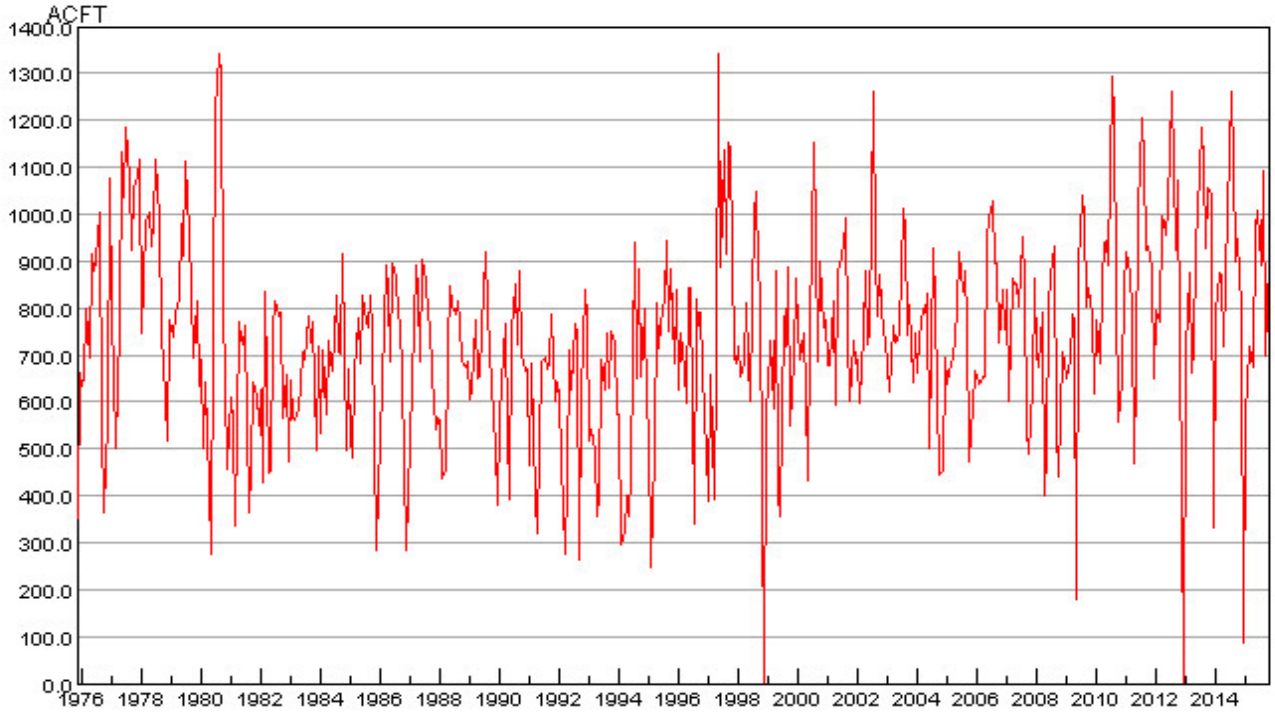

Figure 3: Comanche Pump Station Monthly Diversions

Return Flow Location

The Comanche station consumes approximately 75 percent of diverted supply. Return flows from the Comanche station accrue to the north side of St. Charles Creek near the shared section line between Sections 28 and 29, both of Township 21 South, Range 64 West of the 6th Principal Meridian. The Comanche Power Plant currently discharges to the St. Charles River, approximately 8 miles upstream from its confluence with the Arkansas River.

Pueblo Water can reuse return flows from diversion to the Comanche Power Plant of transmountain supplies.

3. Historic Arkansas Riverwalk of Pueblo (No Structure ID)

The main feature of the Historic Arkansas Riverwalk of Pueblo (HARP) is a concrete channel that carries a portion of the Arkansas River through downtown Pueblo along the historical channel of the Arkansas River that existed prior to the 1921 flood. As a participant in HARP, Pueblo Water agreed to obtain the necessary water rights for the project.

Water is first diverted from the Arkansas River using the water infrastructure from the old downtown power plant (Southern Colorado Power Plant Dam, 1400713) using either a junior HARP direct flow right or a tailwater right associated with old plant. The diversion typically ranges from about 30 cfs in the winter to 60 cfs in the summer. Water travels from HARP through the downtown area (see yellow line in **Figure 1**) and is discharged back to the Arkansas River between the Moffat gage (07099970) and the confluence with Fountain Creek. Evaporation depletions from the HARP are replaced through an augmentation plan.

Note the power plant came online before the 1921 flood and was located on the river. After the 1921 flood, the river channel moved to the south and west against the bluffs and away from downtown. The power plant began diverting from the realigned river channel in 1926 and continued until 2012. For the last decade or two of its operation, it was only used intermittently as a peaking plant or as a backup when other plants were out of service.

