PIKES PEAK REGIONAL WATER AUTHORITY

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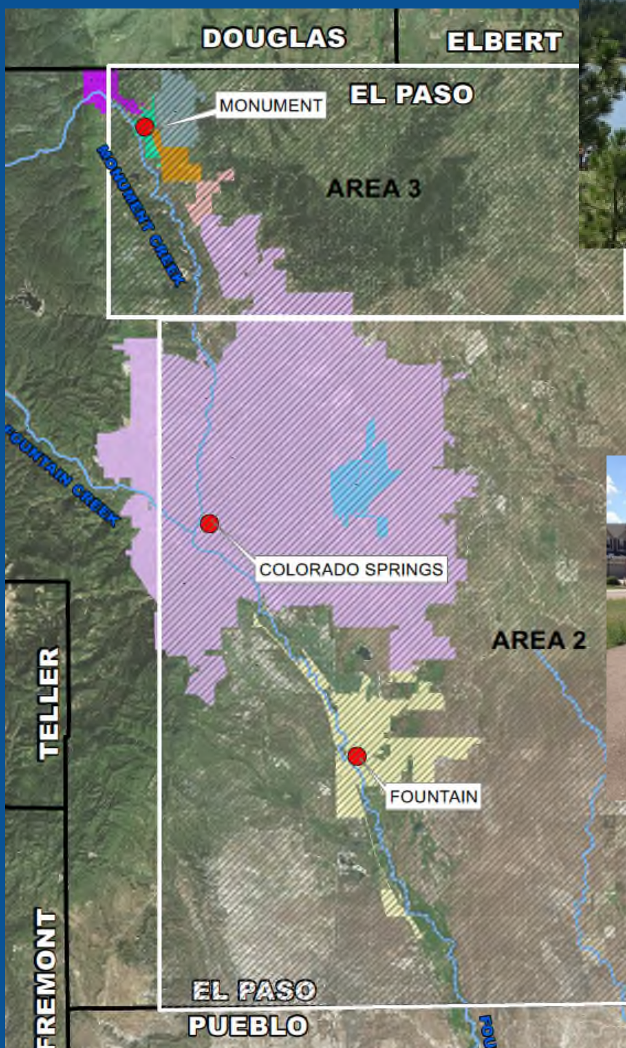
REGIONAL INFRASTRUCTURE STUDY



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EXECUTIVE SUMMARY

The Pikes Peak Regional Water Authority (PPRWA) is made up of several El Paso County water providers with shared interests in water supply issues. Many of those member entities have growing demands, and/or are heavily dependent on nonrenewable Denver Basin groundwater that is being depleted over time. In fact, this region makes up the largest municipal and industrial (M&I) gap in the Arkansas Basin projected through 2050 (CDM, 2010). With this Study, seven PPRWA members have joined together to evaluate the feasibility of developing a regional infrastructure system to (1) use their current supplies more efficiently, and (2) gain access to renewable supplies that are most likely to come from the Fountain Creek system and as far away as the Arkansas River to the PPRWA participants. Some additional capacity is planned for other regional participants likely to join this effort in the future.

This Study builds upon the findings of previous studies, tying alternatives together into a single, technically feasible system that can meet the future supply needs of the project participants. While technical feasibility is critical to the success of this effort, so is economic feasibility. The RIS includes conceptual cost estimates to determine economic feasibility. The overall cost estimate is based on the most technically and economically feasible system concept, based on the current level of information. A preferred alternative was not developed at this phase of study, but would be identified through the preliminary engineering phases of system development.

Each participant's current and future demands, and the adequacy of current and planned production to meet those demands, are summarized in this Study. The basic assumption of this evaluation is that the deficit between each utility's future demand and planned production will be supplied through acquisition of new supplies off the Arkansas River. A key component of this supply analysis is the recognition that Denver Basin groundwater supplies are declining. It is assumed that by 2035, Denver Basin supplies will be economically produced at only 35 percent of their current levels and, by 2050, it will not be economical to produce any Denver Basin supplies. In addition to declining Denver Basin supplies, planned development will increase demands on participant systems.

The proposed regional system would accommodate new water supplies from the Arkansas River. The system would include the facilities to store, convey, and possibly treat new supplies for delivery to the PPRWA participants. Although it may be possible to purchase capacity in the Southern Delivery System (SDS) project that is being constructed by Colorado Springs Utilities (CSU) to deliver water from the Arkansas River to the Colorado Springs area, there would be a number of political, financial, and permitting challenges to this option. An SDS alternative is contemplated in this Study: new supplies from the Arkansas River would be exchanged upstream for supplies diverted and stored off of Fountain Creek. Proposed storage off the Arkansas River would be used as an exchange mechanism for new storage and diversion facilities near Fountain. From this storage facility in Fountain, raw water supplies would be conveyed to the project participants, possibly with centralized treatment prior to delivery for municipal use.

Participants own a total of 8,332 AF of renewable, municipally adjudicated surface water, 12,048 AF of renewable alluvial supplies from a designated basin and other sources, and 14,920 AF of nonrenewable Denver Basin water resources (a grand total of 35,300 AF) that are contemplated for conveyance, treatment, storage, use and reuse. The estimated total demand under current conditions for participants in the study is approximately 16,284 acre-ft/year (AFY), ranging from 222 AFY for Palmer Lake to 4,704 AFY for the City of Fountain.

Projected demands increase for all entities through 2035, but many anticipate reaching buildout by that time. Total regional demand in 2035 is estimated at 25,024 AFY, approximately 154 percent of current demand and representing approximately 2.3 percent annual growth. Total regional demand in 2050 is estimated at 29,960 AFY, representing approximately 184 percent of current demand or approximately 1.8 percent annual growth. Some entities, including Palmer Lake, Monument, TMD, and DWSD reported that they do not anticipate significant expansion or associated increase in water demand after 2035. WWSD, CMD, and Fountain all project continued growth through 2050.

By 2050, a regional water supply deficit of approximately 11,080 AFY is projected for the study participants, if supplies of some are used to offset the deficits of others. Successful efforts to secure new water supplies and use current supplies more efficiently, and a slower growth rate evidenced in recent years, have reduced the magnitude of the anticipated shortfall compared to previous projections. However, some entities that have secured additional water still require the means to deliver that secured water. If the water supply deficit is calculated excluding offsets (i.e. assuming that supply for any one entity would not be used to offset deficit of another), the regional water supply deficit would be approximately 11,900 AFY; this projected deficit is used as the basis for planning in this Study.

Some existing facilities owned by PPRWA participants could be integrated into the regional system. The primary benefit of these facilities could be realized in project phasing. For example, if interconnectivity among the project participants is established, there is a potential to share Denver Basin supplies while regional projects are implemented. Alternatively, these supplies could be used as emergency or back-up supplies if renewable supplies are restricted during a dry year, or an emergency occurs within a participant's system.

The collective need for the PPRWA participants to secure new, renewable supplies to replace declining Denver Basin supplies and/or meet future demands supports a collaborative approach to water supply development. It is much more cost-effective to approach importation projects together. This also provides reliability benefits in that the ultimate system would allow interconnectivity among the participant systems. Each provider will have a distinct capacity need in the proposed system, based on estimated supply shortfalls in 2035 and 2050.

The project area extends into Pueblo County, where the Arkansas River storage facility would be located. But the primary project area is in western El Paso County, from the Fountain area north to the Palmer Divide near Monument. Based on functionality and geographic proximity, the project area is subdivided into three distinct areas:

Area 1 – Arkansas River east of Pueblo
Area 2 – Fountain Area to Black Forest
Area 3 – Black Forest to Palmer Divide
There are no apparent restrictions or fatal flaws to acquiring new water supplies off of the Arkansas River to support the Regional Infrastructure Project. Similarly, there are no apparent issues related to the implementation of the physical infrastructure to deliver that water to the PPRWA participants. From a technical and financial standpoint, no fatal flaws have been identified that preclude further development of the regional system.

Conceptual, order-of-magnitude costs were estimated for the collection of facilities that would make up the PPRWA regional infrastructure system, excluding water rights. The "basis of cost" alternative is estimated at $35M in soft costs (such as engineering, permitting, and property acquisition), and $242M in capital facilities costs (construction), for a total of $277M in 2015 dollars. Also in 2015 dollars, it is estimated that this system would have an annual operating cost of $10.6M. Based on these conceptual costs, the regional system is financially feasible if it is phased over a number of years, and the PPRWA participants work together on project funding. An implementation schedule is provided in this Study, targeting development of the entire system by 2028.

Findings/Recommendations

- A regional water supply system is technically feasible
- A regional system is cost effective
- The system should be phased over 10-15 years
- Each of three project areas could be completed for stand-alone functionality, with immediate benefits to the participants
- Work should begin with Area 3, then Area 2, and finally, Area 1
- A new entity could be formed for governance of the regional system
- Financial resources to implement the system would consist of grants, low-interest financing, and matching funds from participants

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CHAPTER 1
INTRODUCTION

1.1 BACKGROUND

The Pikes Peak Regional Water Authority (PPRWA) is made up of several El Paso County water providers with shared interests in water supply issues. Many of those member entities have growing demands, and/or are heavily dependent on nonrenewable Denver Basin groundwater that is being depleted over time. In fact, this region makes up the largest municipal and industrial (M&I) gap in the Arkansas Basin projected through 2050 (CDM, 2010). Therefore, these entities share a project-oriented purpose of securing new, renewable water supplies for the region. The following PPRWA members have joined together to evaluate the feasibility of developing a regional infrastructure system to (1) use their current supplies more efficiently, and (2) gain access to additional renewable supplies that are most likely to come from the Arkansas River:

- Town of Palmer Lake (TOPL)
- Town of Monument (TOM)
- Woodmoor Water and Sanitation District (WWSD)
- Donala Water and Sanitation District (DWSD)
- Triview Metropolitan District (TMD)
- Cherokee Metropolitan District (CMD)
- City of Fountain (COF)

These water providers have commissioned this Regional Infrastructure Study (RIS) to evaluate the physical facilities needed to deliver new, renewable supplies to their respective service areas. Some have already acquired renewable water rights, but need the infrastructure to deliver that water to their customers. There has also been some interest by other entities in the region to participate, and it is prudent to plan for these nonspecific demands that will develop as the region grows; these are collectively referred to as “Regional Participants” in this report.

The first major effort that some PPRWA members collectively undertook was to complete the Water Infrastructure Planning Study (WIPS) in 2008. The WIPS took a broad view of alternatives for consideration to use Denver Basin supplies more efficiently, and acquire and deliver new, renewable supplies to the Monument area.

1.2 PURPOSE

Some of those members have now joined others in the PPRWA to support a more focused effort to quantify future participant demands and capacity needs for a larger regional system, develop specific facility needs to meet the demands, explore current or planned infrastructure that could support the overall project purpose, develop conceptual costs for these facilities, and point toward a governance structure and implementation plan to move forward. The RIS facilitates the continued development of a regional approach to optimize use of current supplies and develop new water supplies to meet common needs of project participants, and allow them to benefit from economies of scale while collaborating to implement projects.

The RIS builds upon findings previously identified in the WIPS and other studies. The RIS ties these alternatives together into a single, technically feasible system that can meet the future supply needs of the project participants. While technical feasibility is critical to the success of this effort, so is economic feasibility. The RIS includes conceptual cost estimates to determine economic feasibility. The overall cost estimate is based on the most technically and economically feasible system concept, based on the current level of information. A preferred alternative was not developed at this phase of study, but would be identified through the preliminary engineering phases of system development.

1.3 SCOPING AND OBJECTIVES

Each participant's current and future demands, and the adequacy of current and planned production to meet those demands, is summarized in this Study. The basic assumption of this evaluation is that the deficit between each utility's future demand and planned production will be supplied through acquisition of new renewable supplies, possibly from the Arkansas River.

A key component of this supply analysis is the recognition that Denver Basin groundwater supplies are declining. Participants relying on the Denver Basin will continue to optimize those supplies through careful management, water conservation, and reuse with the goal of extending the economic life of those supplies. But it is assumed for the RIS that by 2035, Denver Basin supplies can be economically produced at only 35 percent of their current levels and, by 2050, it will not be economical to produce any Denver Basin supplies. In addition to declining Denver Basin supplies, planned development will increase demands on participant systems.

The proposed RIS system could accommodate new water supplies from the Arkansas River, possibly irrigation water rights that could be converted to municipal use. The system would include the facilities to store, convey, and possibly treat new supplies for delivery to the PPRWA participants. Although it may be possible to purchase capacity in the Southern Delivery System (SDS) project that is being constructed by Colorado Springs Utilities (CSU) to deliver water from the Arkansas River to the Colorado Springs area, there would be a number of political, financial, and permitting challenges to this option. An SDS alternative is contemplated in this Study: new supplies from the Arkansas River would be exchanged upstream for supplies diverted and stored off of Fountain Creek. Proposed storage off the Arkansas River would be used as an exchange mechanism for new storage and diversion facilities near Fountain. From this storage facility in Fountain, raw water supplies would be conveyed to the project participants, possibly with centralized treatment prior to delivery for municipal use.

1.4 LITERATURE REVIEW

Numerous prior studies have been conducted that have explored options for integrating renewable supplies into the project participant service areas and interconnecting participant systems. These reports were reviewed for applicability to the goals of the RIS. A listing of literature reviewed as part of this study, and a brief summary of those documents, is presented in Appendix A.

Our review included particular emphasis on leveraging previous studies to avoid duplication and improve efficiency by eliminating options from consideration that had already been proven ineffective. For example the *Arkansas River Renewable Water Economic Feasibility Study Part 2* (Boyle, 2008) provided a detailed assessment of the potential costs associated with installing a pipeline from the Arkansas River up to the Fountain area. The cost information provided a basis for comparing a pipeline option to an exchange option for "transmission" of water from the Arkansas River. The WIPS study was used to provide data describing reservoir and trunk line options, and the *Arkansas Basin Consumptive Use Needs Assessment* (Applegate, 2008) was reviewed to confirm adequacy of estimated demands and supplies.

1.5 ABBREVIATIONS

This section presents common abbreviations used in this report.

AF: acre-feet
AFY: acre-feet per year
CDPHE: Colorado Department of Public Health and Environment
CMD: Cherokee Metropolitan District
CSU: Colorado Springs Utilities
CWCB: Colorado Water Conservation Board
FT: feet
FT-MSL: feet, mean sea level
GAL: gallons
GPCD: gallons per capita per day
GPD: gallons per day
GPM: gallons per minute
HP: horsepower
IPR: indirect potable reuse
KGAL: one thousand gallons
MCL: maximum contaminant level
MGAL: one million gallons
MGD: million gallons per day
PER: persons
PPRWA: Pikes Peak Regional Water Authority
SDS: Southern Delivery System
SFE: single family equivalent
WTP: water treatment plant
WWTP: wastewater treatment plant

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CHAPTER 2
CURRENT AND FUTURE DEMANDS

2.1 GENERAL

An important element of this Study is to identify opportunities to jointly optimize the diverse portfolios of water sources and infrastructure held by the study participants to improve the region's supply reliability. A fundamental part of that assessment is to develop current water system demands and develop projected demands for future conditions. For this analysis, we have projected demands for the years 2035 and 2050.

For reference, an overall map of water providers and water infrastructure is shown in Appendix B, Figure 1. The service areas for all participants and "Potential Participants," or entities with potential interest in the regional plan, are shown in Appendix B, Figure 2.

2.2 WATER DEMANDS FOR EXISTING CONDITIONS

Estimated water demands for current conditions are summarized in Table 2-1. These demand estimates and projections were developed based on previous studies and on interviews with water providers. The demand summaries show a wide range of estimated use from a low of 222 AFY for Palmer Lake to a high of 4,704 AFY for the City of Fountain. Estimated total demand under current conditions for participants in the study is approximately 16,284 AFY. Note that for this analysis, three different categories of water demand are used as described below.

- Average Annual Demand
  Potential regional projects to be evaluated will be intended to meet long-term water supply objectives, targeting average annual demand as an initial basis of comparison. Further development/evaluation of components will incorporate contingencies and design elements to accommodate dry-year conditions.

- Peak Season Demand
  This category represents demand conditions during the peak use period, typically from May to October. During this timeframe, water use is typically higher and the ability to move water may be limited. For this study, an understanding of peak season demands vs. off-peak delivery potential is important when analyzing required storage volumes. Based on our review of water use data for the region, peak season demand is typically 60 percent of the average annual demand. Study participants suggested that about one-third of that peak can be met through direct use of water supplies, and about two-thirds will need to be stored during off-peak periods in order to meet the demand. Therefore, this analysis uses Peak Season Storage Volumes equal to 40 percent of average annual demands to represent the storage volume needed to meet peak season demands.

- Maximum Day Demand
  This value represents the maximum volume to be delivered in a given day. Generally, this is an intra-system data point for each provider used to manage well production or size water storage tanks. However, some infrastructure elements of interest may need to account for maximum day water delivery, such as a pipeline delivering water from operational storage.

Table 2-1
Estimated Demands for Current Conditions

Study Participant	CURRENT DEMAND		
	Average Annual Demand (AFY)	Peak Storage Volume (AF)	Maximum Day Demand (MGD)
Town of Palmer Lake	222	89	0.6
Town of Monument	395	158	0.7
Woodmoor Water and Sanitation District	1,389	556	2.7
Triview Metropolitan District	740	296	1.7
Donala Water and Sanitation District	1,400	560	3.2
Cherokee Metropolitan District	3,934	1,574	7.7
City of Fountain	4,704	1,882	10.9
Potential Participants	3,500	2,275	8.1
Regional Total	16,284	5,114	27.5

2.3 WATER DEMANDS FOR SHORT-TERM FUTURE CONDITIONS (2035)

For this evaluation, existing demand estimates and growth trends are used to project future water demands. The values used for estimating future growth depended on either (1) recommended/ requested growth scenario by the entity or (2) projected growth from evaluation of population dynamics. Projected regional demand was estimated for the year 2035 to facilitate near-term planning, and for the year 2050 to support long-range planning. Along with estimated demand for study participants, we have included a “Potential Participants” category to represent the demand and supply associated with other entities not currently participating, but that may join as regional plans take shape. Based on direction from current participants, an additional demand volume of 3,500 AFY has been added to allow for those future participants.

As shown in Table 2-2, projected demands increase for all entities through 2035, but many anticipate reaching buildout by that time. Total regional demand in 2035 is estimated at 25,024 AFY, approximately 154 percent of current demand and representing approximately 2.3 percent annual growth. This appears to be consistent with historic growth trends. Based on US Census data on population trends in El Paso County, population has consistently increased for at least the last 50 years, with an average population increase of 2.3 percent since 1980 and 1.9 percent since 2010.

For the most part, entities expect similar growth to occur within their respective service areas. Palmer Lake anticipates very little new growth; Monument, TMD, and DWSD each expect primarily infill development. The City of Fountain suggested new development during this period may occur as both infill, including the Kane Ranch, and in areas outside the existing service area. WWSD anticipates buildout of its existing service area by 2035, but continued growth is anticipated beyond that area through potential annexation of surrounding areas. CMD also reported potential for expansion outside its current service area. Based on service areas for CMD and adjacent providers, this expansion is likely to be primarily to the east.

Table 2-2
Projected Demands for 2035

Study Participant	2035 DEMAND FORECAST		
	Average Annual Demand (AFY)	Peak Storage Volume (AF)	Maximum Day Demand (MGD)
Town of Palmer Lake	234	94	0.6
Town of Monument	870	348	1.6
Woodmoor Water and Sanitation District	2,214	886	4.2
Triview Metropolitan District	3,100	1,240	3.3
Donala Water and Sanitation District	1,760	704	4.1
Cherokee Metropolitan District	5,846	2,338	13.6
City of Fountain	7,500	3,000	31.2
Potential Participants	3,500	1,400	8.1
Regional Total	25,024	8,610	58.5

2.4 WATER DEMANDS FOR LONG-TERM FUTURE CONDITIONS (2050)

Projected water demand was also developed for the year 2050 to facilitate long-range planning, see Table 2-3. Total regional demand in 2050 is estimated at 29,960 AFY, representing approximately 184 percent of current demand or approximately 1.8 percent annual growth. Some entities, including Palmer Lake, Monument, TMD, and DWSD reported that they do not anticipate significant expansion or associated increase in water demand after 2035. WWSD, CMD, and Fountain all project continued growth through 2050.