HydroBase Data

The HARP has operated continuously since October 2000, except for about a month each winter when it is drained for maintenance. The records related to HARP are typically available starting in about 2003 or 2004 as follows:

Total River Diversions

- Diversions from the river are not directly measured. The entire diversion is carried through the power plant and discharged into the HARP channel. The HARP outflow is metered and discharges to Runyon Lake and returns to the Arkansas River through the ARK227CO gage.

Total River Outflows (see **Figure 4**)

- Complete record since the HARP came online in 2004.
- Pueblo Water provides flow data to Division of Water Resources based on its HARP meter, which is supplemented with the Arkansas River tributary above Hwy 227 at Pueblo stream gage (07099973, ARK227CO) in case the HARP meter data is questionable.

Augmentation of Evaporation Depletions (1407010)

- Recorded replacements (approximately 9 to 13 acre-feet per year) from non-sewered transmountain return flows (1400623) were recorded during the 2003-2010 period. The HARP augmentation plan has been in operation since diversions through HARP began in October 2000.
- Data in HydroBase available from various Release Class and Diversion Class records

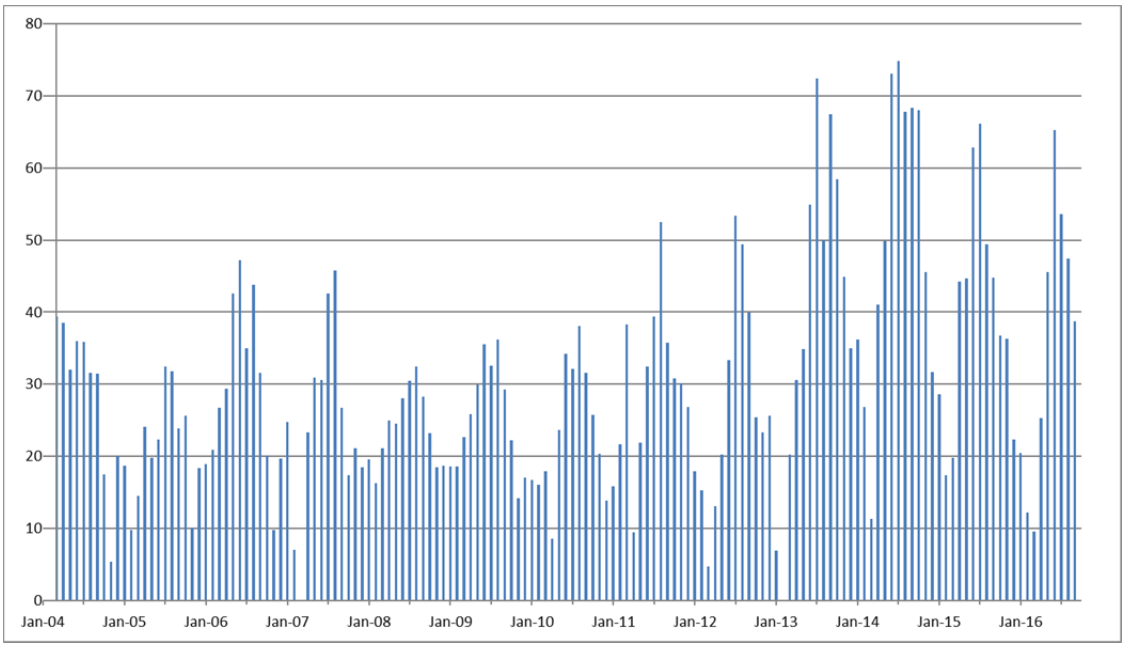

Figure 4: HARP Daily Outflow (Average cfs)

4. Clear Creek Reservoir (Structure ID 1103504)

Clear Creek Reservoir is the only storage unit owned and operated by Pueblo Water. A need for additional storage capacity was identified to help provide carry-over storage and enhance the flexibility within its water resources system. Pueblo Water purchased Clear Creek Reservoir from the Otero Canal Company in 1955 to address these needs.

The dam across Clear Creek was constructed in 1902. The dam is an earth-fill type, rip-rapped on the upstream side. Pueblo Water uses the reservoir primarily to store its transmountain water. Clear Creek Reservoir also includes a junior native right to store the flow of Clear Creek, a tributary of the Arkansas River. The Water Court approved the addition of municipal use to the uses of the water stored from Clear Creek (Case No. 90CW153). To address future needs for more storage space, Pueblo Water adjudicated a conditional reservoir enlargement storage right of 18,561 acre-feet, for a total of 30,000 acre-feet (Case No. 04CW130).

uncovercolorado.com/national-lands/clear-creek-reservoir/

Specifics regarding Clear Creek Reservoir include:

- 11,439 acre-feet total capacity
- 9,200 acre-feet capacity at bottom of spillway when radial gate is open
- Approximately 32 acre-feet dead storage

Due to concern about seepage losses when water is stored above the spillway for long periods of

time, Pueblo Water has limited storage to about 9,200 acre-feet over the past few years. Note that the reservoir was emptied in 1997 and 2007 for maintenance. An elevation-capacity curve for Clear Creek Reservoir was provided by Pueblo Water. A subset of the data points on the curve is included in **Table 1**.

Table 1: Clear Creek Reservoir Stage - Area - Capacity Curve

Elevation	Area	Capacity	Elevation	Area	Capacity
(Feet)	(acres)	(acre-feet)	(Feet)	(acres)	(acre-feet)
12.4	7	32	44.7	239	3,850
14.7	9	50	47.2	260	4,470
17.2	19	85	49.7	285	5,160
19.7	45	164	52.2	303	5,890
22.2	71	307	54.7	329	6,680
24.7	95	514	57.2	350	7,530
27.2	117	779	59.7	368	8,430
29.7	135	1,090	61.9	382	9,250
32.2	151	1,450	64.2	400	10,200
34.7	167	1,850	66.7	415	11,200
37.2	183	2,290	69.2	430	12,200
39.7	199	2,760	71.7	445	13,300
42.2	217	3,280	74.2	463	14,500

Source: Pueblo Board of Water Works.

Notes: Base elevation 8819.32 feet.

HydroBase Data

The monthly data over the 1950-current period for Clear Creek Reservoir include the following:

End-of-Month Contents (see **Figure 5**)

- End-of-month contents available for two months per year in 1963 and 1968 (not visible in figure) and complete years in 1970 and over the 1977-1984 period
- Pueblo Water provided the end-of-month storage contents for the 1990s included in **Figure 5**

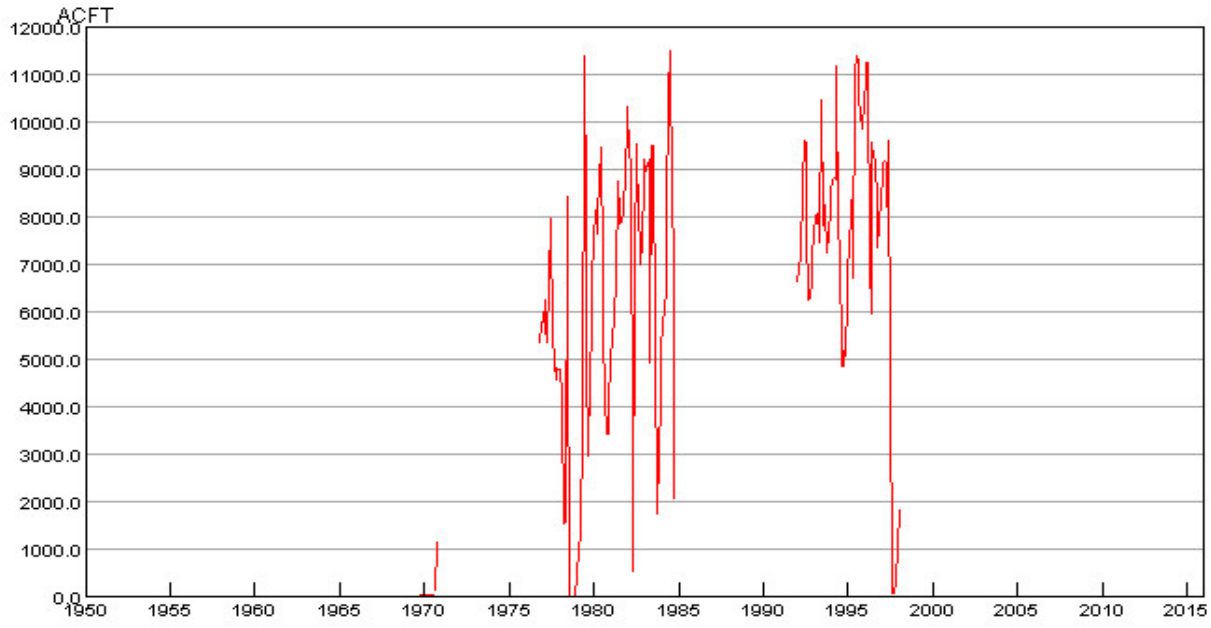

Figure 5: Clear Creek Reservoir End-of-Month Storage Contents

5. Transmountain Ditches – Wurtz Ditch (Structure ID 1100501) and Ewing Ditch (Structure ID 1100500)

Pueblo Water is the sole owner of the Warren E Wurts (Wurtz) and Ewing Ditches, which were purchased in 1938 and 1955, respectively. Pueblo Water's predecessors extended the Wurtz Ditch in 1953 to capture runoff in neighboring tributaries. The two ditches divert water from upper tributaries of the Eagle River, predominantly during the spring runoff season. Water is carried across the Continental Divide and delivered to Tennessee Creek (Wurtz and Ewing). Return flows from diversion of the transmountain water supplies are fully reusable.