We also performed a cursory comparison to other water use projection studies. The SWSI 2010 report suggests that water demand in the Arkansas Basin is likely to double by 2050. Projected water use for 2050 in this Study is nearly double (184 percent) current use. We also compared this projection to the projected gap as reported in the *Arkansas Basin Consumptive Use Needs Assessment* (Applegate, 2008). A comparison table (A-1) is included in Appendix A. The comparison showed a notable difference between the estimated gap in 2008 vs 2014, but the differences appeared to reflect the change in conditions during that time period. The biggest changes are in participant water supplies and in new growth projections. Since 2008, many of the participants have added renewable water to their portfolio. By so doing, they have addressed some of the gap previously identified for the region. In addition, the projected increase in water system demands is significantly different. In 2008, when the *Needs Assessment* was written, the region was in a development boom and the projected demands were very high. Since development has slowed, demand projections have dropped and, in the six years since that study, growth rates have slowed significantly.

Table 2-3
Projected Demands for 2050

Study Participant	2050 DEMAND FORECAST		
	Average Annual Demand (AFY)	Peak Storage Volume (AF)	Maximum Day Demand (MGD)
Town of Palmer Lake	234	94	0.6
Town of Monument	870	348	1.6
Woodmoor Water and Sanitation District	2,628	1,051	5.2
Triview Metropolitan District	3,100	1,240	7.2
Donala Water and Sanitation District	1,760	704	4.1
Cherokee Metropolitan District	7,868	3,147	18.3
City of Fountain	10,000	4,000	37.2
Potential Participants	3,500	1,400	8.1
Regional Total	29,960	10,584	74.1

CHAPTER 3
SYSTEM SUPPLY, EXISTING INFRASTRUCTURE, AND FACILITY NEEDS

3.1 GENERAL

Based on information gathered from interviews with participating entities and background documents, this chapter summarizes existing water supplies, anticipated water supply deficits, water provider objectives, and available infrastructure that could be used to meet system needs and objectives.

3.2 SUMMARY OF WATER SUPPLIES

Supplies are divided into the following:

- Denver Basin Groundwater (less not-nontributary requirements)
- Alluvial Groundwater (less augmentation requirements)
- Surface Water

Denver Basin Groundwater. This water is produced from the Dawson, Denver, Arapahoe, and Laramie-Fox Hills aquifers. The Denver Basin area is generally within the area south of Greeley, east of the Front Range, west of Limon, and north of central El Paso County (Colorado Division of Water Resources, 2012) as shown in Appendix B, Figure 3. As has been noted, Denver Basin groundwater levels are generally declining, and costs to produce water from this supply are increasing as levels decline. The Denver Basin cannot economically sustain heavy usage as a primary long-term source. However, Denver Basin groundwater in an entity's water supply portfolio has its merits. The Denver Basin bedrock aquifers are protected from surface contamination, and essentially drought-proof.

Alluvial Groundwater. This is water produced from the subsurface using wells, but classified as being replenished from an adjacent surface water source (rivers, streams, ponds, etc.). These supplies have the advantage of being independent of the depletion conditions in the Denver Basin. However, a disadvantage compared to other groundwater sources, is that surface water requirements (such as augmentation) apply because of the potential for withdrawal from alluvial groundwater to directly affect surface water delivery.

Surface Water. This water is diverted from surface water bodies such as rivers and streams. For the study participants, surface water resources are predominantly taken from Monument Creek, Fountain Creek, and tributaries to these streams. Some examples are water delivered from Pueblo Reservoir via the Fountain Valley Authority pipeline (FVA) and soon, the SDS pipeline to the City of Fountain, and water to be delivered from Willow Creek Ranch to DWSD. Given that Denver Basin supplies are unsustainable as a primary source, many of the study participants need to secure or expand their holdings of renewable surface water to improve supply reliability. Denver Basin water could continue to be an important resource for drought protection for some time, however.

As noted in Table 3-1, the supply volumes listed represent, to the extent possible, the amount of water available for use less augmentation requirements, unless such requirements are met using other water supplies. As we discuss water supplies in this study, it is important to differentiate between (1) decreed water rights, (2) water supply planned production, and (3) water supply delivery capacity. Prior to use of water by a water purveyor, a water right must be obtained for the subject source. A decreed water right identifies the purveyor's legal right to put that water to beneficial use and defines a maximum quantity of water that can be used; often called "paper water." However, because of other constraints (physical, operational, economical, etc.) the water purveyor may not be able to make full use of the decreed right. A water user's planned production represents the quantity of water from a secured water source that the user will actually be able to divert and use ("wet water"), even if they do not have the current infrastructure to use that quantity. Finally, the water supply delivery capacity represents that quantity of water that a user can currently use with existing infrastructure.

When considering water supplies to meet an identified demand deficit, the water supply planned production value will be used to represent available supply. When considering infrastructure needs, the difference between planned production and delivery capacity will be used when proposing add-on system improvements or retrofit solutions.

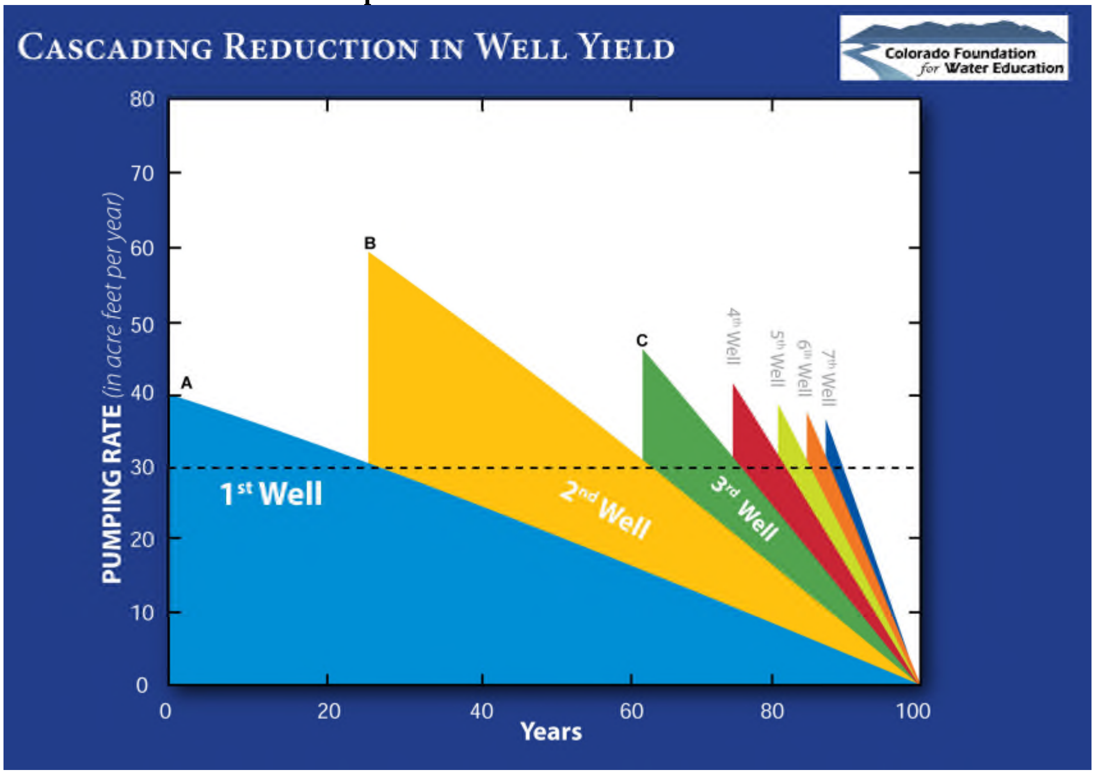
It should also be noted that projected Denver Basin well production rates have been discounted in this study. We have assumed that by 2035, Denver Basin wells will be able to economically produce only 35 percent of what they can currently produce, and that by 2050, the Denver Basin water supplies will no longer be economically feasible to use for meeting the majority of water demands. This assumed discounting is based on groundwater modeling results of potential Arapahoe well production loss in the WWSD Long Range Plan (WWSD, 2012). Continued drawdown of Denver Basin aquifer levels will require constructing an ever-increasing number of wells to maintain production, as shown conceptually in Fig. 3-1 (CFWE, 2007). It is also noted that El Paso County requires new developments to plan service based on a 300-year withdrawal of Denver Basin water instead of the state standard 100-year withdrawal used to determine annual pumping limits.

Table 3-1
Current and Projected Water Supplies

Study Participant	CURRENT SUPPLY				2035 SUPPLY ESTIMATE				2050 SUPPLY ESTIMATE			
	Total (AFY) (1)	GW (AFY) (2)		SW (AFY) (3)	Total (AFY)	GW (AFY)		SW (AFY)	Total (AFY)	GW (AFY)		SW (AFY)
		DB	Alluv.			DB	Alluv.			DB	Alluv.	
TOPL	893	759	0	134	400	266	0	134.0	134		0	134
TOM	1,419	1,344	0	75	321	246	0	75	75		0	75
WWSD	5,438	1,995	0	3,443 (4)	4,141	698	0	3,443	3,443		0	3,443
TMD	3,000	3,000	-	-	1,050	1,050	-	-	0		-	-
DWSD	2,724	2,444	0	280	1,012	732	0	280	280		0	280
CMD	9,148	1,878	7,270	0	7,927	657	7,270	0	4,770		4,770	0
COF	9,178	0	4,778	4,400	9,178	0	4,778	4,400	9,178		4,778	4,400
Potential Participants	3,500	3,500	0		1,225	1,225	0		1,000		1,000	
Regional Total	35,300	14,920	12,048	8,332	25,254	4,874	12,048	8,332	18,880	0	10,548	8,332
Percent of Total (5)		42%	34%	24%		19%	48%	33%		0%	56%	44%

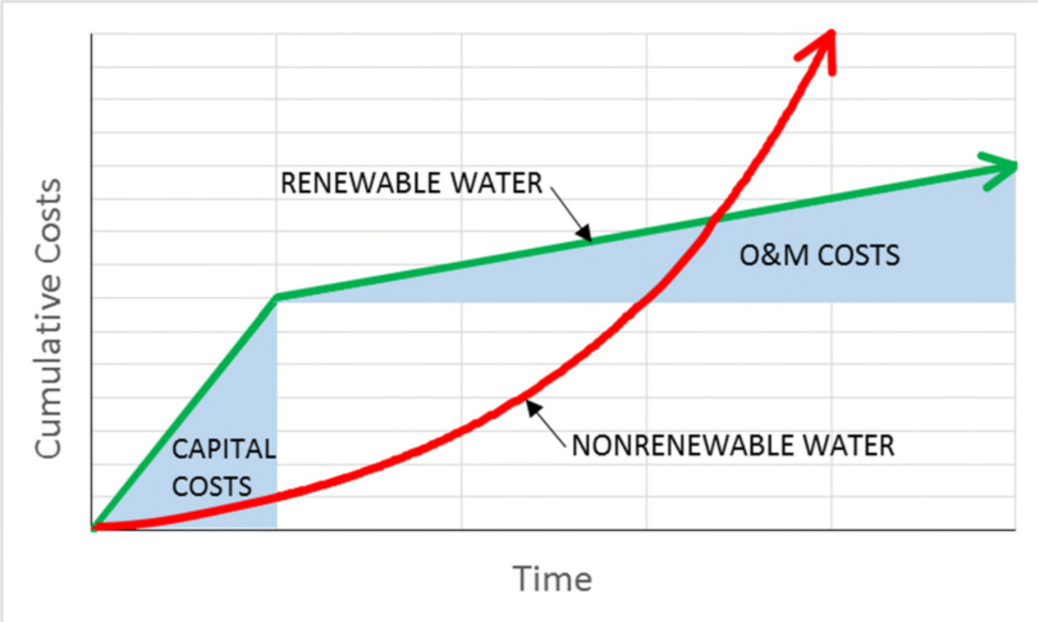
Notes:
1. Total Current Supply Acre-ft/Year (AFY)
2. Groundwater Supply in Acre-ft/Year (AFY). Groundwater supply consists of Denver Basin (DB) sources and Alluvial (Alluv.) sources
3. Surface Water (SW) Supply in Acre-ft/Year (AFY)
4. 3,443 AFY of surface water supply represents average-year consumptive use yield from WWSD's JV Ranch water rights. Dry-year consumptive use yield is estimated at 2,568 AFY.
5. Percent of Total = Total quantity of each type of supply (e.g. Denver Basin GW) for the region divided by total supply for the region.

Figure 3-1
Anticipated Future Denver Basin Well Yield



In contrast to the escalating costs and diminishing returns of adding more Denver Basin wells, a renewable water project generally allows for long-term cost control. Figure 3-2, based on an economic analysis by WWSD, illustrates this point. Capital costs accumulate over a period of years needed to implement the renewable water project, but costs thereafter are only what is needed to operate and maintain the system. Reliance on nonrenewable water, however, results in ever-increasing costs as more wells are added, and each adds a smaller incremental capacity than the one before.

Figure 3-2
Renewable Versus Nonrenewable Water Costs



However, Denver Basin water still has advantages as part of a water supply portfolio with regard to hardening against drought and emergencies, when less renewable water is available. For that reason, water providers would be well served to extend the useful life of their Denver Basin wells through changes in water use patterns and proactive water management. Aquifer storage and recovery (ASR) may be able to provide localized replenishment to some extent, and conjunctive use with renewable water sources may slow aquifer depletions. This would be consistent with participating entities' plans to transition their water supply portfolios to include more renewable water resources.

Finally, current wastewater return flows are partially accounted for in the reported water supply values. Participants noted that they generally use wastewater return flows for augmentation or exchange to allow for, or facilitate use of the water supplies listed in Table 3-1. Therefore, we conservatively assumed that return flows are generally utilized to support other supplies and thus did not report them as separate supplies. We did account for return flows in the facility sizing approach described in Chapter 8. This assumption is by no means intended to minimize the importance of continued development of localized reuse capabilities. It is anticipated that future evaluation of regional infrastructure will include careful evaluation of means to incorporate localized reuse. At this stage of analysis the overall infrastructure requirements have been developed without accounting for all reuse opportunities assuming that as the system is further defined, the regional participants can take advantage of reuse opportunities to reduce infrastructure requirements.

3.3 EXISTING INFRASTRUCTURE AND PRODUCTION CAPACITY

This section identifies existing supplies, production capacities, and the means to treat, transport, and store that water.

3.3.1 Current Water Production Capacity

Table 3-1 lists the sources of supply and quantities from each source. Also shown are projections of how current supplies could diminish in the years ahead due to assumed declines in the economic productivity of Denver Basin aquifers. As shown in Table 3-1, on a regional basis, the distribution of current water supplies among Denver Basin groundwater, alluvial groundwater, and renewable surface water is approximately 42, 34, and 24 percent, respectively. Most of the participants in the Monument area (Palmer Lake, Monument, DWSD, and TMD) are heavily reliant on Denver Basin groundwater. The supply for each of these entities is at least 70 percent Denver Basin water. Current Denver Basin supplies for regional participants total 14,566 AFY.

WWSD, because of a 2011 water purchase, has 63 percent of its water supply in renewable surface water, CMD has approximately 80 percent of its water supply in alluvial groundwater and the City of Fountain has its supply fairly evenly divided between surface water and alluvial groundwater. Total regional production capacity for surface water and alluvial groundwater is 8,332 and 12,048 AFY, respectively. These sources are assumed to still be available in 2050.

3.3.2 Current Water Treatment Capacity

Table 3-2 lists the known, existing, and estimated ultimate capacities of known water treatment facilities. The estimated regional treatment capacity totals 15.6 MGD, excluding chlorination stations. It is anticipated that regional demand will nearly double by 2050, necessitating at least an additional 15 MG of treatment facilities within the region, assuming similar treatment requirements. It is estimated that during the planning period for this study, new treatment facilities sufficient to bring the total treatment capacity to 43 MGD are being planned for regional entities other than CSU. As components are further evaluated, it will be essential to determine to what extent the treatment facilities may need to be modified as treatment needs change due to regulatory and source water changes.

Table 3-2
Current Water Treatment Capacity

Facility	TREATMENT FACILITIES									
	Facility Size		Entity Owner (O) or Interested (I)							
	Current (MGD)	Ultimate (MGD)	CMD	DWSD	Monument	TMD	Fountain	Palmer Lake	WWSD	CSU
Fountain Valley WTP (1)	1.7	1.7	I	I	I	I	I		I	O
R. Hull WTP (2)	1.5	1.5		O	I	I			I	
Holbein WTP (2)	3	3		O		I				
Well 4-5 WTP (3)	0.17	0.17			O					
Well 7 WTP (3)	0.31	0.31			O	I				
Well 3-9 WTP (3)	0.36	0.36			O	I				
Well 8 WTP (3)	0.5	0.5			O	I				
WTP A (3)	0.5	0.5		I		O				
WTP B (3)	1.5	1.5		I	I	O			I	
Lake WTP (3)	0.5	0.5						O		
Wells WTP (3)	0.5	0.5						O		
South WTP (3)	3.3	4		I	I	I			O	
Central WTP (4)	1.74	1.74			I				O	
Fountain RO/MF WTP (5)	0	5	I	I			O		I	
Fountain MF WTP (5)	0	15	I	I			O		I	
Fountain portion of SDS WTP (1)	0	2	I	I			O		I	O
JV WTP (4)	0	4	I	I					O	
Total Regional Capacity	15.6	42.9								

<u>Notes:</u>
Data Sources: (1) CSU Water Conservation Plan (2) Utility Resources Report for DWSD, (3) WIPS, (4) WWSD LRP 2012, (5) Fountain 2006 Water Supply Master Plan

Entity Owner includes Owner or potential project sponsor. Entity Interested refers to a party that may be benefit from use of an existing facility or participation in the development of a potential facility.

3.3.3 Current Water Transmission Capacity

Table 3-3 lists the current and potential capacities of known transmission facilities. The only current transmission facilities used by regional participants is the FVA pipeline, and SDS is scheduled to be operational in 2016. The City of Fountain uses or owns capacity in both of these facilities. Fountain receives 1.900 AFY (2,000 AFY – 100 AFY for transit loss) through contracts associated with the FVA pipeline, and it is anticipated that they will receive 2,500 AFY from the SDS pipeline upon its completion. The transmission facilities listed in Table 3-3 represent those facilities that would most likely be beneficial to regional objectives to move water along the analysis corridors.

There are other potential means of water conveyance in the region such as the FMIC and Chilcott ditches, and CMD's Ellicott transmission line that are not included in this table because they are not likely to be used by regional participants to move water through the corridor. For example, the Ellicott pipeline generally runs east/west to convey water from the Upper Black Squirrel Creek basin to CMD's service area. This pipeline is therefore unlikely to be of use for transmission by regional entities because it would do little to help move water through the north/south corridor. Similarly the aforementioned ditches are not likely to be used specifically for the purpose of moving water along the corridor. For the purposes of this study, these assets are considered as possible appurtenances to other types of facilities. The Ellicott pipeline and the ditches are part of the infrastructure related to potential water storage facilities that could be used to support regional objectives.

The required transmission capacity will depend on the components pursued by the participating entities. However, probable transmission capacity needs can be estimated as follows. The anticipated demand for regional participants in 2050 is approximately 30,000 AFY and it is anticipated that by that time, all water will need to come from renewable supplies. Current infrastructure includes facilities to deliver approximately 16,660 AF (15 MGD) of renewable water. This includes 209 AF in local surface water supplies (Palmer Lake and Monument), 12,048 AF in alluvial supplies (CMD and Fountain) and 4,400 AF Arkansas River supplies through FVA or SDS (Fountain). Therefore, additional transmission capacity on the order of 12 MGD will be needed. This assessment is based on the assumption that the capacity available to the City of Fountain for conveyance through the FVA and SDS pipelines represents a peak season average day amount, not an average annual amount.

Table 3-3
Current Water Transmission Capacity

Facility	TRANSMISSION FACILITIES									
	Facility Size		Entity Owner (O) or Interested (I)							
	Current (MGD)	Ultimate (MGD)	CMD	DWSD	Monument	TMD	Fountain	Palmer Lake	WWSD	CSU
Fountain portion of SDS Pipeline (78 MGD max) (1)	2.2	2.2	I	I			O		I	O
FVA Pipeline (17.95 MGD max) (2)	1.7	1.7					O			O
Sundance Pipeline (3)	3.6	3.6	O	I	I	I		I	I	
JV Ranch Transmission Pipeline (4)	0.0	3.1	I	I					O	
Total Regional Capacity	7.5	10.6								

Notes:
(1) SDS Pipeline Transmission Capacity is reported as follows: The total pipeline capacity (from the CSU Water Conservation Plan) is 78 MGD. However, only 2.2 MGD is available for use by the City of Fountain, a regional participant.
(2) FVA Pipeline Transmission Capacity is reported as follows: The total pipeline capacity (from Fountain 2006 Water Master Plan) is 17.95 MGD. However, only 1.7 MGD is available for use by the City of Fountain, a regional participant.

Data Sources: (3) CMD Revenue Bonds Doc, (4) WWSD LRP 2012 pg 87

Entity Owner includes Owner or potential project sponsor. Entity Interested refers to a party that may be benefit from use of an existing facility or participation in the development of a potential facility.

3.3.4 Current Water Storage Capacity

As shown in Table 3-4, regional water storage may also be a limiting factor. The existing aggregate storage volume, although slightly more than the 2050 regional peak storage volume, may not all be available for use by the region. Some facilities listed may not be available or economically feasible for use by regional participants. There may also be ownership issues limiting or restricting use, or reservoirs may not be in the most effective locations to optimize water supplies. The existing water storage volumes represent potentially available storage and suggest that there may be sufficient existing storage, but further analysis will be required to determine the feasibility of utilizing the existing reservoirs.

The storage volumes described in this assessment did not include subsurface storage at existing Aquifer Storage and Recovery (ASR) sites. Based on the state of development of ASR in the region, it is unclear at this point whether ASR will develop into a viable mechanism for managing water resources. In addition, this study does not include existing/potential storage facilities in the area that are either unavailable or are too preliminary in their development. The

Lower Williams Creek Reservoir, which is a potential storage facility described in future phases of the SDS project, was not included because it is in very preliminary stages of consideration. The Widefield Aquifer was not included in the potential storage volume because it is understood to be fully allocated. Another reservoir, the Keeton Reservoir, was not considered here because it is part of the City of Fountain's augmentation system and was therefore considered unavailable for the purposes of this study.

Table 3-4
Current Water Storage Capacity

Facility	STORAGE FACILITIES									
	Facility Size		Entity Owner (O) or Interested (I)							
	Current (AFY)	Ultimate (AFY)	CMD	DWSD	Monument	TMD	Fountain	Palmer Lake	WWSD	CSU
Stonewall Springs Reservoir (1)	0	2,600	I	I			I		I	
Keiwit Gravel Pit (2)	0	8,320	I	I			O		I	
Schmidt Gravel Pit (2)	0	20,000	I	I			O		I	
Lafarge Gravel Pit (2)	3,700	7,800	I	I			O		I	
Bristlecone Reservoir (3)	1,650	1,650		I	I	I		I	I	
Monument Lake (3)	300	300			O	I		I	I	
Lake Woodmoor (3)	675	675			I	I		I	O	
Calhan Reservoir (4)	241	8,400	I	I			I		O	
Big Johnson Reservoir (5)	5,000	10,000	I	I			I		I	
Upper Williams Creek Reservoir (6)	0	30,000	I	I					I	O
Glen Park Reservoir (7)	148	148		I	I	I		O		
Palmer Lake (7)	144	144						O		
Monument Lake	300	300			O	I		I	I	
Total Regional Capacity	12,158	90.337								

Notes:
Data Sources: (1) Website: http://www.sdseis.com/files%5Cdocuments%5CComDoc00269.PDF, (2) Gravel Pit Feasibility Study, (3) WIPS, (4) WWSD LRP 2012, (5) FMIC Interview, (6) CSU Interview, (7) Palmer Lake Summary Info.

Entity Owner includes Owner or potential project sponsor. Entity Interested refers to a party that may be benefit from use of an existing facility or participation in the development of a potential facility.

3.4 2050 PLANNED PRODUCTION VERSUS PROJECTED DEMAND

Water supply estimates for current, 2035, and 2050 conditions were developed from entity-supplied information and summarized for the region. As shown in this chapter, existing production capacities meet current demand for each entity. Some entities (e.g. WWSD, DWSD), have already purchased significant quantities of renewable water as part of their portfolio, but have yet to establish delivery to their service areas. Other entities are still looking to identify and deliver renewable water sources.

Our evaluation suggests that by 2050, the regional study participants will face a regional water supply deficit of approximately 11,080 AFY, assuming that one participant's water supply is used to offset another's deficit (see Table 3-5). Some successful efforts to secure new water supplies, and a slower growth rate evidenced in recent years have reduced the magnitude of the anticipated shortfall compared to previous projections, but the specter of water shortage still looms. In addition, strides made by some entities to secure water still depend on being able to deliver that secured water. It should also be noted that if the water supply deficit is calculated assuming that excess supply for any one entity would not be used to offset deficit of another, the regional water supply deficit would be 11,895 AFY. Because there are currently no plans in place to use one entity's supply to offset another's deficit, we will utilize the regional water supply deficit of 11,895 AFY when describing a shortfall. However, it is worth noting that regional participants can reduce water supply deficit through cooperation. Thus a regional effort for water delivery and shared water resources is of significant value.

Table 3-5
Anticipated Water Supply

Study Participant	AVG ANNUAL WATER SUPPLY AVAILABLE (AFY)	
	2035	2050
Town of Palmer Lake	166	-100
Town of Monument	-549	-795
Woodmoor Water and Sanitation District	1,927	815
Triview Metropolitan District	-2,050	-3,100
Donala Water and Sanitation District	-749	-1,480
Cherokee Metropolitan District	2,081	-3,098
City of Fountain	1,678	-822
Potential Participants	-2,275	-2,500
Regional Total	230	-11,080
Regional Total Excluding Offset	-5,622	-11,895

Notes:
1. Avg Annual Supply Available = Total Supply – Total Demand
2. Regional Total = Sum of all supplies for a given year.
3. Regional Total Excluding Offset = Sum of all deficits for a given year.

3.5 ENTITY NEEDS AND OBJECTIVES

In addition to evaluating potential components based on comparison of supply and demand, it is also important to consider the specific goals and objectives of the individual participants and identify partnering opportunities to achieve those goals. The following summary of objectives and priorities describes primary goals identified in document review and from interviews.

- Palmer Lake seeks to secure augmentation water to allow full use of their surface water rights.
- Monument is interested in diversifying their water supply portfolio by securing renewable water resources.
- WWSD has purchased JV Ranch water and seeks to determine the most cost-effective means of delivery.
- TMD has expressed some interest in pursuing regional reuse projects.
- DWSD has purchased Willow Creek Ranch water, and takes delivery via CSU's system under a short-term contract (until CSU's Southern Delivery System [SDS] project is operational), but seeks to determine the most cost-effective means of long-term delivery.
- CMD seeks to leverage a regional project to help them secure more renewable water. Efforts to secure such have been frustrated when approached as a single entity.
- Fountain has consistently operated on a regional basis and seeks to support regional efforts. In addition, the City anticipates continued growth and is interested in determining if regional participation will support their efforts to secure the required water supplies.
- FMIC has a current need for reservoir repair and changes in water delivery needs. Regional participation could help with reservoir maintenance and with new mechanisms for delivery.

CHAPTER 4
INDIVIDUAL ENTITY SUMMARIES

4.1 GENERAL

This chapter provides a summary of current water demands, projected demands, existing supplies, and potential deficits for each of the study participants. Also included is a description of their existing systems, what improvements are currently planned, and what components of their systems could be integrated as part of the proposed regional water supply system (see Appendix C).

4.2 TOWN OF PALMER LAKE

Current Demand:	222 AFY
2050 Demand:	234 AFY
2050 Planned Production:	134 AFY
Potential Supply Deficit:	**100 AFY**

The Town of Palmer Lake is nearing buildout capacity and does not anticipate any significant increase in demands. Palmer Lake's interest in the PPRWA project focuses on the need to replace its Denver Basin supplies with renewable supplies. Over recent history, Denver Basin supplies have ranged between 30 to 50 percent of its supply mix.

Existing Infrastructure: Palmer Lake's supply includes nonrenewable supplies from two Denver Basin wells and surface water diversions off of Monument Creek. While Palmer Lake has rights of up to 350 gpm off of Monument Creek, these rights are often out of priority. Over recent history, Palmer Lake has diverted well under half their right. Demand that cannot be met by surface water diversions has been made up through groundwater supplies from Denver Basin wells.

Over the prior five years (2009-2013), the range in supplies from each source was as follows:

<u>Raw Water Supply</u>	
Surface Water:	107 to 146 AFY
Denver Basin:	60 to 97 AFY

Palmer Lake's treatment capacity includes the following:

Membrane surface water treatment plant:	1.1 mgd (1,250 AFY)
Groundwater treatment capacity:	1.4 mgd (1,613 AFY)

Over recent history, Palmer Lake's Denver Basin groundwater supplies have ranged from 60 to 97 AFY. For the purposes of this study, it was assumed that the high range of these diversions would be necessary in the future. While Palmer Lake shows a surface water right that exceeds its 2050 demand, it was still assumed that their surface rights alone would not be able to meet these demands due to priority of its diversion off of Monument Creek.

Palmer Lake's existing surface water treatment facility appears to have sufficient capacity to meet future normal and peak demands, assuming all of its supply requires surface water treatment. Retrofit of this facility may be required if advanced treatment becomes necessary (e.g. nanofiltration and advanced oxidation).

Major Planned Infrastructure Projects: No major infrastructure projects are planned. Operational improvement projects are planned that include more efficient operation of the Town's booster pump station and tanks.

Existing and Planned Infrastructure that could benefit PPRWA regionalization partners: Palmer Lake's existing Denver Basin supplies could potentially provide a regional benefit for interim and drought supplies. Palmer Lake has no planned infrastructure improvements that would support a regional delivery system.

4.3 TOWN OF MONUMENT

Current Demand:	395 AFY
2050 Demand:	870 AFY
2050 Planned Production:	258 AFY
Potential Supply Deficit:	**612 AFY**

The Town of Monument operates a water system serving approximately 40 percent of its incorporated area. The system is nearly entirely supplied through Denver Basin wells, with surface rights being used for augmentation for the groundwater sources. Monument has experienced dramatic growth over the prior two decades and expects continued growth through the planning period, with an estimated doubling of its current demand by 2050. New renewable supplies are required to replace its existing Denver Basin supplies and meet future demands.

The potential supply deficit for this analysis assumes full use of Monument's surface water rights. It is further assumed that these rights require augmentation, and that that augmentation will be supplied through Monument's share of reusable return flows discharged from the Tri-Lakes Wastewater Treatment Plant (WWTP).

Existing Infrastructure: Monument's water service is provided through a series of wells, a booster pump station, and groundwater treatment facilities. Monument does not have a surface water treatment facility. Monument Sanitation District is a joint owner of the Tri-Lakes WWTP, but the Town retains rights to its reusable return flows from the WWTP discharge. Historically, these return flows have been used to augment its junior alluvial groundwater rights.

New surface supplies delivered through a potential regional system would require implementation of new surface water treatment facilities. This Study assumes participation in a regional surface water treatment facility that is included in the basis of cost alternative described in a later section.

Planned Infrastructure to meet future demands: Monument recently completed a Water Master Plan (Forsgren Associates, August 15, 2014). Part of the Master Plan identified future supply projects that could meet growing demands and reduce reliance on Denver Basin supplies. On the demand side, recommendations are made for additional well development. To address issues related to diminishing Denver Basin supplies, several alternatives are presented. These include increased water efficiency, water reuse, and new supplies. The new supply alternatives include consideration of the proposed regional system.

Existing and Planned Infrastructure that could benefit PPRWA regionalization partners: Monument's existing Denver Basin supplies could provide a regional benefit for interim and drought supplies. The planned facility recommendations presented in the Master Plan include improvements internal to Monument's distribution system and do not specifically support integration into a regional system. While new supplies delivered via the regional system are recommended as a new supply alternative, no specific facility improvements were identified as part of this recommendation.

4.4 WOODMOOR WATER AND SANITATION DISTRICT

Current Demand:	1,389 AFY
2050 Demand:	2,628 AFY
2050 Planned Production:	3,443 AFY (2,568 AFY dry-year yield)
Potential Supply Deficit:	**0 AFY**

Woodmoor Water and Sanitation District depends almost exclusively on Denver Basin groundwater. Woodmoor operates 15 Denver Basin wells. The majority of water produced from these wells is combined and treated at one of two treatment facilities, the Central WTP (groundwater only) and the South Water Treatment Plant (groundwater and surface water). Woodmoor also has surface water rights derived from three sources: Monument Creek, Dirty Woman Creek, and Lake Woodmoor.

To reduce reliance on Denver Basin water, the District recently acquired JV Ranch, which provides surface supply off of Fountain Creek that is conveyed to Calhan Reservoir via the Chilcott Ditch. The water right provides an estimated yield of 3,443 AFY, but a dry-year consumptive use yield of only 2,568 AFY. Water rights at JV Ranch are generally sufficient to meet all of Woodmoor's 2050 demands; however, there is currently no mechanism to deliver these supplies to its service area. Therefore, while Woodmoor has no potential supply deficit, they do require infrastructure to move and treat their existing supplies from JV Ranch. To treat its JV Ranch supplies, Woodmoor has evaluated implementing a new 5-mgd facility with advanced treatment likely including microfiltration, nanofiltration, and advanced oxidation processes.

Existing Infrastructure: Major components of Woodmoor's water system include 15 groundwater wells, three treated water storage tanks, and two water treatment facilities. The South WTP can treat both groundwater and surface water supplies at a capacity up to 2.2 mgd. Woodmoor has surface supplies that may be delivered to its service area through Lake Woodmoor, Monument Creek, and Dirty Woman Creek.

Planned Infrastructure to meet future demands: Woodmoor is exploring a variety of opportunities to optimize and expand its existing water service system. Many of these are short-term alternatives that continue to rely on Denver Basin groundwater.

Existing and Planned Infrastructure that could benefit PPRWA regionalization partners: Woodmoor has evaluated opportunities to move its surface supplies from JV Ranch (southeast of Fountain) to its service area. This infrastructure includes expanded storage, piping, pumping, and treatment facilities. These facilities could directly support a regional project if sized appropriately.

The existing storage at Calhan Reservoir is insufficient to meet Woodmoor's needs. Prior studies evaluated potential expanded storage capacities and costs. These expanded storage capacities could consider full PPRWA needs; however, retrofit costs associated with Calhan and the additional conveyance requirements might point to other more economical sites further north. In such a case, Woodmoor should consider participation in the alternate location where they could benefit from cost-sharing. Such a scenario is based on the assumption that Woodmoor's JV Ranch water rights could be diverted and stored at an alternate location off of Fountain Creek.

Woodmoor has also evaluated new surface water treatment for its JV Ranch supplies. This facility could also be integrated into the PPRWA regional system if regional surface water treatment is considered among project participants. Not all PPRWA participants have sufficient surface water treatment capacity, and they could benefit from the economies of scale of a regional treatment facility. Those entities with sufficient surface water treatment capacity may require upgrades to the treatment facilities if it is determined that advanced treatment is necessary.

Woodmoor's existing Denver Basin supplies could potentially provide a regional benefit for interim and drought supplies.

4.5 TRIVIEW METROPOLITAN DISTRICT

Current Demand:	740 AFY
2050 Demand:	3,100 AFY
2050 Planned Production:	0 AFY
Potential Supply Deficit:	**3,100 AFY**

Triview Metropolitan District serves a portion of the Town of Monument, and relies exclusively on Denver Basin groundwater. Substantial growth is forecasted through the 2050 planning period.

Existing Infrastructure: Triview's existing infrastructure includes groundwater wells, groundwater treatment facilities, and one treated water storage tank.

Planned Infrastructure to meet future demands: Triview is currently exploring a direct reuse system for irrigation. Triview is also interested in improved reliability during water emergencies, potentially through interconnectivity with neighboring systems. Operational improvements, including a new booster pump station are being explored within Triview's system.

Existing and Planned Infrastructure that could benefit PPRWA regionalization partners: Triview's existing Denver Basin supplies could potentially provide a regional benefit for interim and drought supplies. There are no planned infrastructure improvements that could benefit the PPRWA regional system.

4.6 DONALA WATER AND SANITATION DISTRICT

Current Demand:	1,400 AFY
2050 Demand:	1,760 AFY
2050 Planned Production:	280 AFY
Potential Supply Deficit:	**1,480 AFY**

Donala provides water service to a mixed development of residential (primarily), commercial, and industrial users between Monument and Colorado Springs, east of Interstate 25 (I-25). Donala has historically relied on Denver Basin groundwater supplies. In 2008, Donala purchased Willow Creek Ranch near Leadville and in 2011, was decreed 280 AF of supply from this purchase. This supply is currently wheeled through the CSU system under a temporary agreement. Donala is exploring the option of a permanent agreement with CSU to deliver and treat its Willow Ranch supply. Alternatively, Donala could consider participation in the PPRWA regional system.

Existing Infrastructure: Major components of Donala's system include Denver Basin wells, four treated water storage tanks, booster pump stations, and two groundwater treatment facilities.

Planned Infrastructure to meet future demands: Donala is planning new storage adjacent to one of its treatment facilities. It is likely to be initiated as a multi-use tank; however, Donala is evaluating whether to include it as part of a reuse system or raw water storage.

Existing and Planned Infrastructure that could benefit PPRWA regionalization partners: Donala's existing Denver Basin supplies could potentially provide a regional benefit for interim and drought supplies. Donala's capital improvement program focuses heavily on implementation of renewable sources for supply. This includes consideration of a long-term agreement with CSU to treat and deliver its Willow Ranch supply, which could also be delivered via the proposed regional system.

Donala is also participating, along with Cherokee Metro District, in the Colorado-Wyoming Coalition. This is a consortium of utilities evaluating delivery of new supplies from Utah's Flaming Gorge Reservoir. This concept would take several years to develop, but could result in delivery of new supplies into El Paso County from the north. This project could serve as a long-term alternative to developing new supplies from the Arkansas River, and could be considered by other PPRWA participants.

4.7 CHEROKEE METROPOLITAN DISTRICT

Current Demand:	3,934 AFY
2050 Demand:	7,868 AFY
2050 Planned Production:	4,770 AFY
Potential Supply Deficit:	**3,098 AFY**

Cherokee primarily relies on alluvial groundwater. Cherokee's alluvial supplies are obtained from the Upper Black Squirrel Creek (UBSC) Basin, the primary source of Cherokee's supplies. Cherokee recently completed the Sundance Ranch Project, which includes integration of new Denver Basin supplies in the Black Forest area.

Cherokee expects a substantial increase in demand by 2050. In its 2015 Water Supply Master Plan, Cherokee evaluated a variety of proposed projects to meet this demand, including new supplies off the Arkansas River as part of the PPRWA regional project.

A significant share of Cherokee's UBSC supply is restricted for use within the boundaries of the UBSC Basin, although the District's service area lies outside the Basin. The planned production presented in this Study assumes that a portion of Cherokee's non-exportable UBSC groundwater supplies are used to meet the estimated demand for the regional participants discussed in the following section.

Existing Infrastructure: Major components of Cherokee's system include alluvial and Denver Basin groundwater wells, storage facilities, pump stations, and groundwater treatment facilities. Recent improvements include construction of wells at Sundance Ranch in the Black Forest area, and appurtenant storage, pumping, and conveyance facilities to move that water south to Cherokee's service area.

Cherokee also owns and operates a wastewater reclamation facility, treating flows from Cherokee's service area, as well as from Meridian Service Metropolitan District, and Schriever Air Force Base. All of the effluent from this facility is discharged to Cherokee's rapid infiltration basins for recharge into the UBSC aquifer, and is partially reused through Cherokee's down-gradient wells.

Planned Infrastructure to meet future demands: The water supply plan identified in the Master Plan identifies a variety of options to meet future demand and reliability goals. These options include further development of alluvial and Denver Basin groundwater supplies, as well as new surface supplies off of Fountain Creek or the Arkansas River. Participation in the PPRWA regional project is identified as a potential alternative to meet future supply needs.

Existing and Planned Infrastructure that could benefit PPRWA regionalization partners: Cherokee is interested in reducing its reliance on groundwater and acquiring renewable surface supplies. While no specific evaluation of new facilities to accomplish this have been completed, Cherokee is interested in exploring partnership opportunities with other utilities for new facilities independent of Pueblo Reservoir and SDS/FVA systems.