Pueblo Water changed the use of the water rights in the early-1990s to be able to divert for municipal, commercial, industrial, and associated uses including storage (Case No. 90CW340). Pueblo Water predominantly stores its transbasin water in Clear Creek, Twin Lakes, and Turquoise Reservoirs.

Pueblo Water's predecessors purchased the Columbine Ditch (Structure ID 1104616) in 1953. This water was used in a similar fashion as its other transmountain supplies. The Columbine Ditch was sold to the Fremont Pass Ditch Company (City of Aurora and Climax Molybdenum Company) in 2009 to help finance Pueblo Water's purchase of shares in the Bessemer Ditch Company.

HydroBase Data

Monthly data over the 1950-current period of record pertaining to the three transmountain ditches include the following:

Wurtz Ditch and Wurtz Ditch Extension

- Complete record during 1950-current at Wurtz Ditch near Tennessee Pass stream gage (09062500, WURDITCO) – combined diversions through the Wurtz Ditch and Wurtz Ditch Extension

Ewing Ditch

- Complete record during 1950-current, except for 1975-1979 at Ewing Ditch at Tennessee Pass stream gage (09062000, EWIDITCO)
- The Ewing Ditch structure in the Eagle River basin (3704642) has records available for 1974-1988, 1991-2003, and 2005-2015. The records are fairly consistent with the gage records over the overlapping period of record, except for 1988, 1998, and 2003. The 1975-1979 missing period for the stream gage should be filled using records for ID 3704642.

6. Arkansas River Mainstem Irrigation Ditches

Pueblo Water is either the sole owner or partial owner of a number of irrigation ditches located above and below Pueblo Reservoir in the vicinity of the City of Pueblo. Many of the associated ditch rights have been changed to municipal, commercial and other uses, including storage. The purchase dates for the various ditch systems and amount of ownership is summarized below. The status of the ditch water rights (changed or not changed) and the opportunities and limitations on the use of the water rights is discussed in the Water Rights section.

- Old Pueblo Rights – purchased in late-19th and early-20th century; Fields Ditch (1400781); Richie Ditch (1400583); Brooks Ditch (1400780)
- Northside Intake (1400589)
- Southside Intake (1400590)
- Booth Ditch (1400591) – purchased in 1972
- Hobson Ditch (1400573) – purchased in 1970
- West Pueblo Ditch (1400535) – purchased 1981-2004 (492 of 500 shares)
- Hamp-Bell Ditch (1400534) – acquired in 2008
- Bessemer Ditch (1400533) – purchased in 2007-2011 (5,540.88 of 19,738.593 shares, 28.1%; leased back to irrigators)

Pueblo Water purchased two ranches in Tennessee Park. The following ditches divert from tributaries to the Arkansas River and continue to be used for irrigation at the ranches.

- Lucas Ditch (1100502)
- Tennessee Park Ditch (1100848)

WATER RIGHTS

Pueblo Water has acquired share ownership in various ditch companies and reservoir storage as a consequence of consistent planning efforts focused on ensuring adequate future water supply. Pueblo Water's ownership in, and use of, these water rights are described below.

The combination of the Intake water rights, reservoir storage, ditch company transfers, and transmountain water has generally provided ample supplies to meet Pueblo Water's demands. In-basin supplies currently supply about 95 percent of the water demand, with the remaining supplies provided by transmountain supplies.

Direct Flow Rights

Arkansas River direct flow rights from Civil Action Numbers 2535, 19693, 20076, 20077 and Case Nos. W-76, W-145, W-3953, W-3954, W-4155, W-4156, and 90CW55 are summarized in **Table 2** and **Table 3**.

Table 2: Old Pueblo Direct Flow Rights

Ditch Name	Approp. Date	Adjud. Date	Admin. No.	Decree Rate (cfs)	Notes
Richie Ditch	3/21/1870	3/23/1896	7385.0	2.5	Transferred to North and South Intakes in CA 20076 & 20077
Brooks Ditch	1/31/1871	3/23/1896	7701.0	1.2	
Fields Ditch	3/21/1872	3/23/1896	8116.0	4.6	
Northside Intake	4/1/1874	10/13/1932	8857.0	20.0	
Southside Intake	4/1/1874	10/13/1932	8857.0	25.0	
			TOTAL	**53.3**	

Source: Colorado Water Rights Tabulation
Notes: Water rights limited to municipal use and power generation, water available year-round

The direct flow rights summarized in Table 2 include the original water rights decreed to the Northside and Southside Intakes and the senior water rights transferred to the intakes. These rights can be diverted at either the Northside Intake or Southside Intake. The Pueblo Dam Outlet Pipeline (1400639) and the Comanche Pump Station (1400618) were adjudicated as alternate points of diversion for the Old Pueblo Rights in Case Nos. W-3953, W-3954, W-4155, and W-4156. The Old Pueblo Rights are single use water rights; the returns from which cannot be reused.