The Sundance Ranch water project, recently completed, will develop additional Denver Basin supplies in Black Forest. The project includes new wells, treatment, conveyance, and storage. The Sundance Pipeline will convey raw water from Black Forest south to Cimarron Hills. This pipeline could potentially serve as part of the PPRWA regional project by reversing direction and delivering new supplies from the south to north, or a parallel pipeline could be added within the same corridor. If the existing line is used, the design criteria for this pipeline will need to be evaluated to establish appropriate facilities for the pipeline to safely operate in this mode. Once active, the new Denver Basin wells could provide a regional benefit for interim and drought supplies.

Cherokee is also participating, along with Donala, in the Colorado-Wyoming Coalition. This is a consortium of utilities evaluating delivery of new supplies from Utah's Flaming Gorge Reservoir. This concept would take several years to develop, but could result in delivery of new supplies into El Paso County from the north. This project could potentially serve as a long-term alternative to developing new supplies from the Arkansas River, and could be considered by other PPRWA participants.

4.8 CITY OF FOUNTAIN

Current Demand:	4,704 AFY
2050 Demand:	10,000 AFY
2050 Planned Production:	9,178 AFY
Potential Supply Deficit:	**822 AFY**

The City of Fountain water service system includes surface water off the Arkansas River acquired through the FVA infrastructure system. This supply accounts for about 70 percent of Fountain's water. Fountain is also a partner in SDS and owns transmission capacity in that pipeline. The City's remaining supply is acquired through groundwater.

Fountain is forecasting substantial growth through the 2050 planning period. One alternative to meet this increased demand is the acquisition of new supply off of the Arkansas River in coordination with the PPRWA regional system. Therefore, Fountain would have an interest in

Area 1 storage at the Arkansas River, along with diverted exchanges off of Fountain Creek. Additionally, Fountain has explored development of the Fountain gravel pits to expand its use of alluvial groundwater.

Existing Infrastructure: The major components of Fountain's infrastructure include the groundwater wells, treatment, booster pumping, storage, and conveyance systems. Fountain also participates in the FVA and SDS systems.

Planned Infrastructure to meet future demands: Planned infrastructure to meet future demands generally consists of further development of groundwater supplies.

Existing and Planned Infrastructure that could benefit PPRWA regionalization partners: The City of Fountain previously investigated opportunities to convert existing gravel pits west of I-25 for reservoir storage. The initial investigation between 2006 and 2008 led to Fountain acquiring the LaFarge Pit (now Martin-Marietta Pit). At the time, the certainty of the SDS project was unknown and Fountain was proactively exploring options to develop new supplies. With the implementation of the SDS project, Fountain does not have specific near-term plans for gravel pit storage. They may look to a future use as augmentation water storage. Fountain's ownership of the pit presents a potential partnership opportunity to mutually develop storage at this site.

4.9 POTENTIAL REGIONAL PARTICIPANTS

Current Demand:	3,500 AFY
2050 Demand:	3,500 AFY
2050 Planned Production:	1,000 AFY
Potential Supply Deficit:	**2,500 AFY**

Regional participants generally include developed areas near Cherokee's service area that rely on Denver Basin supplies. These entities could consider participating in the PPRWA regional project to replace their reliance on Denver Basin supplies with a renewable supply source. In this study, it is assumed that 1,000 AFY of the 2050 demand could be met through Cherokee's non-exportable alluvial supplies. The remaining 2,500 AFY could potentially be supplied through the regionalization project.

Since these regional participants are not specifically identified as part of this study, planned infrastructure projects are not presented below.

Existing Infrastructure: Groundwater wells, storage, groundwater treatment

Planned Infrastructure to meet future demands: None.

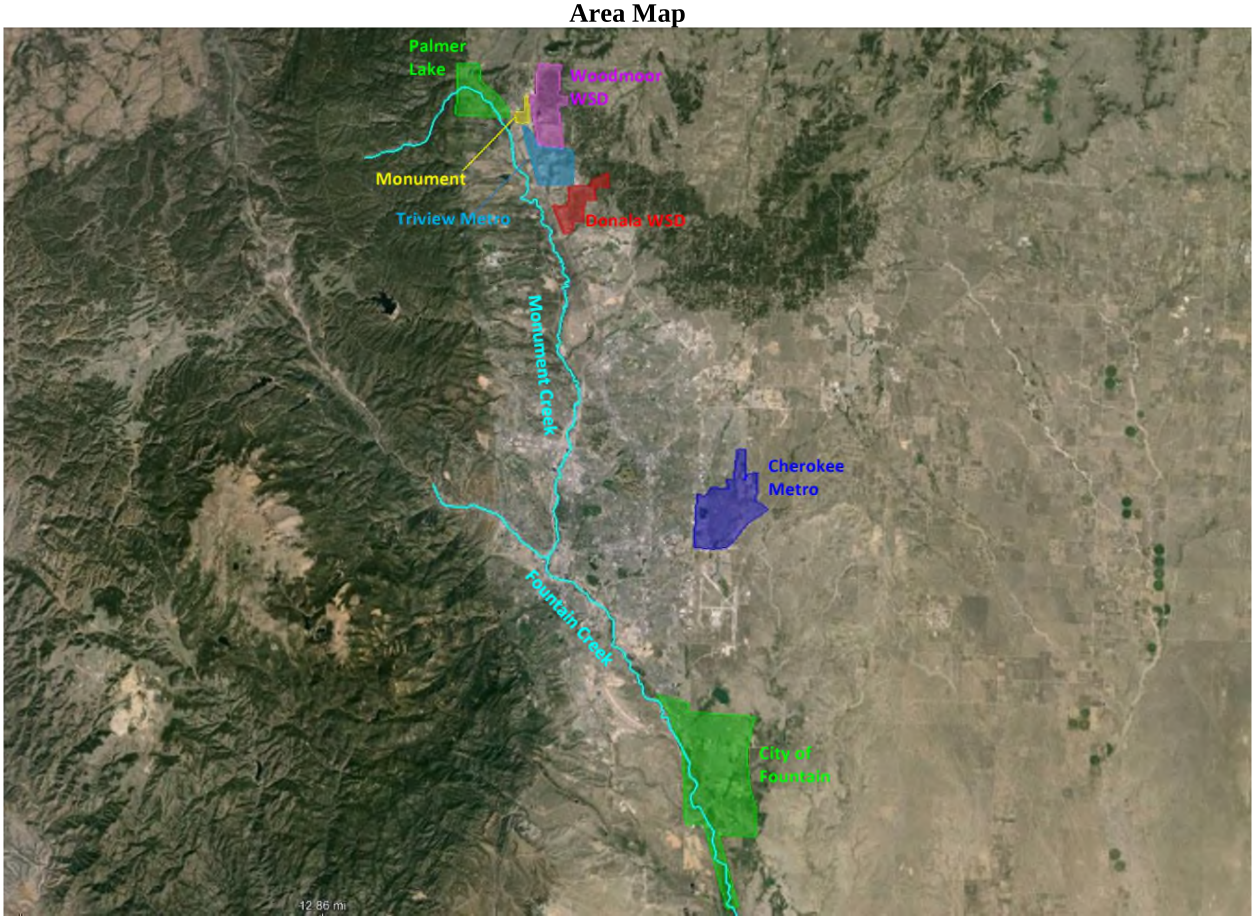
Existing and Planned Infrastructure that could benefit PPRWA regionalization partners: None

CHAPTER 5
COMMON PRIORITIES AND REGIONAL PARTICIPATION

5.1 GENERAL

Forsgren Associates met individually with each project participant to discuss their existing infrastructure system, current and expected demands, and plans for expansion of their infrastructure system. Information obtained from these meetings was important in establishing current and proposed infrastructure that could potentially support the regional system, identifying needs specific to that agency, and establishing a capacity need for conceptual planning of the regional infrastructure system. Table 5-1 presents a summary of the findings of these discussions. Figure 5-1 shows the location of each of the participants.

Figure 5-1
Area Map



5.2 PARTICIPANT DEMANDS AND INFRASTRUCTURE

Table 5-1 presents participant infrastructure that could support the implementation of the regional infrastructure project. This table is followed by a more detailed discussion of each participant's potential role in the regional project.

Table 5-1
Participant Details

Participant	Supply needs	Existing/Planned Infrastructure that could support PPRWA system	Potential PPRWA Infrastructure needs
Palmer Lake	Replacement of Denver Basin supply	**Existing** Denver Basin	Raw water supply Area 1, 2, and 3 storage Raw water conveyance
Monument	Replacement of Denver Basin supply Increased demand	**Existing** Denver Basin	Raw water supply Area 1, 2, and 3 storage Raw water conveyance Surface water treatment Treated water conveyance
Woodmoor	None	**Existing** Calhan Reservoir Denver Basin **Planned** Area 2 storage Area 2 to Area 3 conveyance Surface water treatment	Area 2 and 3 storage Raw water conveyance Surface water treatment Treated water conveyance
Triview	Replacement of Denver Basin supply Increased demand	**Existing** Denver Basin	Raw water supply Area 1, 2, and 3 storage Raw water conveyance Surface water treatment Treated water conveyance
Donala	Replacement of Denver Basin supply Increased demand	**Existing** Denver Basin **Planned** Area 2 storage Area 2 to Area 3 conveyance Surface water treatment	Raw water supply Area 1, 2. And 3 storage Raw water conveyance Surface water treatment Treated water conveyance
Cherokee	Replacement of Denver Basin supply Increased demand	**Existing** Denver Basin Sundance Pipeline **Planned** Area 2 to Area 3 conveyance Surface water treatment	Raw water supply Area 1 and Area 2 storage Raw water conveyance Surface water treatment Treated water conveyance
Regional Participants	Replacement of Denver Basin supply Increased demand	**Existing** Denver Basin	Raw water supply Area 1 and Area 2 storage Raw water conveyance Surface water treatment Treated water conveyance
Fountain	Increased demand	**Planned** Area 2 storage	Area 1 storage

5.3 ENTITY PARTNERING OPPORTUNITIES

This section provides a summary of facilities that are currently owned by PPRWA participants that could potentially be integrated into the regional system, listed in Table 5-2 below. While Woodmoor owns Calhan Reservoir, its existing storage capacity is far below the needs of the regional project and substantial rehabilitation would be necessary. The City of Fountain owns the LaFarge gravel pit, so there is a potential for economic benefit in the collaborative development of storage at this site.

The primary benefit of these facilities could be realized in project phasing. For example, if interconnectivity among the project participants is established, there is a potential to share Denver Basin supplies while regional projects are implemented. Alternatively, these supplies could be used as emergency or back-up supplies if Arkansas River supplies are restricted during a dry year, or an emergency occurs within a participant's system. Also, Cherokee recently completed the Sundance Pipeline delivering new supplies from its Denver Basin wells in the Black Forest area to the Cherokee service area. This pipeline (or a parallel line in that corridor) could be utilized to deliver supplies north, or as an interim supply to Monument area utilities if a new connection is established.

Table 5-2
Partnering Opportunities

Facility	Participant Ownership	Description	Support Mechanism
Sundance Pipeline	Cherokee MD	24" DIP	Pipeline could potentially be repurposed as a bidirectional pipeline supporting the PPRWA needs, or a parallel pipeline could be added.
Calhan Reservoir	Woodmoor WSD	674 AF reservoir	Potentially expand the reservoir to meet WWSD and other PPRWA participant storage needs in Area 2.
Fountain Gravel Pits	City of Fountain	Existing gravel pits	Partner with Fountain to develop raw water storage to meet Fountain and other PPRWA participant storage needs in Area 2.
Monument Lake	Town of Monument	300 AF reservoir	Potentially used to facilitate exchanges for northern participants.
Denver Basin Wells	-	Non-renewable groundwater supplies	Denver Basin supplies may be considered to meet interim demands until proposed facilities are activated, or as a back-up supply during drought conditions when exchange opportunities are reduced.

5.4 ENTITY NEEDS WITHIN REGIONAL SYSTEM

Participant needs within the overall regional system vary. Table 5-3 below presents the likely needs of each participant for each facility component. Participant needs generally depend on where they are physically located within the system. Another factor is existing surface water treatment capacity. While the basis of cost presented later in this Study includes a regional treatment facility, participants may choose to upgrade existing treatment processes to include advanced treatment. Entity facility needs, and capacities within each of these facilities will require further analysis related to each participant's cost share in the overall funding of the regional system.

Table 5-3
Entity Needs

Participant	Area 1	Area 2			Area 3			
	Storage	Storage	South Convey.	North Convey.	Raw Convey.	Raw Storage	Water Treatment	Treated Convey.
Town of Palmer Lake	•	•	•	•	•	•	tbd	tbd
Town of Monument	•	•	•	•	•	•	tbd	tbd
Woodmoor WSD		•	•	•	•	•	tbd	tbd
Triview	•	•	•	•	•	•	tbd	tbd
Donala WSD	•	•	•	•	•	•	tbd	tbd
Cherokee MD	•	•	•					
Regional Participants	•	•	•					
Fountain	•	•						

5.5 SUMMARY

The collective need for the PPRWA participants to secure new, renewable supplies to replace declining Denver Basin supplies and/or meet future demands supports a collaborative approach to water supply development. With no proximal renewable supplies for these providers, they each must look at importing and exchanging from long distances to meet their water supply needs. From an economic standpoint, it is much more cost-effective to approach importation projects together. This also provides reliability benefits in that the ultimate system would allow interconnectivity among the participant systems.

Each provider will have a distinct capacity need in the proposed system, based on estimated supply shortfalls in 2035 and 2050. Each provider also has a varying need for each facility that makes up the overall system. Fountain, for example, has an interest in storage in Area 1 and a partnership interest in Area 2 storage at the Fountain Gravel Pits. They would not have a need for the conveyance facilities that would send water to the Monument-area utilities. The Monument-area utilities, conversely, would have an interest in all of the storage, conveyance, and treatment facilities associated with the regional system. In a future phase of study, it will be necessary to update each participant's capacity and facility interest in the system to provide an appropriate, equitable sharing of costs for the overall system.

The potential to integrate providers' current and planned infrastructure into the regional system is somewhat limited. The primary opportunities are the potential to partner with Fountain in Area 2 storage and a potential repurposing or paralleling of CMD's Sundance Ranch Pipeline as a possible south to north conveyance option. Participants' rights to Denver Basin groundwater could offer the benefit of providing an interim supply during project implementation or as back-up supply during future operation. This approach would be contingent upon providing interconnectivity among the participants' systems.

Although Colorado Springs Utilities (CSU) is not a participant in the proposed regional system, there is an opportunity for participants to acquire capacity in any of CSU's SDS facilities, or join them to develop future facilities. CSU has expressed interest in supporting a regional effort, and is open to the idea of partnering with regional participants on specific elements (e.g. storage) as opportunities are identified. One important consideration, however, is that CSU will not be involved with a project that includes conveyance or storage of Arkansas Basin water outside of the basin.

It should be noted that participation in SDS to any degree may trigger a host of requirements, including NEPA permit compliance and US Bureau of Reclamation conveyance and storage requirements. Conditions of Pueblo County's 1041 Permit would also require participating with CSU in developing some means of stormwater management.

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CHAPTER 6
WATER EXCHANGE OVERVIEW

6.1 GENERAL

Using the proposed Regional Infrastructure Project, new, renewable water supplies to meet future supply deficits could be delivered from the Arkansas River, possibly by exchange. These supplies could be obtained through the acquisition of new water rights off of the Arkansas River.

Because the water rights exchange is such an integral part of the regional system, it is described herein as Chapter 6 to provide the necessary background for discussion of Alternatives Development in Chapter 7. This overview simply describes the mechanics of how an exchange would work, however, there are political challenges to moving large blocks of water from agricultural to municipal use that cannot be underestimated. The participants will need to give careful consideration to how this can be accomplished, possibly through alternative transfer methods such as rotational fallowing.

For an irrigation water right, the diversion would only occur during the summer irrigation period, the actual terms of which would be specific to the water right acquired. Assumed terms for exchange periods are based on work performed by W.W. Wheeler and Associates, "Fountain Creek Water Exchange Analysis", dated October 10, 2014 (Wheeler Report). All discussion of proposed water right acquisition terms and conditions is based on findings of the Wheeler Report. This report is provided in Appendix D.

Wheeler evaluated the conditions of representative water rights of approximately 10,000 AF during normal and dry-year conditions. Providing this 10,000 AF exchange is the basis of this evaluation. This study and the Wheeler Report also make reference to a 20-cfs exchange and a 20-cfs diversion rate at Fountain Creek. However, the 20-cfs reference is not intended to represent a defined diversion from the Arkansas River. Rather, it was determined that a variable rate diversion program at Fountain Creek that diverted up to 20 cfs during the non-irrigation season could meet the 10,000 AF need. Similarly, this analysis does not assess specific water rights and the related requirements for acquiring and utilizing new water rights. The intent of this study is to illustrate that an exchange program can be developed to meet participant's needs.

6.2 EXCHANGE OVERVIEW AND ASSUMPTIONS

Under the concept of a "water exchange", water is diverted at a specific location and an equal quantity of water is released at an alternate location to meet the needs of other users along the water body. This exchange must avoid injury to other users between the exchange locations and requires a baseline surface stream flow at all locations along the exchange. The exchange configuration presented in this report assumes an exchange between water rights acquired and stored off the Arkansas River east of Pueblo with water diverted and stored off of Fountain

Creek near the City of Fountain. This assumption avoids the need for approximately 40 miles of pipeline conveyance and is consistent with conclusions reached in prior studies that conveyance from Area 1 to the north is cost-prohibitive. The assumed water would be a fully consumable right, and may need to be converted to a municipal water right.

The proposed exchange consists of two components. The first component is the exchange of water from Area 1 storage (assumed to be Stonewall Springs) to the confluence of the Arkansas River and Fountain Creek. In this component, the exchange-from point is the Excelsior Ditch turnout from the Arkansas River. The exchange-to point is the confluence with Fountain Creek. The second component consists of the exchange from the Arkansas River confluence in Fountain Creek to the proposed Fountain Creek turnout to Area 2 storage. Although both components are discussed separately, they would essentially operate as a single exchange between the Arkansas River and Fountain Creek. There is no identified injury between the Fountain Creek turnout and the Arkansas River turnout.

The exact exchange mechanism will depend on the water right acquired, but generally assumes two phases throughout the year.

6.2.1 Phase 1 (Summer)

Arkansas River

During the summer period, diversions would be permitted off of the Arkansas River according to the irrigation schedule of the acquired water right if that applies. Additionally, there must be sufficient minimum flows in the Arkansas River at the diversion point. It is generally assumed that diversions may occur between May and September based on review of historical diversions during a dry period for a representative water right.

Fountain Creek

Diversions off of Fountain Creek do not need to follow an irrigation schedule; they are only subject to minimum flows within the creek. It is conservatively assumed that between June and September diversion off Fountain Creek will be restricted. During June, August, and September, diversions would be limited to 10 cfs. During July, flows off Fountain Creek would be completely restricted. This is conservatively based on review of an historic dry-year period. During a normal year, there may be no restrictions to diversions off Fountain Creek.

6.2.2 Phase 2 (Winter)

Arkansas River

During the winter, there are no diversions permitted off the Arkansas River because it is outside of the irrigation period. There will be some discharge out of Area 1 required to account for the portion of historic irrigation flows that would have eventually flowed back into the Arkansas River beyond the irrigation period.

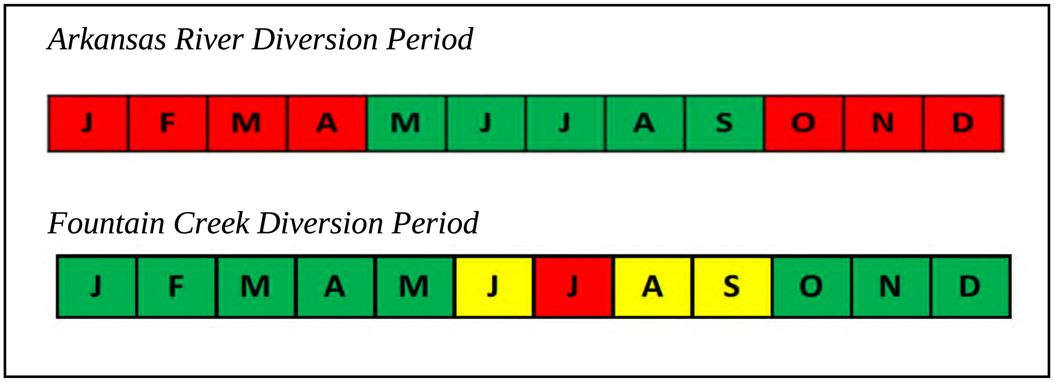
Fountain Creek

Based on review of historic stream flows it is assumed there will be sufficient base flow to permit the 20 cfs diversion rate which our analysis assumes will be available during this period.

6.2.3 Diversion Periods

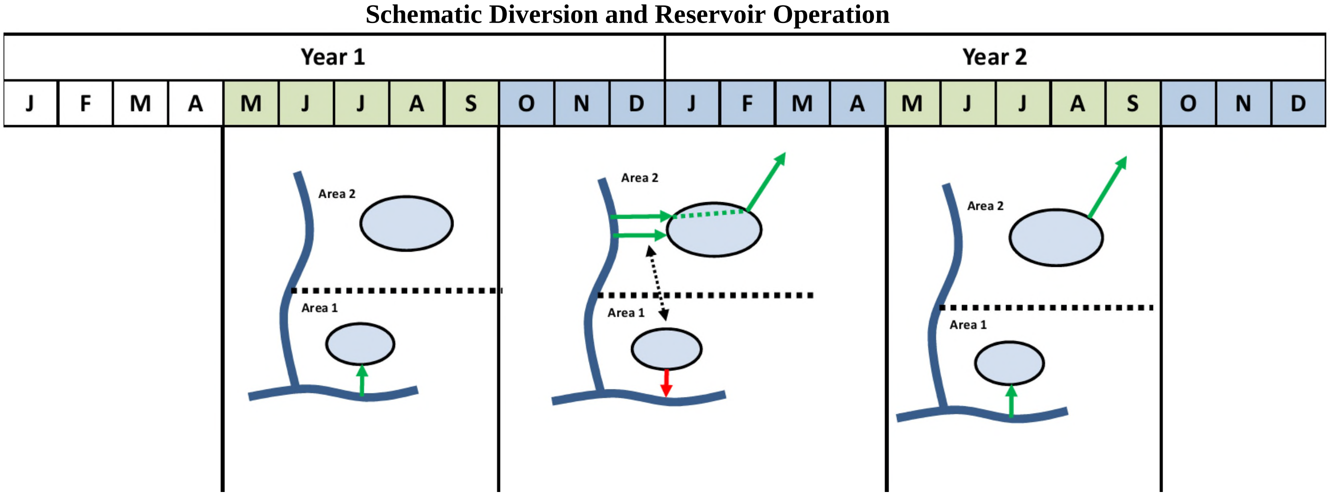
Figure 6-1 below presents the assumed diversions periods off the Arkansas River and Fountain Creek. These fill and diversion periods will dictate storage requirements, and fill and discharge capacity requirements.

Figure 6-1
Diversion Periods



Based on this exchange schedule, the assumed reservoir operation is to fill Area 1 storage during the Year 1 irrigation period. Once the irrigation period ends, water will be discharged out of Area 1 in exchange for water diverted off Fountain Creek in Area 2. During the winter months, these diversions include the pass-through quantity to meet ongoing winter demands, and the Area 2 reservoir fill quantity to meet summer demands when diversions off Fountain Creek are not permitted. During the following summer in year 2, water is being diverted out of Area 2 storage to meet participant demands and water is again diverted off of the Arkansas River to fill Area 1 storage. Ensuing operational years follow this same pattern. During years when diversions off Fountain Creek are restricted, the maximum permitted quantity will be taken. Carryover storage, interim or back-up supplies will be necessary to make up the deficit to meet participant demands during this period. Reservoir operations are presented schematically in Figure 6-2**.**

Figure 6-2
Schematic Diversion and Reservoir Operation



6.3 REGULATORY REQUIREMENTS AND WATER ACQUISITION PROCEDURES

Water rights along the Arkansas River decreed for irrigation use can be changed to municipal use, subject to Water Court approval. This change of use is contingent upon the municipal not exceeding the historical consumptive use of the right. Estimating the historical consumptive use of a specific water right takes into consideration the historical diversions, irrigated acreages, irrigation practices, soil types, aquifer parameters, crop types, and irrigation requirements specific to the decree of the water right to be acquired.

There are numerous decreed exchange appropriations along the Arkansas River. Most of these are arranged for storage in Pueblo Reservoir, located approximately seven miles upstream of the confluence with Fountain Creek. The controlling stream reach for those exchanges is this seven-mile reach between Pueblo Reservoir and the Fountain Creek confluence. That segment includes exchange limitations that require minimum flows for the following purposes:

- Recreational in-channel diversion right for the City of Pueblo
- A multi-party Flow Management Agreement for maintenance of river flows

River flow between Stonewall Springs and the Fountain Creek confluence is never the limiting factor in exchange availability. Therefore, the numerous decrees supporting storage in Pueblo are not in competition with the proposed exchanges for the PPRWA participants.

6.3.1 Water Right Acquisition Procedure

Due to the numerous existing Arkansas River appropriations, any new water acquisition would be so junior that it would rarely yield any supplies for the PPRWA users. The last free-river flow condition occurred in 1999. Therefore, to obtain reliable supplies off the Arkansas River, it would be necessary for the PPRWA participants pursue acquisition of water rights with a consumable portion meeting the supply needs for the participants.

6.3.2 Water Right Negotiation and Purchase

Acquisition of the water right is a party-to-party transaction and occurs outside the court system. The first task in acquiring the water right is to research available rights and begin negotiations with the owner(s) to purchase rights that best suit the PPRWA participant needs in terms of water right seniority and the fully consumable quantity of that right. Once the negotiation(s) is complete and a contract is executed, a change of water right from irrigation to municipal use may need to be executed. In addition, a right of exchange must be executed to authorize the exchange of water from the Arkansas River to the Fountain Creek diversion.

6.3.3 Water Court Procedure

There are two legal proceedings required to authorize the acquisition and exchange of water off the Arkansas River, 1) Change of Water Right, and 2) Right of Exchange. The change of water right and right of exchange process begins with the preparation of an application to be submitted to the water clerk. Since both of the actions are for a common purpose it is likely they can be combined into a single application. The original water right would be an existing irrigation right that would be converted to municipal use in this case. The exchange will be between the Arkansas River east of Pueblo, and Fountain Creek near the City of Fountain.

Information to be submitted and considered by the Water Court as part of this application includes documentation of how much water was historically used under the water right, how the water will be used under the proposed change, and proof of absence of injury to other water rights. Early in the case, the application should be supported by an engineering analysis justifying the historical consumable use and lack of injury under the changed use of water right. It is the applicant's duty to present and prove to the Water Court the historical beneficial consumptive use and absence of injury for the changed water right.

Once the application is submitted it will be published for public review. This is followed by a 60-day review process where parties may file statements of opposition. Following this review period the application and opponents statements will be submitted to the water referee for review. The water referee, without conducting a hearing, will review the application and opponents statements and determine whether the application should be granted or denied, in part or in whole. If the referee makes a ruling, it is subject to review by the water judge. Any person may file a protest to a referee's ruling within 20 days of the mailing of the ruling. If no protest is made within 20 days, the ruling will be made a judgment and decree of the water court, unless the water judge finds the ruling contrary to law. If not, the judge will also sign the ruling and the decree will go into effect.

If an application is heavily contested, the water referee may refer the application directly to the water judge for a ruling. In this case, the water judge will hold a hearing or trial to determine the merits of the application. Given the quantity and location of the change of water right, it is reasonable to assume that the proposed change of water would be brought forth in front of the water judge.

6.4 ARKANSAS RIVER DIVERSIONS

Wheeler prepared a representative monthly pattern of typical consumptive use credits for a fully consumable water right converted to municipal use. Upon change of the water right, conditions would generally require some amount of winter return flow to account for lagged groundwater return flows that would otherwise flow from the irrigated fields back into the Arkansas River. This return flow must be accounted for in the sizing of Area 1 storage. Figure 6-3 presents a representative monthly flow pattern for the example of an irrigation water right off of the Arkansas River. Given the small percent of total for the months of April and October, it was assumed that the diversion period is May through September.

Review of prior 20 years of historical data found that the minimum daily flow rate in the Arkansas River near the proposed turnout was 87 cfs. This occurred at the nearby Avondale gage. Typical daily flows at this gage have nearly always exceeded 180 cfs. As previously explained, there are no significant competing diversions in the reach between the Fountain Creek confluence and Stonewall Springs. Therefore, it is reasonable to assume that up to 40 cfs diversions would be available at all times during the irrigation period provided in the figure below.

Figure 6-3
Representative Arkansas Water Deliveries

Water Deliverable to the Arkansas River Reservoir Expressed as a Percentage of the Annual Total
(Negative numbers indicate winter return flow release requirement)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
-2	-1	0	6	18	26	26	19	12	3	-4	-3	100

Table Courtesy of W.W. Wheeler and Associates

6.4.1 Reduction During Dry Years

Typical irrigation rights along the Arkansas River will be reduced during dry years by competition among the rights due to the reduced stream flow and the seniority of that right. A typical reduction in available diversions during a dry year was estimated based on historic review of diversion records for the Bessemer Canal and Catlin Ditch. These are two large irrigation systems along the Arkansas River with moderate and senior water right conditions. Diversion records for these systems was reviewed for the prior 50 years and found that the most critical dry-year period for these rights occurred between 2002 and 2006.

For the combined systems, the average reduction in yield during the dry-year period is presented in Figure 6-4.

Figure 6-4
Dry Year Reductions Off Arkansas River

Diversions as a Percentage of the 50-Year Average Annual Total

2002	2003	2004	2005	2006
46%	63%	76%	98%	89%

Table Courtesy of W.W. Wheeler and Associates

Under this scenario, a 10,000 AFY consumable water right would have only yielded 4,600 AFY in 2002. In 2005, the yield would have been 9,800 AFY. So during this dry period, yields were never below 46 percent, but also allotted nearly the full yield only once. Average yield during this dry year period was 74 percent.

Various options may be considered to address reduced yields during dry years:

- Oversize the raw water reservoirs to account for carryover storage.
- Increase the quantity of water acquired
- Keep Denver Basin wells on standby as a back-up supply

For the purposes of facility sizing presented in this report, it was assumed that some carryover storage would be considered in sizing those facilities. In addition, drought-year reductions could be addressed through alternative supplies, acquisition of a larger water right, or demand reductions. Acquisition of a larger water right will increase the overall project cost.

6.5 FOUNTAIN CREEK DIVERSIONS

For the exchange analysis off of Fountain Creek, we assumed that the nominal volume of 10,000 AF could be exchanged based on a 20-cfs rate of diversion between October and May to meet ongoing demands and fill Area 2 storage. The analysis also assumes there would be a zero-flow restriction for one month (July), and limited restrictions to 10 cfs for up to three months, June, August, and September. This was the restriction scenario that was assumed for facility sizing.

Historically, Fountain Creek was an intermittent stream, with dry-stream conditions caused by limited natural flows during drought, municipal and irrigation diversions, and seepage due to sandy streambed conditions. With the growth in Colorado Springs, wastewater discharge and urban runoff have resulted in Fountain Creek becoming nearly a perennial stream. Based on review of stream gauge data and consultation with Water Commissioner Doug Hollister, the lowest recorded flow in Fountain Creek occurs at its confluence with the Arkansas River. For the purposes of the analysis and in consultation with Commissioner Hollister, Wheeler suggested that gauge readings below 15 cfs at the Fountain creek confluence with the Arkansas River represents the low point in which no upstream diversions off of Fountain Creek would be available for the PPRWA participants. Between 15 and 35 cfs flows, a 10-cfs diversion would be available, and flows above 35 cfs would allow for diversion of at least 20 cfs.

For general planning purposes used as the basis of facility sizing, Wheeler recommended the following exchange assumptions off Fountain Creek listed in Figure 6-5.

Figure 6-5
Fountain Creek Exchange

Year	Period of Zero Exchange	Period of 10 cfs Exchange	Period of Full 20 cfs Exchange
Extreme Drought Year 1	July	June, Aug, Sept	Oct - May
Extreme Drought Year 2	July	Aug, Sept	Oct - June
All Other Years		Aug	Sept - July

Table Courtesy of W.W. Wheeler and Associates

For the purposes of this study, a worst-case condition was assumed that would prevent diversions off of Fountain Creek in July, and limit diversions to 10 cfs during June, August, and September.

6.6 DIVERSION AND EXCHANGE QUANTITIES

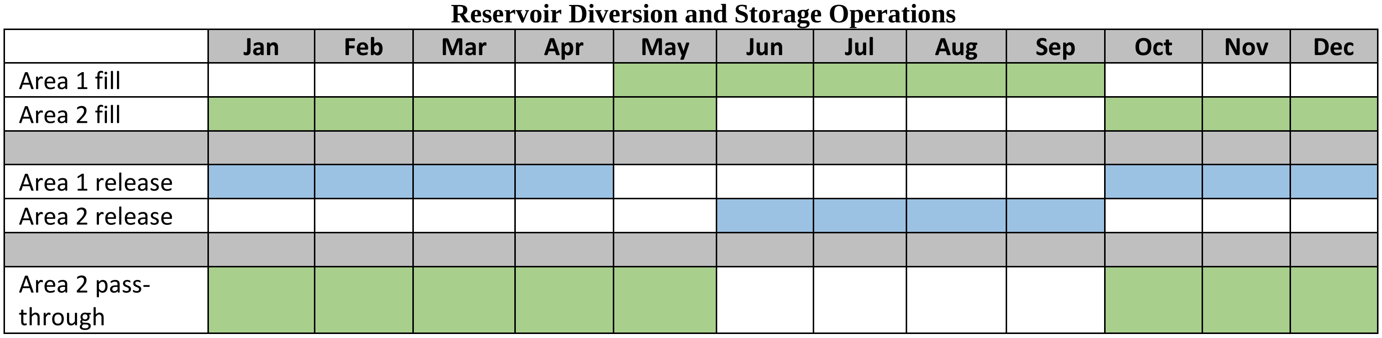
Diversions off of the Arkansas River into Area 1 storage must meet the entire project participants' demand during the remaining non-diversions periods of the year and account for evaporative losses (minus return flows and Woodmoor's existing water rights under the JV Ranch acquisition).

In Area 2, storage is conservatively sized to assume there are no diversions off of Fountain Creek in July, and 10-cfs diversions in June, August, and September. Therefore, this facility must be sized for the participants' remaining demand during this period (minus return flows). For the remaining months, diversions off of Fountain Creek are passed-through storage and are directly delivered to meet participant demands. All diversions off of Fountain Creek must be exchanged with discharges from Area 1 storage back into the Arkansas River.

Return flows assume 50 percent of water supply is consumed, and 50 percent is returned back to Monument Creek. Transit losses from the Monument area downstream to the Fountain Creek diversion is assumed at 0.5 percent per mile. Discharges from CMD and the proposed regional participants are not returned to Fountain Creek and are therefore not included in the calculation of return flows.

Figure 6-6 presents the annual diversion, fill, and release operations for Area 1 and Area 2 storage.

Figure 6-6
Reservoir Diversion and Storage Operations



6.7 SUMMARY

Based on the preliminary assessment of water exchange opportunities, there appears to be sufficient flow available to allow for exchange from the Arkansas River to meet the PPRWA participant needs. Given the quantity of water necessary, this would likely require multiple water rights acquisitions and it is anticipated that these acquisitions may be completed by individual entities. As such, a critical part of regional cooperation and a governance structure will be establishing a mechanism for cooperative use of water rights, and the operation of infrastructure to utilize the water rights. Once a governance structure is established for project implementation, it is recommended to begin research and negotiations to acquire rights. As contracts for water purchases are executed, it is recommended to prepare and submit applications to the Water Court for changes of use and water exchange decrees. These applications should be supplemented with an engineering analysis fully describing the acquired right and justifying the consumable use for each water right acquired. It is expected that the Water Court process will take approximately five years to complete.

New supplies off the Arkansas River would be exchanged with diversions off of Fountain Creek, near the City of Fountain. There are limitations on when these diversions can occur. For the Arkansas River, diversions must occur during the irrigation period for an irrigation right. This occurs during the summer months and, for the purposes of this study, was assumed to occur May through September. For Fountain Creek, limitations on when diversions can occur are based on minimum flow rates in the creek. Reviewing historic creek flow during a dry-year period indicated that diversions may be restricted completely during July, and limited to 10 cfs during June, August, and September. It is expected that diversions of up to 20 cfs would be available for the remainder of the year.

When considering an exchange, it is important to clearly consider participant objectives and potential risks. The Wheeler Report identifies that the potential for exchange exists, and it provides prudent cautions regarding decision making based on the current potential. For example, the report points to the fact that Fountain Creek was historically an intermittent stream, and notes that development within the drainage has modified the hydrology of Fountain Creek such that it is almost a perennial stream. As such, there is the potential for changes in urban water resources management to affect exchange potential. Other risks such as climate change are noted. When considering these risks it is important to keep in mind that:

- The participating entities determined that access to a renewable water source is a critical objective of this regional study. Risks associated with hydrologic change on Fountain Creek or any other renewable water source will be inherent with renewable water as a primary water source.
- The proposed exchange appears to be the most reasonable access to a renewable water source as an alternative to supply through the SDS.

The success of the regional system is not based on a single means of delivery. If the potential exchange does not provide the required water supply, the proposed infrastructure could be integrated with some components of the SDS pipeline. While it is the intent of the report to document a potential stand-alone regional system, it is not the intent to rule out other water supply options. The project should be phased such that as the infrastructure is being put into place, the ultimate water supply source is carefully examined and the best delivery option that meets the region's needs is selected.

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CHAPTER 7
ALTERNATIVES DEVELOPMENT

7.1 GENERAL

The purposes of the regional system are to provide the infrastructure to: (1) allow more efficient use of existing supplies; and (2) supply, store, convey, possibly treat, and deliver new, renewable supplies from the Fountain Creek system and as far away as the Arkansas River to the PPRWA participants. This section describes the physical system needed to accomplish those purposes.

7.2 SYSTEM OVERVIEW

Under the proposed scenario described in Section 6, new water supplies may be obtained through the acquisition of water rights off of the Arkansas River for exchange to the Fountain area. Water diverted from the Arkansas River could be stored in a new reservoir off the Arkansas River, east of Pueblo. Water stored in this reservoir would be used as exchange for water diverted and stored near the City of Fountain. This exchange mechanism would serve as a viable alternative to participation in SDS, and would save substantial cost by avoiding the need for approximately 40 miles of conveyance pipeline and associated pumping facilities.

New diversion and storage facilities in the Fountain area off of Fountain Creek will provide the physical water supply for the PPRWA users. From this new storage facility, raw water will be pumped and conveyed north to the PPRWA users in the Monument area. Treatment requirements will be based on Fountain Creek water quality since that is the physical water that will be delivered to the end users. Water quality in Fountain Creek will vary considerably throughout the year. During much of the summer, the base flow in the creek is primarily CSU effluent. During other times of the year, it is a mix of CSU effluent and surface runoff.

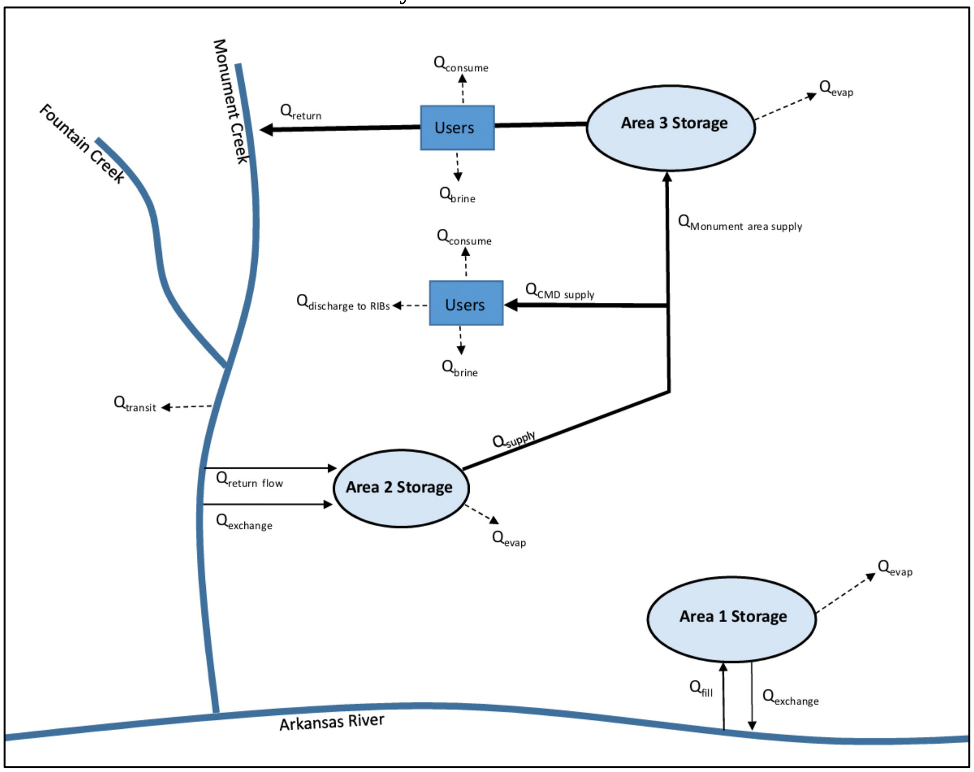
An intermediate turnout from these conveyance facilities will provide supply to CMD and the anticipated regional participants in the Falcon and Peyton area. These conveyance facilities will terminate at a new raw water storage reservoir in the vicinity of Black Forest. This water could then be treated and delivered to a main trunk line in the Monument area.