Pueblo Water has ownership in a number of other Water District 14 irrigation ditches. Some of these water rights have been changed to municipal, commercial, industrial, and other uses. Most of these change cases are limited to a single use, other than the West Pueblo and Hamp-Bell Ditch water rights, which can be used and reused to extinction. The West Pueblo Ditch rights and the Hamp-Bell Ditch rights are the only changed Arkansas River water rights that can also be stored.

Table 3: Direct Flow Rights

Ditch Name	Approp. Date	Adjud. Date	Admin. No.	Decreed Rate (cfs)		Ownership
				Total	Pueblo Water	
Booth Ditch	4/1/1861	3/23/1896	4109.0	7.0	7.0	100
	4/1/1864		5205.0	8.0	8.0	
	12/31/1872		8035.0	1.0	1.0	
	12/31/198981		11688.0	2.0	2.0	
			TOTAL	18.0	18.0	
Hamp-Bell Ditch	11/30/1870	3/23/1896	7639.0	2.05	1.03	50
	12/31/1878		10592.0	0.7	0.29	41
	12/31/1888		14245.0	1.6	1.0	63
			TOTAL	4.8	2.32	
Hobson Ditch	3/31/1871	3/23/1896	7760.0	1.6	1.6	100
	4/1/1886		13240.0	2.46	2.46	
			TOTAL	4.06	4.06	
West Pueblo Ditch	4/1/1872	3/23/1896	8127.0	1.2	1.156	96
	4/1/1874		8857.0	1.0	0.963	
	10/1/1878		10501.0	0.6	0.578	
	12/31/1883		12418.0	0.4	0.385	
	12/17/1887		13865.0	15.0	14.445	
			TOTAL	18.2	17.527	

Source: Colorado Water Rights Tabulation

Notes: Hobson Ditch 1.94 cfs of 1886 right abandoned in W-76 change case

West Pueblo Ditch – Case No. 90CW55 adjudicated changes for 481.5 of 500 outstanding shares; 10.5 additional shares owned by Pueblo Water have not been changed

West Pueblo Ditch shareholders also entitled to a portion of yield from Winter Water Storage Program

The ownership amounts listed in Table 3 include only those ditch shares owned by Pueblo Water that have been changed in water court. Pueblo Water has additional share ownership in one of these ditch companies and other ditch companies that have not yet been changed. These water rights include approximately 2.1% (10.5 of 500 shares outstanding) of the West Pueblo Ditch and 28.1% (5,540.880 of 19,738.593 shares outstanding) of the Bessemer Ditch. Diversion limits and other conditions associated with these changed water rights are shown in Table 4. The annual volumetric limits are typically based on the longer term cumulative volumetric limits (e.g., average of 30-year running limit). Shorter volumetric limits and annual maximum limits can be found in the associated change case decrees.

Table 4: Volumetric Limitations (acre-feet) on Changed Direct Flow Water Rights

Ditch Name	Annual Total	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov
Old Pueblo Rights	None		One-time use; Cannot be stored							
Booth Ditch	9,000		One-time use; Cannot be stored							
Hamp-Bell Ditch	589		78.6	109.0	122.2	142.7	112.4	85.3	90.9	
Hobson Ditch	1,488		One-time use; Cannot be stored							
West Pueblo Ditch	1,941	92	173	369	584	454	360	185	191	87

Source: Colorado Water Court decrees (available at http://dwrweblink.state.co.us/)

Notes: Booth Ditch - Annual limits affected by projected delivery to Comanche Power Plant; see W-145 decree for details
Comanche Pump Station not decreed as alternate point of diversion; delivery to plant must be through Pueblo Water diversion structures

Hamp-Bell Ditch – Water rights fully reusable, subject to replacement of lagged winter return flows
Average annual limit of 362 acre-feet based on average of 21-yr total volumetric limitation
Pueblo Water responsible for replacement of Transit Mix West Pit (aka Chain of Lakes, ID 1406220) evaporation depletions, as discussed under Water Demands

West Pueblo Ditch – Water rights fully consumable subject to replacement of return flows, but they are not reusable; can be stored. Average annual limit of 1,403 acre-feet based on average of 30-yr total volumetric limitation.

Diversions at alternate points are limited to the following periods

Old Pueblo Rights	Year-round
Booth Ditch	Year-round
Hobson Ditch	April 7 – October 10 (206 days max)
West Pueblo Ditch	March 16 – November 14

Storage Rights

Storage water rights in Table 5 include rights owned by Pueblo Water and storage accounts in other reservoirs available for use by Pueblo Water.

- Storage rights decreed for Clear Creek Reservoir from the Arkansas River in Civil Action 2346, and Case Numbers 90CW53 and 04CW130
- Storage space available in various Fryingpan-Arkansas Project reservoirs pursuant to ownership of Twin Lakes Reservoir and Canal Company and contracts with Bureau of Reclamation. Additional information regarding the upper basin reservoirs and associated transbasin projects are described in the ArkDSS Fryingpan-Arkansas Facilities and Related Operations memorandum.

Table 5: Storage Water Rights

Storage Unit	Approp. Date	Adjud. Date	Admin. No.	Decreed Amount (acre-feet)	Notes
Clear Creek Reservoir	6/12/1902	7/14/1913	22888.19155	9,401	Absolute
	8/20/1910		22888.22146	2,038	
			TOTAL	11,439	
	9/19/2000	12/31/2004	56247.55049	18,561	Conditional
			TOTAL	30,000	

Available Storage Space in Reservoirs Owned by Others

Pueblo Reservoir				31,200	Fry-Ark
				15,000	If & When
			TOTAL	46,200	
Twin Lakes Reservoir				12,600	TLCCo
Turquoise Reservoir				5,000	CF&I

Source: Colorado Water Rights Tabulation and Pueblo Board of Water Works

Notes: Twin Lakes Reservoir storage space pursuant to share ownership in Twin Lakes Canal Company (TLCCo) – 11,476 of 49,589 shares

Turquoise Reservoir storage space pursuant to 1984 purchase of perpetual storage contract previously held by Colorado Fuel and Iron Company (CF&I)

Transbasin Water

Pueblo Water obtains water from the transbasin ditches described above along with its pro-rata ownership in the Twin Lakes Canal Company (23.1%) and Busk-Ivanhoe system (50%). Portions of the Pueblo Water service area are within the Southeastern Colorado Water Conservancy District boundaries and are entitled to a pro-rata yield of the Fryingpan-Arkansas Project (10%). The yield of Pueblo Water's transbasin supplies ranges broadly and is typically in the range of 10,000 acre-feet per year to 30,000 acre-feet per year. Note Pueblo Water almost always stores its transbasin water prior to use.

The firm yield of the Twin Lakes Canal Company shares included in past augmentation plans is 0.78 acre-feet per share (8,951 acre-feet for Pueblo Water's 11,476 shares). Note that following more recent drought periods, a value of 0.73 acre-feet per share has been used. The irrigation uses in the transbasin ditches and the Busk-Ivanhoe systems were changed to municipal, industrial, augmentation, exchange, and other uses in Case No. 90CW340. The average yield for these systems totals approximately 7,000 acre-feet per year. Terms of the change of use are summarized in **Table 6**.

Table 6: Limitations on Changed Transmountain Water Rights

Ditch Name	Season of Use	60-Year Average (acre-feet)	Annual Maximum (acre-feet)	20-Year Average (acre-feet)
Busk-Ivanhoe	3/24 – 11/25	2,593	5,041	3,370
Ewing Ditch	4/18 – 10/28	1,164	2,402	1,966
Wurts Ditch	4/18 – 10/28	1,841	4,083	2,333
	TOTAL	6,935	14,674	9,489

Source: Case No. 90CW340 decree
Notes: Average historical yields from 90CW340 Findings based on 60+ years for each system
Systems have 10-yr, 20-yr, and 60-yr running volumetric limits; see 90CW340 decree for details

In addition to these supplies, Pueblo Water operated through a trade agreement with the City of Aurora between 1990 and 2011 whereby Pueblo Water received 4,000 acre-feet per year from Aurora's changed Rocky Ford Ditch share water at Pueblo Reservoir in exchange for a like amount of Pueblo Water's stored water in Twin Lakes and Turquoise Reservoirs.

Exchange Rights

In addition to the alternate points of diversion decreed for its changed ditch water rights, Pueblo Water adjudicated exchanges in Case Nos. 84CW177, 86CW111A, and 86CW111B for the return flows generated from use of its transmountain supplies. The exchanges include returns from the City of Pueblo wastewater treatment plant (WWTP) and Comanche Power Plant discharge up to the Intakes, Pueblo Reservoir, Clear Creek Reservoir, Twin Lakes Reservoir, and Turquoise Reservoir. Pueblo Water has operated several of these exchanges and will operate additional exchanges as future conditions permit. Non-sewered return flows have also been adjudicated as a source of exchange.

The quantification of sewered and non-sewered transmountain return flows are discussed below under Operational Information. Exchange rights decreed from the Arkansas River and St. Charles River are summarized in Table 7. Note the progress on operation of the exchanges has resulted in multiple priority dates associated with when portions of the exchange were made absolute; starting with the 1976 appropriation originally adjudicated in Case No. 84CW177 and the 1985 appropriation adjudicated in Case No. 86CW111. For modeling purposes, the total water rights are listed below based on the 86CW111 decree. Administration numbers assigned to exchange operations should be re-visited during development of the ArkDSS Surface Water Model.

Table 7: Exchange Water Rights

Source	Destination	Approp. Date	Adjud. Date	Admin. No.	Decreed Amount (cfs)
Arkansas River - Pueblo Water WWTP, CF&I WWTP, Pueblo Airport WWTP	Northside Intake, Southside Intake, Pueblo, Twin Lakes, and Turquoise Reservoirs	7/1/1985	12/31/1986	46490.0	60 cfs
St. Charles River – Comanche Plant Outfall					20 cfs

Ground Water Rights

Pueblo Water does not use any ground water supplies in its potable system.