The project area extends into Pueblo County, where the Arkansas River storage facility would be located. But the primary project area is in western El Paso County, from the Fountain area north to the Palmer Divide near Monument. Based on functionality and geographic proximity, the project area is subdivided into three distinct areas (See Appendix B, Figure 2):

Area 1 – Arkansas River east of Pueblo
Area 2 – Fountain Area to Black Forest
Area 3 – Black Forest to Palmer Divide

Figure 7-1 presents the system schematic of the regional system.

Figure 7-1
System Schematic



The following sections describe the alternatives considered for facility needs in each area. This is primarily driven by the siting of storage reservoirs in Areas 1, 2, and 3. Alternative alignments were considered to convey water from Area 2 to Area 3. Consultation and input from the project participants suggested that developed areas around Colorado Springs should be avoided. Therefore, an overland alignment in undeveloped areas east of Colorado Springs was selected as the base alignment.

Two alternatives are considered for treating raw water off of Fountain Creek. One alternative is to place the treatment facility in Area 2. In this scenario, treated water would be delivered to operational storage in the Monument area. The second alternative is to move raw water to a new reservoir in Area 3 sized for seasonal storage. In this scenario, treatment facilities would be sited in Area 3 adjacent to the new reservoir. In either alternative, it is assumed that a new treated water trunk line would be constructed through a main corridor in the Monument area.

The basis of cost presented in this report assumes seasonal storage and regional treatment in Area 3. This alternative represents a more favorable phased approach as a near-term use exists for conveyance and storage in Area 3.

The fact that alternatives developed in this study are based on generalized routes and sites identified in existing studies should not be interpreted to mean that these are the only routes and sites that will be considered in future development of the regional infrastructure. This study focused on assessing feasibility. To that end and as directed by project participants, this study does not identify new sites for reservoir or treatment facilities, nor does it include a detailed evaluation of all possible conveyance routes. The study simply identifies a feasible system. As further study is conducted to define the infrastructure, other routes and sites will be considered if they can improve functionality or reduce project cost.

7.3 AREA 1 FACILITIES

The Area 1 facilities include a new raw water reservoir, inlet and outlet connection facilities to the Arkansas River, and potential modifications to the Excelsior Ditch for the Stonewall Springs alternative.

Three alternatives were considered for Area 1 storage off the Arkansas River: new reservoir development at Stonewall Springs, new reservoir development at East Reservoir Sites, and leasing of storage at Pueblo Reservoir. Table 7-1 presents a summary of these findings. Appurtenant facilities include reservoir fill, return, and overflow facilities to the Arkansas River.

Table 7-1
Area 1 Storage Options

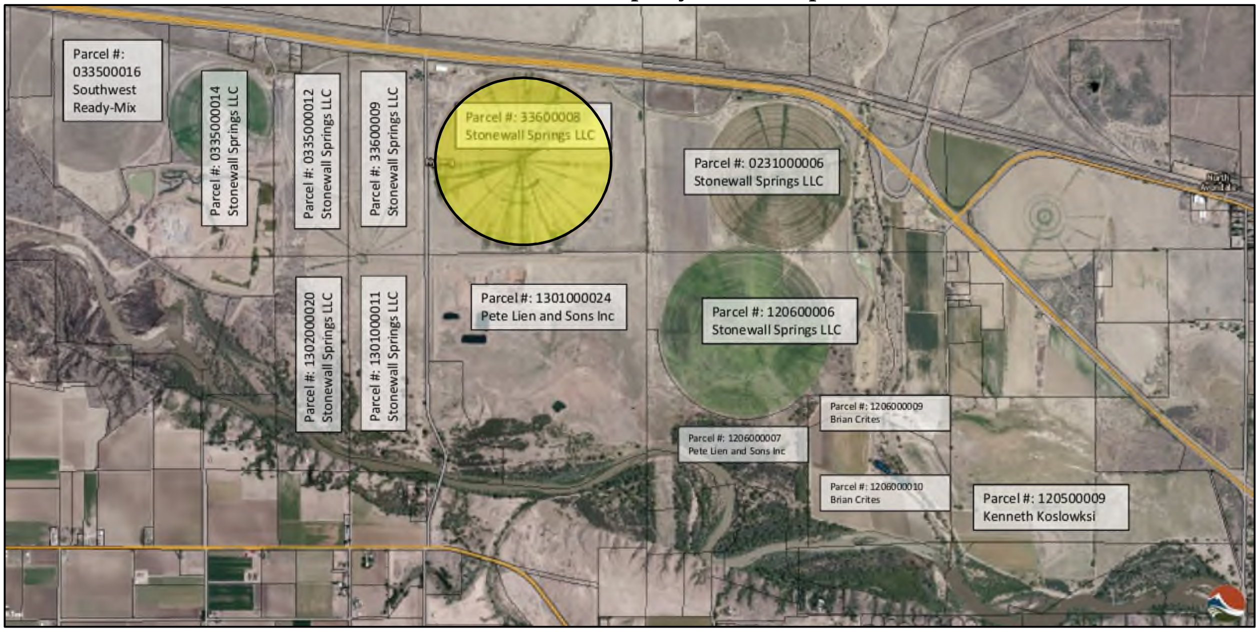
Alternative	Implementation Plan
Stonewall Springs	
Reservoir	*Undeveloped land that could be co-developed through mining operation converted to reservoir storage*
Fill facilities	*Modifications and reuse of Excelsior Ditch and head gate. Gravity influent flow.*
Return facilities	*New facilities from proposed reservoir to Arkansas River. Additional land may need to be purchased from separate landowner. May need to pump a portion of flows*
East Reservoir	
Reservoir	*Current mining operation ongoing. Convert to reservoir storage following completion of mining operation.*
Fill facilities	*New intake facilities off Arkansas River. Will require pumping*
Return facilities	*New facilities from proposed reservoir to Arkansas River. Will require pumping*
Pueblo Reservoir	*Lease existing storage within Pueblo Reservoir. No new facilities required.*

7.3.1 Stonewall Springs/Excelsior Ditch Reservoir Site

Property Owners	Stonewall Springs LLC; Pete Lien and Sons, Inc; Southwest Ready-Mix
Reservoir Type	Gravel Pit restoration. Lined gravel pit with earth embankment
Current Status	Undeveloped land. Potential arrangements could be made with property owners to consider a joint-use site development including gravel mining with conversion to a water storage reservoir.
Fill and Return Infrastructure	Arkansas River via gravity feed through existing Excelsior Ditch. Arrangements to use the ditch will need to be made with ditch shareholders. Decreed and hydraulic capacities should be further evaluated to confirm suitability with proposed capacity needs. New return infrastructure will need to be constructed and may require pumping depending on operational depths of the proposed reservoir.

The Stonewall Springs site is an undeveloped parcel of land located approximately 10 miles east of Pueblo, between Highway 50 and the Arkansas River. The majority of the property in this area is owned by Stonewall Springs LLC, see Figure 7-2**.** Acquisition of additional land from a separate property owner, Pete Lien and Sons, may be required to facilitate the construction of new discharge facilities back to the Arkansas River.

Figure 7-2
Site Area and Property Ownership



Financial – The capital costs associated with this alternative include the development of a new reservoir, development of new fill facilities from the Excelsior Ditch, discharge facilities to the Arkansas River, and possible modifications to the Excelsior Ditch and head gate. Costs associated with the development of the reservoir may be shared with mining operations if a cooperative development agreement is established. Ongoing operating costs will primarily involve pumping return flows out of the reservoir back to the Arkansas River.

Prior studies prepared by Tetra Tech at Woodmoor's direction included a preliminary cost estimate for a reservoir at Stonewall Springs. This analysis looked at 2,600 AF of storage at a total cost of approximately $12 million.

Permitting – General construction activities related to reservoir development will require a 1041 Permit from Pueblo County. The State Engineer's Office (SEO) regulates water storage facilities throughout the state. Reservoirs that store water above natural ground surface and meet one of the following criteria are under SEO's jurisdiction: 1) water surface area greater than 20 acres, 2) water storage greater than 100 AF, or 3) normal high water surface elevation greater than 10 feet from the lowest point of natural ground. This proposed reservoir meets those criteria and therefore would fall under SEO jurisdiction. The reservoir will also need to meet the SEO leakage criteria for a water storage facility. Written approval from the SEO is required for a dam/embankment system for this reservoir.

There are two decrees associated with the Excelsior Ditch that allow diversions up to 60 cfs when in priority. The Arkansas Groundwater Users Associate (AGUA) is the majority shareholder of the ditch, owning 53 percent of the shares. Stonewall Springs LLC owns the remaining 47 percent. Modifications to the Excelsior Ditch for majority municipal purposes may result in the loss of the ditch's 404 Permit exemption for any required modifications to the head gate or ditch.

Ownership and Operation – The proposed reservoir and appurtenant infrastructure would likely be owned and operated by the PPRWA cooperative.

7.3.2 East Reservoir Site

Owner	Valco, Inc.
Reservoir Type	Gravel Pit restoration. Lined gravel pit with earth embankment.
Current Status	Ongoing mining operation. Consider agreement with mining operator to take over conversion, ownership, and operation of mining pits to a raw water storage reservoir.
Fill and Return Infrastructure	No existing infrastructure for fill and return facilities. New facilities required off the Arkansas River to divert and store flows in the new reservoir. Will require pumping for filling operations. New return facilities back to Arkansas River are required and will also require pumping.

The East Reservoir Site consists of an ongoing mining operation just north of the Arkansas River, approximately 4 miles east of Pueblo (see Figure 7-3).

Figure 7-3
East Reservoir Site

Financial – The capital costs associated with this alternative include the repurposing of an existing mining pit to raw water municipal storage and development of new fill and discharge facilities. Costs associated with the development of the reservoir may be shared with mining operations if a cooperative development agreement is established. Ongoing operating costs will primarily involve pumping fill and return flows into and out of the reservoir back to the Arkansas River.

There has been no detailed prior analysis on the estimated cost for development of this facility.

Environmental Compliance and Permitting – General construction activities related to reservoir development will require a 1041 Permit from Pueblo County. This proposed reservoir also meets the criteria for SEO jurisdiction. The reservoir will also need to meet the SEO leakage criteria for a water storage facility. Written approval from the SEO is required for a dam/embankment system for this reservoir.

Ownership and Operation – The proposed reservoir and appurtenant infrastructure would likely be owned and operated by the PPRWA cooperative.

7.3.2 Pueblo Reservoir

Owner	U.S. Bureau of Reclamation
Reservoir Type	Existing concrete and earthen dam
Active capacity	234,347 AF
Fill infrastructure	Arkansas River
Delivery infrastructure	SDS Pipeline
Operational Scenario	This alternative should be considered as a contingency plan in the event full system implementation is unsuccessful. Project participants may consider leasing storage within Pueblo Reservoir from USBR and potentially using excess capacity in SDS pipeline during off-peak periods.

Pueblo Reservoir has an overall capacity of 357,678 AF and active capacity of 234,347 AF. The facility is owned and operated by the U.S. Bureau of Reclamation (USBR). Prior work completed in 2010 (*Facilities Feasibility Study for Court Case 09CW140, Tetra Tech)* indicated storage contracts are available from the USBR on a year-to-year basis. Given the large quantity of active storage within Pueblo Reservoir, it is assumed there is sufficient available storage to meet the RIS supply requirements.

Financial – Storage within Pueblo Reservoir would be acquired under a lease with the USBR. Terms of such an agreement are beyond the scope of this study. However, a general search found that existing rates were approximately $200/AF. This is a present-year value and would certainly escalate through the planning period to 2050, and vary based on the quantity of storage acquired. Under a simple present value assessment through 2050 assuming a $200/AF rate, 3 percent annual discount, and conservatively assuming no escalation of the rate, the present value associated with this alternative is $18 million.

Environmental Compliance and Permitting – Pueblo Reservoir is a federally-owned facility and acquisition of a storage contract will likely trigger NEPA compliance. It is assumed that the project scope would not trigger the need for an EIS, but would require an EA and FONSI. This is primarily due to the small amount of storage that would be acquired relative to the active storage within the reservoir. It is also assumed that no significant modifications to existing infrastructure at the reservoir would be required. Since there are no substantial construction activities or material changes to the operation of Pueblo Reservoir associated with this alternative, a 1041 Permit requirement may not be triggered.

Ownership and Operation - Under a leasing system, project participants would not own the storage in Pueblo Reservoir and would be subject to the rates, terms, and conditions established by the USBR. There is an inherent risk in cost control through this arrangement, and it is in conflict with the substantial capital and ownership investment in all other facilities associated with this project in which PPRWA participants would retain ownership. However, such an arrangement does preserve the opportunity to utilize the existing SDS as a conveyance alternative. Potential conveyance capacity in SDS may be available in the near term without limitations on time of use. However, for long-term planning, it is anticipated that capacity is likely to be available only during off-peak periods.

7.4 AREA 2 FACILITIES

The Area 2 facilities would be needed to divert and store exchanged flows in the Fountain area, and convey that water approximately 20 to 30 miles into Area 3. An intermediate delivery point will provide water to project participants in Area 2 (Cherokee and Regional Participants). Facilities associated with downstream deliveries to Cherokee and the Regional Participants are not included as part of the project facilities presented in this report.

Conveyance facilities include pipeline, pump stations, and appurtenances (blow-offs, air vac/release, and, potentially, surge control facilities). Treatment facilities may also be considered for deliveries to Cherokee and regional participants. The termination point for Area 2 conveyance is a new storage facility within Area 3.

7.4.1 Storage

Prior studies identified various storage areas in Area 2 that were referenced for this analysis. These facilities include (listed from south to north):

- Calhan Reservoir (Existing)
- Fountain Gravel Pits
- Big Johnson Reservoir (Existing)

Table 7-2
Area 2 Storage Options

Alternative	Implementation Plan
Fountain Gravel Pits	
Reservoir	*Ongoing mining operation west of I-25 in the south Fountain Area.*
Fill facilities	*New fill facilities off of Fountain Creek.*
Big Johnson Reservoir	
Reservoir	*Approximately 5,000 AF existing reservoir (storage limited due to sediment accumulation. Design capacity approximately 10,000 AF)*
Fill facilities	*Existing FMIC Canal*
Calhan Reservoir	
Reservoir	*674 AF existing reservoir*
Fill facilities	*Existing Chilcott Ditch*

7.4.1.1 Fountain Gravel Pits

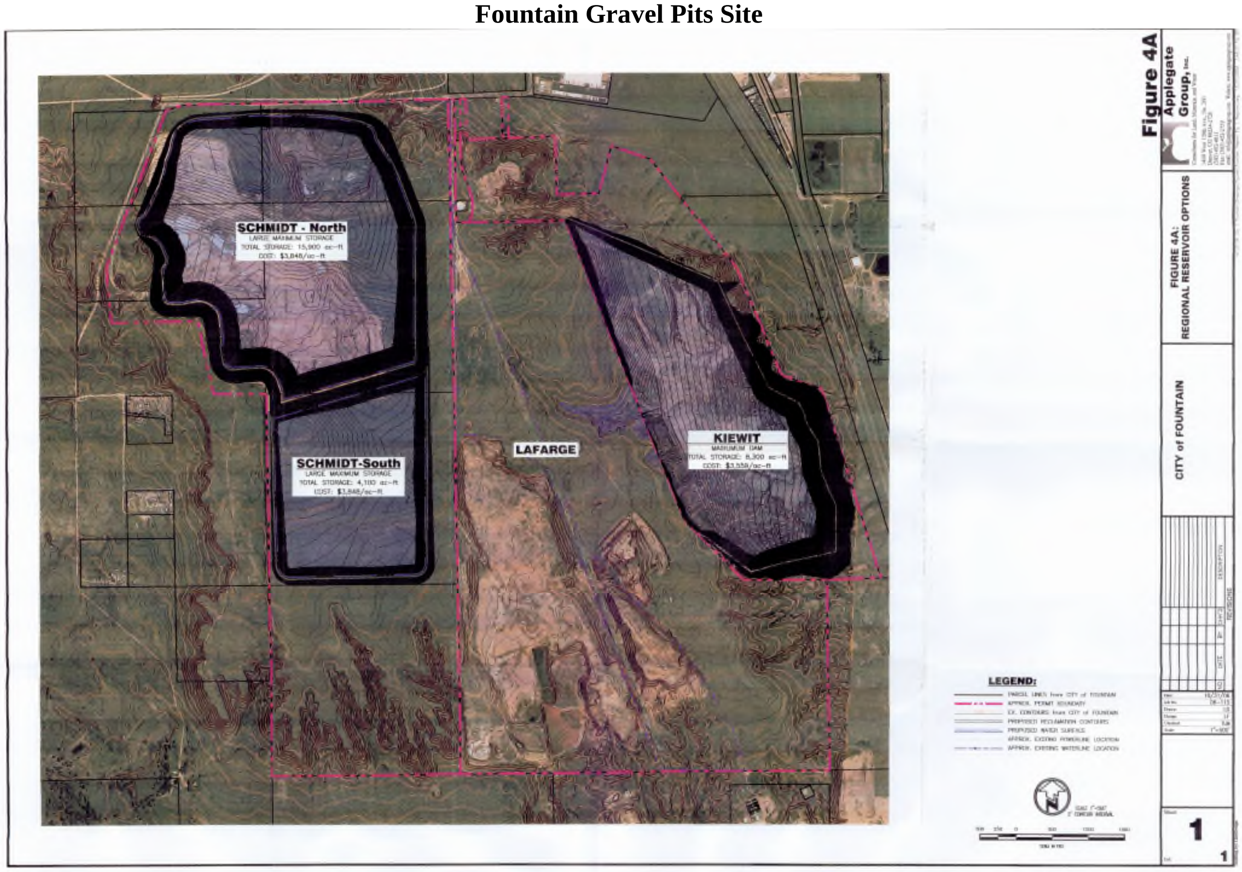
Owner	Schmidt Aggregates, Kiewit Corporation, Fountain (acquired LaFarge gravel pit in 2008)
Reservoir Type	Existing gravel pit to be repurposed for municipal supply raw water storage
Potential capacity	4,100 to 15,900 AF
Fill and Return Infrastructure	New diversion facilities off of Fountain Creek. Fill and return operations will require pumping.