Pending Water Rights Cases

Pueblo Water has two cases pending in the Division 2 water court - 16CW3103 is for exchanges of Pueblo Water's Bessemer Ditch rights and 17CW3050 is for changes of type and place of use of Pueblo Water's Bessemer Ditch rights.

OPERATIONAL INFORMATION

Water Demands

Pueblo Water's potable demand for municipal and industrial users was approximately 26,600 acre-feet in 2013, corresponding with a population of about 109,000 within the Pueblo Water potable service area. This equates to approximately 218 gallons per capita per day (gpcd). Removal of the commercial uses (approximately 30 percent of total) results in a use of approximately 152 GPCD (18,620 acre-feet/year). Pueblo Water's current demand level is approximately 84 percent of the per capita demand prior to the early-2000s drought.

Pueblo Water began to supply water to the HARP with the HARP Water Right and the HARP Tailwater Right in 2004. Those water rights are almost always out of priority, so they are operated under a decreed augmentation plan (Case No. 93CW86). Pueblo Water also has annual non-potable contractual obligations of about 13,000 acre-feet for the Comanche Power Plant; 1,500 acre-feet for other mining and industrial uses; 5,250 acre-feet for non-City municipal uses; and 900 acre-feet for agricultural uses. Pueblo Water has supplied the Comanche Plant since 1973 with the Old Pueblo water rights, supplemented with Twin Lakes native water and their transbasin supplies. The Comanche Plant demand increased to about 13,000 acre-feet/year after a third generating unit was added in 2009.

Other water demands often required of municipalities include the obligations to maintain historical return flows associated with the municipal use of water changed from irrigation company ditch shares. The return flow obligations from the changed direct flow rights are unique to each ditch.

The replacement obligations associated with the use Hamp-Bell Ditch credits for the Pueblo West Pit evaporation depletions and associated return flow obligations are summarized in the **Table 8** based on HydroBase data for the Transit Mix Aug Plan (14007006) and the decree in Case No. 03CW08. Pueblo Water typically uses its Hamp-Bell Ditch water rights and makes the necessary replacement deliveries by leaving enough Hamp-Bell water in the river to cover return flows and augmentation requirements during the irrigation season, and storing any excess Hamp-Bell Ditch water in Pueblo Reservoir for release for the augmentation plan during the non-irrigation season.

Table 8: Evaporative Depletions and Return Flow Obligations–Hamp-Bell Ditch Credits (acre-feet)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Evap.	8.45	9.85	11.2	15.99	16.15	15.06	11.25	12.65	12.42	11.79	11.26	8.45	144.5
Evap. + Returns	12.9	8.92	8.86	9.93	11.2	16	16.1	15.1	11.9	13.1	14.6	13.7	152.3

Use of the West Pueblo Ditch changed water rights creates return flow obligations that are a function of diversions by the water rights in the current month and five previous months, as follows; Current Month 54.86 percent of diversion plus 7.83 percent of past month's diversion plus 3.10 percent of previous 4 months' diversions. Return flows from municipal use of changed West Pueblo Ditch water rights can be used to offset return flow obligations associated with the change case. Return flows were adjudicated as equal to 97 percent of inside use. Non-sewered returns from outside residential uses were adjudicated as 1 percent surface runoff and 17 percent deep percolation, after initially accounting for 12 percent spray (incidental) losses. Deep percolation of lawn irrigation return flows (LIRFs) are lagged back to the river system based on a 60-year schedule. For modeling purposes, the lagging factors have been shortened to the 10-year schedule shown in **Table 9**.

Table 9: 10-year Lagging Factors for West Pueblo Ditch Lawn Irrigation Return Flows

Year	1	2	3	4	5	6	7	8	9	10	Total
%	26.5	15.3	11.7	9.9	8.5	7.4	6.4	5.5	4.7	4.1	100

The adjudicated return flow locations for the LIRFS include 22.5 percent to Fountain Creek above the Fountain Creek at Pueblo, CO (07106500) gage; 8 percent to Dry Creek, tributary to Arkansas River below Southside Intake and Southside Reservoirs; and 69.5 percent to Arkansas River above Avondale. The LIRFs are considered to be constant throughout the year.

Replacements of historical return flow obligations associated with Pueblo Water's use of its changed shares are provided by return flows, both from the WWTP and lawn irrigation return flows (LIRFs), from the municipal use of West Pueblo Ditch shares, release of stored West Pueblo Ditch

water, transmountain return flows from the WWTP, LIRFs, or releases of transmountain water from storage.

Modeling Considerations

Demands associated with Pueblo Water's water rights portfolio should be represented in the ArkDSS StateMod model as three demand nodes:

- City of Pueblo Municipal Demand
- Comanche Station Demand
- HARP Demand

The following describes the recommended general priority for meeting Pueblo Water's demands supplies in the ArkDSS StateMod model. In general, direct flow rights are used first to meet demands, followed by storage rights. Pueblo Water attempts to store transmountain supplies first in Clear Creek Reservoir, then in Pueblo Reservoir.

Direct Flow Rights –

- Old Pueblo Rights first to the Comanche Pump Station and remaining to Pueblo Municipal Demand via Pueblo Water Pueblo Dam Outlet.
- Booth Orchard Grove Ditch to Pueblo Municipal Demand via Pueblo Water Pueblo Dam Outlet
- Hobson Ditch to Pueblo Municipal Demand via Pueblo Water Pueblo Dam Outlet
- West Pueblo Ditch to Pueblo Municipal Demand via Pueblo Water Pueblo Dam Outlet
- West Pueblo Ditch Winter Water to Pueblo Municipal Demand via Pueblo Water Pueblo Dam Outlet

Storage and Releases –

- Transbasin water and return flow credits are almost always stored prior to use. Priority is to exchange transbasin water to Clear Creek first, then to Twin Lakes and Turquoise reservoirs. Pueblo Water usually operates a 5,000 acre-feet book-over from Twin Lakes and Turquoise reservoirs to Pueblo Reservoir each year; about 2,500 acre-feet in July and 2,500 acre-feet in November through a Pueblo Reservoir trade with Aurora.
- Release stored transbasin water to supplement Comanche Plant demands and other non-potable contractual obligations.
- Clear Creek releases to demand and for storage in Pueblo Reservoir occur in July and August to help meet the VFMP flows, generally brining storage volumes to about 6,000 acre-feet by fall. Winter storage, between November 14 and March 14, generally brings storage to about 8,000 acre-feet. Transmountain diversions exchanges to the reservoir can generally fill storage to the 9,200 acre-feet current working capacity by June.

- Clear Creek or Twin Lakes stored native water to unmet Pueblo Municipal Demand via Pueblo Reservoir and Pueblo Water Pueblo Dam Outlet
- Non-Project Transbasin store water (including return flows) to unmet Pueblo Municipal Demand via Pueblo Reservoir and Pueblo Water Pueblo Dam Outlet
- Project Water (including return flows) stored in Project Reservoirs to unmet Pueblo Municipal Demand via Pueblo Reservoir and Pueblo Water Pueblo Dam Outlet

Pueblo Water's direct flow rights at thetwo Intakes and the Pueblo Dam Outlet pipeline and the changed irrigation water rights are sufficient to meet approximately 95 percent of the annual potable water demands. Winter demands are supplied by direct flow rights; direct flow rights are supplemented with stored water during the irrigation season on days when demand exceeds the amount of direct flow rights available in priority.

Where to find more information:

- Additional information on ditch and reservoir operations in and around the Pueblo Water service area is presented in the ArkDSS Water District 14 memorandum.
- Additional information on Comanche Power Plant operations and Colorado Fuel & Iron operations is presented in the ArkDSS Water District 15 memorandum.
- Additional information on Fry-Ark Project and operations and transmountain deliveries in the upper Arkansas River basin is included in the ArkDSS Fryingpan-Arkansas Facilities and Related Operations memorandum.
- Additional information on Rocky Ford Ditch operations and Columbine Ditch operations is included in the ArkDSS City of Aurora Operations memorandum.
- Additional information on the Homestake Project and Twin Lakes diversions is included in the CDSS Colorado River Basin Information Report and in the ArkDSS Colorado Springs Utilities Operations memorandum.
- The final model representation of Pueblo Water and associated operations will be documented in the Arkansas River Surface Water Model User's Manual.

REFERENCES

1. Meeting with Water Division 2, Water District 11 Commissioner Brian Sutton (brian.sutton@state.co.us, 719.221.0367).
2. Meeting with Water Division 2, Water Districts 14 and 15 Commissioner Steve Stratman (steve.stratman@state.co.us, 719.250.1657).
3. Communication with Pueblo Water Works representative: Alan Ward (award@pueblowater.org, 719.584.0235).
4. Water Resources Division 2009 Annual Report, Pueblo Board of Water Works Utilities. May 2010.
5. Board of Water Works of Pueblo memorandum. Paul Fanning. 2014.

6. State of Colorado 2050 Municipal & Industrial Water Use Projections. Camp Dresser & McKee Inc. and Harvey Economics on behalf of Colorado Water Conservation Board. July 2010.
7. Description of Water-Systems and Operations in the Aransas River Basin, Colorado. USGS Water Resources Investigations Report 85-4092. P.O. Abbot. 1985
8. Decrees, engineering reports, and associated water court material available at http://dwrweblink.state.co.us/
9. State of Colorado, Division of Water Resources, HydroBase database.