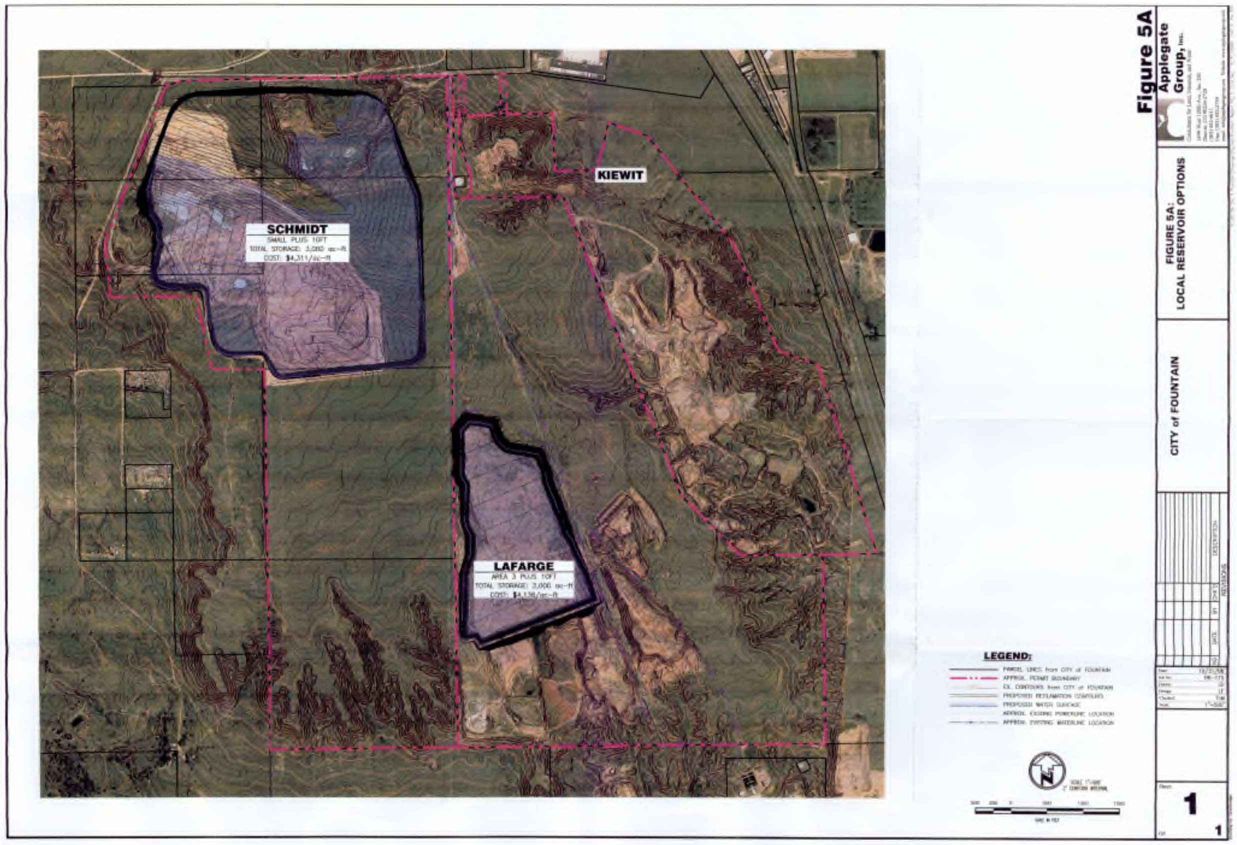
The City of Fountain previously investigated opportunities to convert existing gravel pits west of I-25 for reservoir storage. The initial investigation between 2006 and 2008 led to Fountain acquiring the LaFarge Pit (now Martin-Marietta Pit). At the time, the certainty of the SDS project was unknown and Fountain was proactively exploring options to develop new supplies. With the implementation of the SDS project, Fountain does not have specific near-term plans for gravel pit conversion to storage. They may look to a future use as augmentation water storage. Fountain's ownership of the pit presents a potential partnership opportunity to mutually develop storage at this site. PPRWA interests in partnering with Fountain would focus on oversizing Fountain's augmentation water storage to include raw water storage supporting the PPRWA regional infrastructure project.

Three gravel pit areas were considered during Fountain's 2006 investigation, all located adjacent to one another just west of I-25, in the southwest area of Fountain. The three pits are owned by Schmidt Aggregates, LaFarge, Inc., and Kiewit Corporation. Various reservoir configurations have been evaluated for the site, including at-grade reservoirs and reservoirs with dam embankments.

WWSD also considered storage at the Fountain gravel pits as part of its evaluation to secure renewable water supply off the Arkansas Reservoir. Findings of this evaluation were presented in the "Facilities Feasibility Study for Court Case 09CW1140", Tetra Tech, 2010. Under this study, a reservoir size of 2,000 AF was considered to meet WWSD's supply needs. This analysis suggested that a pumping system is required to move water off Fountain Creek to the new storage facility.

Figure 7-4
Fountain Gravel Pits Site





7.4.1.2 Big Johnson Reservoir

Owner	Fountain Mutual Irrigation Company
Reservoir Type	Earth embankment dam
Current capacity	~5,000 AF
Potential capacity	10,000 AF through a 15 feet dam Raise
Fill infrastructure	FMIC Canal

Ownership and Operation - The Big Johnson Reservoir is owned and operated by the Fountain Mutual Irrigation Company (FMIC). FMIC also owns the FMIC Canal, which conveys water from Fountain Creek to Big Johnson Reservoir. FMIC began operating their system in the late 1880s, with the oldest water rights originating in 1861. FMIC is run by an elected board of directors and overseen by FMIC shareholders, including irrigators and augmenters. Most shareholders today are augmenters, who use their rights under augmentation plans as water providers.

Reservoir Description – The dam was originally constructed in 1907 and then raised in 1947. The dam is 54 feet high, approximately 2,900 feet long, and has a crest elevation of 5,820 feet. It is classified as a high-hazard dam per the SEO's regulatory criteria. The reservoir has historically been used to store irrigation and augmentation water, with the current use primarily dedicated to augmentation water. The reservoir is fed by approximately 10 miles of the FMIC canal, which has a headgate at Fountain Creek near CSU's Las Vegas Street WWTP. A single outlet works discharges water from the reservoir when it can either be diverted to a continuation of the FMIC canal or to a natural drainage back to Fountain Creek.

The reservoir's decreed storage amount is 10,000 AF under the FMIC's March 18, 1903 priority date as decreed on June 2, 1919.

The current storage capability is approximately 5,000 AF due to significant silt build up in the reservoir. In 2007, FMIC hired a drilling company to collect data to determine the depth of silt and depth to bedrock.

Current Operating Conditions – There is approximately 5,000 AF of usable storage in the reservoir that is primarily used to provide shareholders' augmentation water. The remaining use is for shareholders' irrigation water. FMIC has indicated that the current storage capacity is nearly fully subscribed.

Operational Issues – Prior inspection and evaluation indicates the outlet piping is in poor condition. The SEO reports that these outlet pipes are in "acceptable but poor condition". The upstream valves in the outlet pipe have been inoperable for at least 15 years, leaving flow control entirely to the downstream valves. This condition pressurizes the outlet piping running through the earth dam embankment. This poses a potentially high risk situation where failure of the pipeline could result in seepage into the earth embankment. This seepage could liquefy the soils and potentially result in failure of the dam. Dam failure poses very serious consequences due to the dense development downstream of the dam.

Silt build-up has reduced the reservoir storage capacity by nearly 50 percent.

Potential Capacity – There are two options to consider for increasing storage within Big Johnson Reservoir: raising the dam or excavating the silt that has collected within the reservoir.

<u>Dam Raise</u> - Prior studies concluded that obtaining the full decreed amount of 10,000 AF of storage in the reservoir would require the dam to be raised 15 feet. This assumes no removal of existing silt collected in the dam. Based on current conditions and the SEO annual reports, the dam enlargement would require repair of the outlet pipes and valves, inlet modifications, and spillway redesign. Dam enlargement would inundate areas outside the FMIC parcel boundaries.

<u>Silt Excavation</u> – Based on the 2007 drilling analysis, it was estimated that approximately 8.6 million cubic yards of silt (~5,000 AF) has accumulated in the reservoir. The preferred method of silt removal would be in dry conditions. This would present challenges as it would take most, if not all, of the reservoir out of service. Wet dredging is feasible, but would increase cost and time. This alternative was found to be a more costly alternative, and prior study recommended the dam raise alternative over silt excavation.

Estimated Cost – The estimated cost to raise the dam 15 feet and increase storage to the decreed amount of 10,000 AF is $8.3 million.

Figure 7-5
Big Johnson Reservoir Embankment (Looking Southeast)

Figure 7-6
Big Johnson Reservoir Outlet Works

7.4.1.3 Calhan Reservoir

Owner	Woodmoor Water and Sanitation District
Reservoir Type	Earth embankment dam
Current capacity	674 AF
Potential capacity	3,200 to 8,400 AF
Fill infrastructure	Chilcott Ditch
Chilcott Canal capacity	

Ownership and Operation – Calhan Reservoir is owned by Woodmoor Water and Sanitation District (WWSD). It was acquired though the purchase of the JV Ranch water rights. Under the JV Ranch purchase, WWSD also became the majority shareholder of the Chilcott Ditch Company.

WWSD acquired 3,400 AFY of water rights through this acquisition.

Reservoir Description – Calhan Dam was originally constructed in the early 1900s. It has been modified several times, with the most recent modification occurring in 1964. According the National Inventory of Dams (NID) database, the dam is approximately 25 feet high with a crest width of 12 feet and is about 1,900 feet long. The reported maximum storage is 679 AF, with a normal storage of 374 AF. The emergency spillway is an open channel, unlined earth-cut spillway and follows an existing drainage path back to Fountain Creek.

Operational Issues – The existing dam for Calhan Reservoir is not up to modern dam safety requirements. The reservoir level is currently restricted by the SEO. An assessment performed by URS found that the dam was in poor to fair condition and may not be worth rehabilitating. The consequence of failure is currently considered low due to minimal downstream development.

Potential Capacity – In previous studies, WWSD directed URS to analyze potential reservoir upgrades to store between 3,000 and 15,000 AF. The URS study analysis suggested that a raise to the existing dam may increase storage to approximately 5,000 AF. However, based on the preliminary URS evaluation, the existing dam would need to be significantly altered to consider a dam raise. It was therefore assumed that a new embankment would be constructed downstream of the existing embankment.

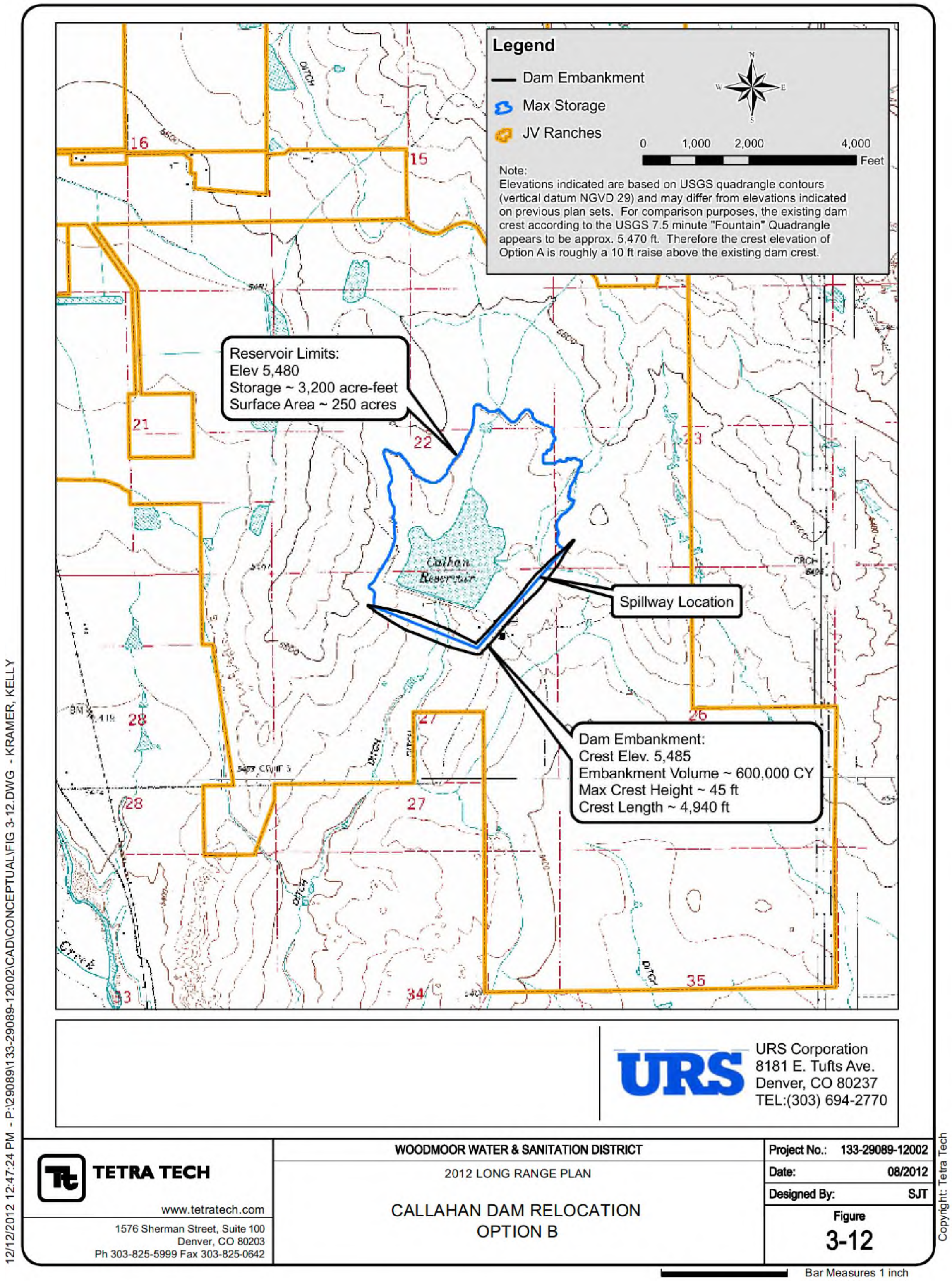
The URS study analyzed three sizing alternatives: 2,200 AF, 3,200 AF, and 8,400 AF. Preliminary estimates of Area 2 storage requirements for the PPRWA varies between 2,000 and 6,000 AF depending on whether or not seasonal storage is implemented in Area 3. Therefore, either of the latter two options above would meet these preliminary storage requirements.

Estimated Cost:
3,200 AF = $24,000,000
8,400 AF = $42,000,000

Chilcott Canal Operation and Capacity – The overall condition of the Chilcott Ditch was previously found to be satisfactory. Two areas of concern were noted. The first area of concern is a siphon under Jimmy Camp Creek where all the water in the ditch is conveyed under the creek in a single pipe. Without redundancy, if the pipeline becomes clogged or otherwise incapacitated, then there is no way to move water from Fountain Creek to the reservoir. Consideration should be given to installing a second siphon under the creek. The second area of concern is the capacity of the ditch as it passes under the railroad tracks in Fountain. Low clearance under the railroad track is assumed to be limiting the capacity of the ditch. If a regional system at Calhan is considered, then the capacity of the ditch will need to be increased. This may be accomplished through installation of low friction materials and deepening the ditch.

On-Ranch Delivery System – Prior studies concluded that improvements to the on-ranch delivery system is likely required before water from the ranch can be used for domestic use by WWSD. It is assumed that any repurposing or resizing of the reservoir for use under the PPRWA regional infrastructure study will require modifications to the headgate and on-ranch delivery system.

Figure 7-7
Potential Calhan Expansion



7.4.2 Conveyance Pipelines

The conveyance facilities will need to deliver water from Area 2 storage (at approximate elevation of 5,500 to 5,800 feet) to Area 3 storage (at approximate elevation of 7,000 feet). An intermediate delivery point will be provided to deliver water to the Cherokee Metro District and the designated Regional Participants in that area. Facilities associated with connecting to the Cherokee and Regional Participants are not included as part of the regional system presented in this report.

Capacity requirements north of this delivery point will be reduced by the quantity of deliveries to Cherokee and the Regional Participants. Therefore, capacity requirements upstream and downstream of the intermediate delivery point differ. Conveyance facilities include piping, pump stations, and pipe appurtenances (blow-offs, air-vac/air-release valves, and surge control facilities).

Capacity for the Area 2 pipeline is sized assuming seasonal storage in Area 3. If only operational storage is preferred for Area 3, the conveyance pipeline will need to be sized to meet peak-day demands for Area 3 project participants. Seasonal storage reduces the capacities by averaging out the delivery capacities during the allowable Fountain Creek diversion period. The fill period for storage is assumed to occur over eight months of the year, where up to 20 cfs may be diverted.

Seasonal versus operational storage in Area 3 should consider both financial and operational impacts. Based on this preliminary assessment, it appears to be more cost-effective to consider seasonal storage in Area 3. This will reduce the capacity requirements for the substantial conveyance facilities necessary to move water from Area 2 to Area 3. This includes both pipe sizing and the number and capacity of pump stations, which would reduce initial capital and ongoing operating costs.

To minimize the number of pump stations, ductile iron pipe should be evaluated due to its higher pressure rating. PVC pipe should also be considered, but that will result in a lower pressure class rating and would likely require additional pump stations. It is recommended that a life-cycle cost analysis be performed in the next phase of study to compare the costs and benefits of pipe selection and pump station requirements.

Pipeline alignment was selected to most efficiently meet the following criteria:

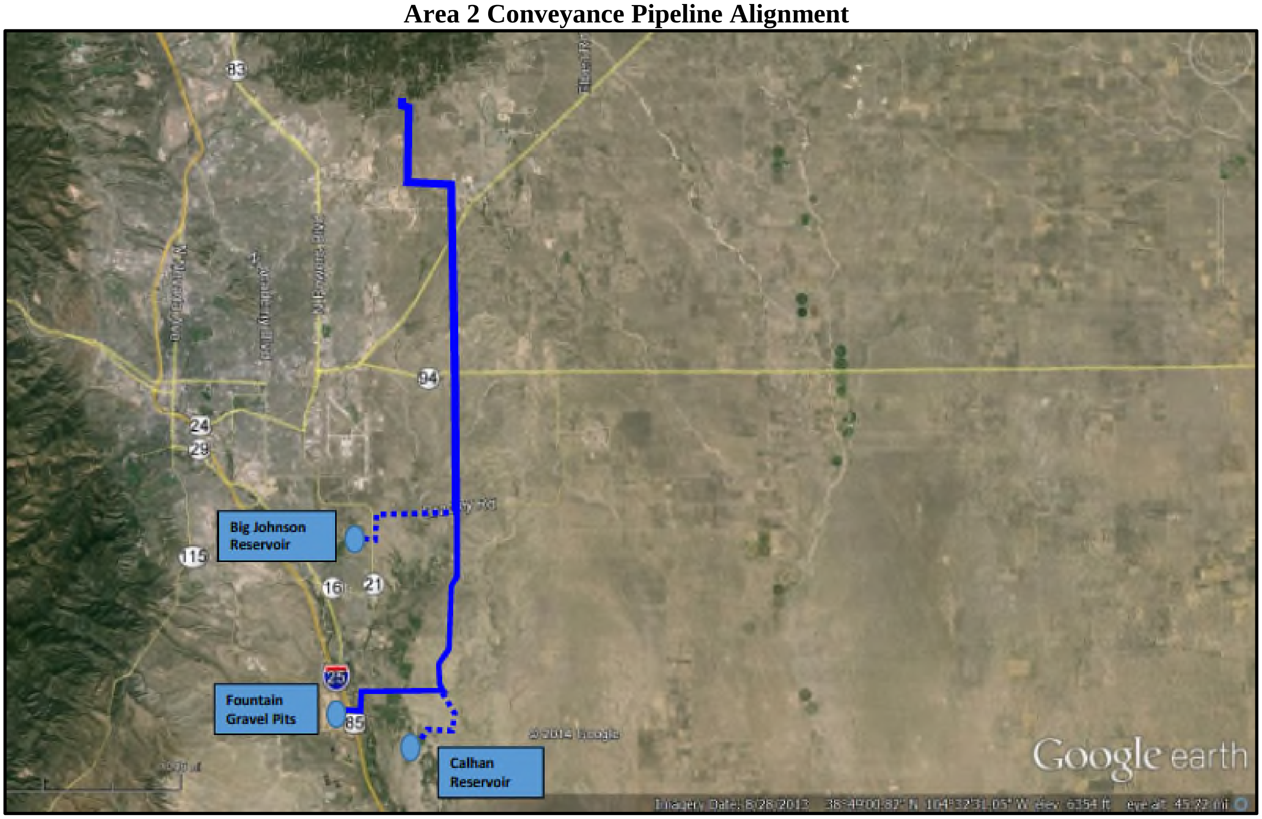
- Avoid areas of urban development
- Avoid sensitive environmental areas
- Avoid significant geologic features
- Minimize high points
- Follow existing utility easements to the extent possible
- Follow roads not under heavy traffic load
- Minimize overall distance

Under these criteria, the preferred alignment was determined to generally follow CSU's SDS pipeline in the southern reach of Area 2 and Cherokee Metro District's Sundance Pipeline in the northern reach of Area 2.

Pipeline Design Criteria

- Pipe material: DIP
- Pressure class: 300 psi
- Length: ~40 miles (211,200 feet)
- Max. operating pressure: 300 psi
- Min. operating pressure: 20 psi
- Max. (normal) velocity: 7 fps

Figure 7-8
Area 2 Conveyance Pipeline Alignment



7.4.3 Pump Stations

Storage elevation in Area 2 would be at approximately 5,600 feet. This assumes storage at the Fountain Gravel Pit. Water from Area 2 storage will be conveyed to a new storage facility in Area 3 at an approximate elevation of 7,100 feet, an elevation gain of 1,500 feet. In addition to the elevation gain, the system will have to overcome dynamic and minor losses for over 50 miles of conveyance pipeline between Area 2 and Area 3 storage. The total hydraulic losses were estimated at approximately 1,400 feet. This resulted in a total hydraulic grade line (HGL) increase of 2,900 feet. Assuming maximum pressure and minimum pressure of 300 psi and 20 psi, respectively, resulted in siting pump stations at each 280 psi (647 feet of water) step loss in pressure. This would require a minimum of six (6) pump stations to move water from Area 2 storage to Area 3 storage.

It is assumed each pump station would be equipped with three variable speed pumps, two duty and one standby. Each pump would be rated for 50 percent of the design flow. Each pump would be designed to boost the pressure to 300 psi when pressure reaches a low point of 20 psi. This results in an approximate total horsepower requirement ranging between 1,200 and 1,400 HP, north and south of the CMD turnout respectively. It is assumed then that pump stations south of the turnout will contain three 600 HP pumps and north of the turnout will have three 700 HP pumps.

To account for surge, consideration should be given to designing certain pump stations with a wetwell for influent storage. The volume of this forebay would be designed to allow for adequate fluctuations in water level to respond to pipeline surge. Alternatively, new surge tanks may be installed at high points along the alignment. Surge analysis is beyond the scope of this study, but should be performed under the next phase of study.

Pump Station Design Criteria

- Max operating pressure: 300 psi
- Minimum operating pressure: 20 psi
- Total capacity: 17 to 20 cfs
- No. of pumps: 3 (two duty, one standby)
- Pump drive: VFD
- Pump capacity: Each pump sized for 50% max flow

7.4.4 Pipeline Appurtenances

Appurtenant facilities include isolation valves, blow-offs at low points to remove water during a pipe drain down, air-vac/release at high points to relieve air in the line during normal operation and allow air into the line during pipe drain down, and surge facilities to mitigate for high surge pressures in the event of an unplanned pump station shutdown. Surge facilities may be incorporated into pump stations as well. Final determination of appurtenances is beyond the scope of this study. Budget for pipeline appurtenances is assumed to be 1 percent of the total pipeline cost.

7.4.5 Power Supply

Each of the proposed pump stations will have three pumps installed, each at an estimated 600 to 700 HP each. Power supply requirements will assume two pumps operating which will require power supply between 1,200 and 1,400 HP. It is recommended during the preliminary engineering phase to work with the local electrical utilities to evaluate the power supply requirements and the associated costs to install these facilities.

7.5 AREA 3 FACILITIES

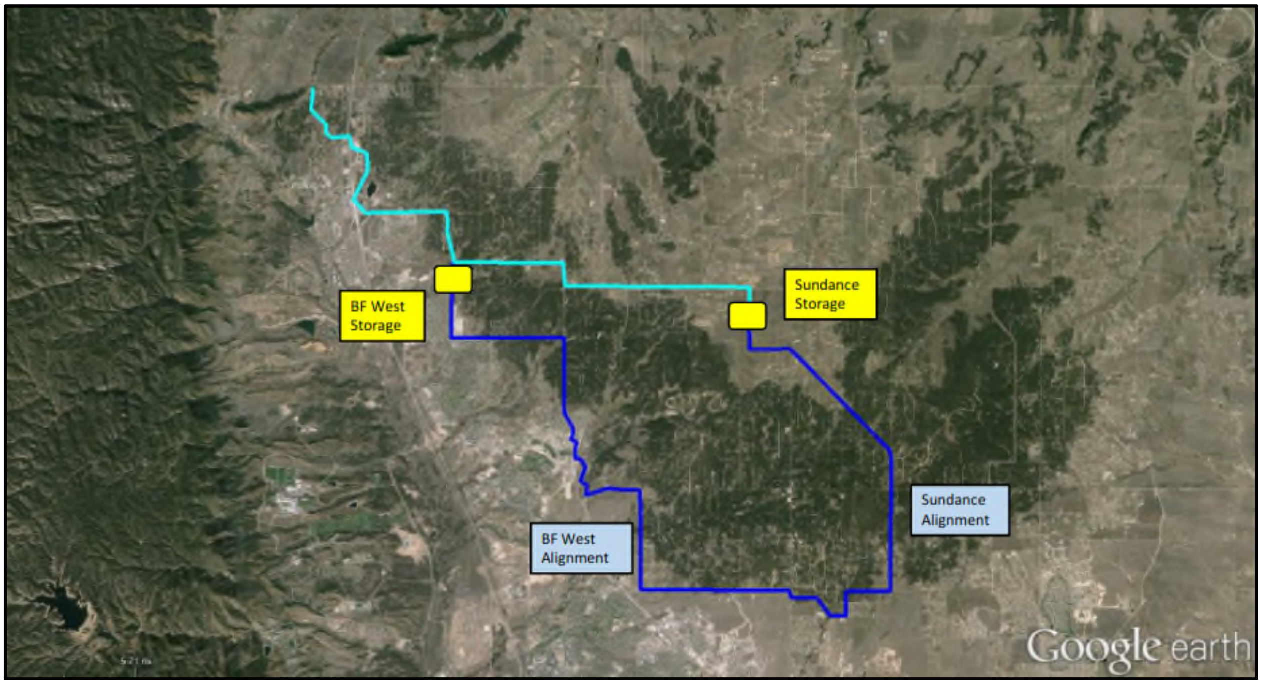
The Area 3 facilities include a raw water conveyance pipeline, raw water reservoir, possible surface water treatment, and a treated water conveyance pipeline into the Monument area. It is assumed that the surface water treatment facility could require advanced treatment due to water quality in Fountain Creek. During certain times of the year, flows will contain a significant share of CSU effluent and urban runoff.

Siting of Area 3 storage was generally based on previous work performed under the Water Infrastructure Planning Study (WIPS) completed in 2008. That study included consideration of many different alternatives in a variety of capacities in the Black Forest area. The previously identified sites were reviewed based on the estimated need of approximately 4,500 AF of storage to meet the PPRWA system needs. Additionally, sufficient adjacent area is necessary to site the proposed regional surface water treatment facility. One additional site was considered within Sundance Ranch. This site requires further review because it is located outside of Division 2 (Arkansas River Basin). Restrictions for some participants in water rights and operational policies regarding use of water originating in Division 2 may preclude storage in Division 1 (South Platte Basin). This should be further assessed in the preliminary engineering phase of study.

Figure 7-9
Major Basin Divisions

Two alternatives were considered for Area 3 storage: west of Black Forest near Higby Road (Site 13 from WIPS) and a location within Sundance Ranch. One conveyance alignment for each storage site was identified. See Figure 7-10 for Area 3 facility alternatives.

Figure 7-10
Area 3 Facilities



7.5.1 Area 3 Raw Water Conveyance

Area 3 conveyance will connect to the northern termination point of Area 2 conveyance, at the south end of Black Forest. Two alignments were considered, one to connect to the BF West storage site and one to the Sundance Site. The capacity and size is the same as the Area 2 conveyance north of the CMD turnout.

The Sundance alignment follows the alignment of CMD's existing Sundance Pipeline. An advantage of this alignment is the potential to install the pipeline within CMD's existing easement. Working in cooperation with CMD, this alignment can potentially reduce right-of-way (ROW) acquisition costs. This alignment includes water conveyance and storage outside of Division 2 and as such may be precluded from consideration because of previously noted participant limitations. It is also important to note that the Sundance storage site is at higher elevation than the BF West site, requiring the water to be pumped higher. This would require an additional pump station, and impose perpetual operating costs of that additional pumping. But that pumping energy would then simply be lost as the water is conveyed west to the Monument area at lower elevation.

It should also be noted that constructing an east-west line from the Sundance area to Monument for an interim phase of the regional system would allow further development of Denver Basin water in the Black Forest area, serving as a satellite well field to meet the needs of Monument-area participants (as well as CMD). The concept of a satellite Denver Basin well field to serve the region was introduced in WIPS as a means to reduce heavy localized pumping of Denver Basin wells within the service areas, helping extend the economic life of the aquifers.

The BF West alignment generally follows the southwest extent of Black Forest to the BF West site near Higby Road, along public ROWs, within existing streets. While acquisition cost for this alignment is minimal, there are added costs for pavement restoration and traffic control for this reach.

The capacity and material of the Area 3 raw water conveyance pipeline will match the Area 2 conveyance pipeline. See previous discussion related to assumptions made for the untreated pipeline.

7.5.2 Area 3 Storage

Two storage sites were considered in Area 3. Both sites are undeveloped parcels of land that would be purposed strictly for reservoir storage. Development would require excavation and construction of embankment facilities. The area surrounding the Sundance site is more remote, and is surrounded by undeveloped land. It would also require additional conveyance alignment length. The BF West site is proximal to developed areas. The distinction of proximity to developed areas would likely impact design of the reservoir. It is expected the BF West site would be classified as high hazardous and would need to be designed accordingly. The Sundance site could potentially avoid this classification.

There has been no detailed prior work related to storage development in Area 3. Therefore, costs associated with storage in this area are the most speculative and contain a higher level of contingencies. The costs presented in this report are based on findings presented in WIPS. Reservoir development in this area will likely be considerably higher due to the development of these facilities as reservoir-only projects. There is no opportunity to cost-share development with mining activities.

Another distinction between the two sites as previously noted is related to the basin location. The Sundance site is located within Division 1 (South Platte Basin) and the BF West site is located within Division 2 (Arkansas River Basin). Project participants have noted water right and policy restrictions that preclude storage of water from the Arkansas Basin at a Division 1 storage site.

7.5.3 Area 3 Surface Water Treatment

During certain times of the year, diversions off of Fountain Creek will contain a high proportion of Colorado Springs Utilities wastewater effluent. For this reason, it is assumed advanced treatment will be necessary. While some of project participants already have surface treatment capacity, they do not have advanced treatment facilities. For this study, it is assumed that a new, regional treatment facility meeting the collective needs of the Monument area utilities would be constructed. This surface treatment facility would include an advanced treatment process, most likely a nanofiltration process followed by advanced oxidation. Historic TDS levels in Fountain Creek are low enough that reverse osmosis (RO) will not likely be required. Development of an RO system would add considerable cost to the project due to increased operating cost, lost water to brine, and the construction and operation of injection wells to dispose of the brine.

7.6 REGIONAL SYSTEM SUMMARY

Table 7-3 provides an overall summary of the basis of cost (BOC) alternative, and other alternatives considered for each of the project components.

Table 7-3
System Summary

	BOC Alternative	Alternates	Discussion
Area 1			
Storage	Stonewall Springs		Least cost alternative Existing fill infrastructure
		East Reservoir	More costly New fill and discharge facilities Requires pumping
		Pueblo	High life cycle cost No facility ownership Lease process challenging
Area 2			
Storage	Fountain Gravel Pits		Existing mining operation Cost-share with Fountain Lower unit cost
		Big Johnson Res.	Rehabilitate existing reservoir Consider dredging or dam raise
		Calhan Res.	Significant reservoir expansion Most costly alternative WWSD owns
Conveyance	SDS/Sundance		Overland alignment Co-locate within existing ROW
		Central CO Springs	Public ROW installation in streets Congestion issues
Area 3			
Storage	BF West		Previously identified site in WIPS High unit cost Proximal to participant demand
		Sundance Ranch	Co-locate with CMD facilities Increased undeveloped areas Division 1 location may restrict
Conveyance	BF West		
		Sundance Ranch	
Treatment	BF West		
		Sundance Ranch	
Trunk Line	Monument Central		Same alignment as WIPS No alternatives considered

As discussed previously, there are no apparent restrictions or fatal flaws to acquiring new water supplies off of the Arkansas River to support the Regional Infrastructure Project. Similarly, there are no apparent issues related to the implementation of the physical infrastructure to deliver that water to the PPRWA participants.

From a technical and financial standpoint, no fatal flaws have been identified that preclude further development of the regional system. Three alternatives were evaluated for storage in Area 1 and Area 2. Two alternatives were evaluated for storage in Area 3. Seasonal versus operating storage was also evaluated for Area 3. Based on information available at this time, it is recommended to consider seasonal storage in Area 3. This will reduce the conveyance and pumping costs from Area 2 to Area 3.

Alternative alignments were evaluated for Area 2 to Area 3 conveyance. Consensus was reached among the project team to avoid developed areas around Colorado Springs. The alignment recommended for further consideration generally follows the SDS and Sundance Pipeline alignments. Through coordination with the respective pipeline owners, it may be feasible to install the pipeline within existing easements of these pipelines.

A regional treatment facility in Area 3 is proposed at this level of study. This facility would be located proximal to Area 3 storage. This supports a phased approach whereby Area 3 storage and conveyance facilities could be implemented in advance of remaining project facilities. A satellite well field could also be developed in this first phase, using facilities that could later be integrated into the larger regional supply system. This could provide a near-term benefit by introducing supplemental Denver Basin supplies from Sundance Ranch.

An alternative approach would be to locate regional treatment in Area 2, and deliver treated water to the northern project participants. Under this scenario, Area 2 storage would be sized for seasonal storage. Area 3 storage would only include operational, treated water storage.

CHAPTER 8
FACILITY SIZING

8.1 GENERAL

There are several factors used in developing the proposed facility sizing, beginning with determining each participant's future supply deficits. The values presented in this section are the ultimate supply deficits for 2050. It is assumed that these supply deficits would be met entirely through the acquisition of renewable supplies off the Arkansas River under the PPRWA regional project. The next consideration is where the utilities are physically located. Finally, the diversion periods off of the Arkansas River and Fountain Creek will dictate the storage and conveyance requirements.

8.1.1 Exchange Operations

The source of new supply for delivery via the PPRWA regional system will likely be Arkansas River water rights. In the case of irrigation rights converted to municipal use, the diversion timing must mimic that of the irrigation rights. Based on review of historical data, this period will generally occur between May and September each year. Water diverted and stored off of the Arkansas River will be exchanged with water diverted and physically used off of Fountain Creek.

There are no period-of-the-year restrictions off Fountain Creek. As long as sufficient base flow exists in Fountain Creek, diversions may be executed. Historical records of dry-year conditions indicate that there are sufficient base flows to divert up to 20 cfs between October and May. In June, August, and September, there are sufficient base flows to divert up to 10 cfs. It was assumed that no diversions would be permitted from Fountain Creek in July due to insufficient base flows. Sizing of facilities was conservatively based on flow restrictions that have historically occurred during dry-year conditions. We also assumed that due to seasonal variability in surface water flows, some carry-over storage would be beneficial. As described below, carryover storage was added to meet regularly recurring limitations, but was not intended for more extreme events. This seemed a practical approach in that it provides for storage that can meet system needs during the typical lower water conditions, but is not oversized to address infrequent shortfalls. Such infrequent events are better addressed through diversifying the water rights portfolio and drought management planning.

8.1.2 Return Flows

Return flows are an important consideration when performing the sizing analysis. When water is delivered to each participant, only approximately half of that water is fully consumed on an annual basis. The other half is returned to Monument Creek for most of the participants, which eventually flows into Fountain Creek. As a fully consumable water right, the PPRWA participants retain ownership of this supply and have the right to divert and reuse the supply.

This process is cyclical, meaning that the same molecules of water may be reused multiple times. It is not a fully perpetual process, however, as transit and evaporative losses will occur with each return cycle.

To account for return flows in our facility sizing, we considered losses associated with consumptive use, non-return conditions, and other losses. First, we assumed 50 percent of the water delivered for use would be consumed. We also assumed that water delivered to CMD and the yet-to-be-identified Regional Participants would not be returned because water delivered to these entities may not discharge to Fountain Creek. Knowing that all of the water discharged in the Monument area will not physically be available due to evaporative and percolation losses, we estimated approximately 15 percent total reduction in return flow based on transit loss of 0.5 percent per mile for 30 miles. We also conservatively accounted for only a single instance of return flow. Based on these assumptions, it is theoretically possible to reduce the required demand by up to 1,000 AF. However, at this level of analysis, we considered it prudent to provide a conservatively larger storage estimate.

8.2 AREA 1 STORAGE

Area 1 storage must be sized to provide the entire annual demand, minus return flows, of PPRWA users that require new supply. This includes all of the PPRWA participants except Woodmoor. Woodmoor has acquired new supplies as part of their purchase of JV Ranch and therefore, would not need to participate in the Arkansas River acquisition and storage in Area 1.

During the first year of operation, Area 1 storage will begin filling during the summer diversion period. At the conclusion of the fill period in September, Area 1 storage will begin releasing flows back into the Arkansas River in exchange for flows that will begin diverting off of Fountain Creek. This process will occur throughout the winter and spring until the diversion period off the Arkansas River resumes in May. The process of refilling Area 1 storage will resume.

Carryover storage requirements were estimated as follows. Using the monthly records for the reference diversions from the Wheeler report (Bessemer Ditch and Catlin Canal) for the last 50 years, we compared each year's diversion to the average diversion for the time period. The data showed that, with the exception of drought periods during the late 1970s and early 2000s, diversion was either near average or not less than 75 percent of average followed by a near average year. Therefore, the Area 1 reservoir sizing includes 25 percent carryover storage.

Apart from the storage volume estimated to account for supply and return flows, there are three additional factors that must be included in the calculation of Area 1 storage:

- Evaporative losses
- Minimum pool elevation
- Winter return flows (10 percent of annual total)

Quantities for evaporative loss and minimum pool will depend on the characteristics of the reservoir design and will be refined in future, with more detailed analyses of storage areas. Winter return flows, as a function of the total necessary supply, also will depend on these factors. For the purposes of cost estimating, it is assumed that the additional functional storage requirements for these criteria is 1,000 AF.

<u>Area 1 storage sizing</u>

Participant demand out of Area 1:	11,895 AFY
Return Flows:	2,700 AFY
Total New Supply and Storage:	**9,195 AF**
Carryover Storage	2,298 AF
Additional Functional Storage:	1,000 AF
Total Estimated Area 1 Storage:	**12,493 AF**

8.3 AREA 2 AND 3 STORAGE

Area 2 and Area 3 storage sizing must meet the total demand of all participants, including Woodmoor, during the restricted summer diversion period. Outside of this period, diversions off of Fountain Creek will pass through storage for direct delivery to the project participants. The restricted summer diversion period assumes diversions of 10 cfs in June, August, and September, and zero diversions during July.

For the Fountain Creek diversion, we estimated carryover storage as follows. As noted in the Wheeler Report, we assumed that when the stream gage for Fountain Creek at Pueblo registers more than 35 cfs, our assumed 20 cfs diversion should be available; when it registers less than 35 cfs but more than 15 cfs, our assumed 10 cfs diversion should be available. From a review of the Fountain Creek discharge data, we estimated a percent of exchange value. This value represented the percentage of days in a given year on which the proposed exchange program could be conducted as we have outlined in this study. In other words, it represents the percentage of days from October to May where Fountain Creek flow exceeded 35 cfs and the percentage of days in June, August, and September that exceed 15 cfs. The data showed that there have been two years in the last 20 where the exchange value was below 90 percent, and the lowest of these was 87 percent. Based on this information, it seems reasonable to plan for 10 percent carryover storage.

Additional functional storage will be required per the discussion under Area 1 storage. For the purposes of cost estimating, it is assumed an additional 1,000 AF of functional storage is required.

Participant demand during restricted period:	6,905 AFY
Return flows during restricted period:	1,870 AFY (equals 10 cfs diversion limitation)
Total Supply Storage:	**5,035 AF**

Carryover Storage	504 AF
Additional Functional Storage	1,000 AF
Total Estimated Area 2 and Area 3 Storage:	**6,540 AF**

Area 2 storage only needs to be sized to meet the demands of Cherokee and the Regional Participants during the restricted summer diversion period. Cherokee and the Regional Participants account for 41 percent of the total participant demand, therefore their supply storage need is 41 percent of the total storage requirement (6,540 AF). This establishes a practical minimum size for Area 2 storage. It would also be possible to serve CMD and the Regional Participants from Area 3 storage, but that would not be the normal operation because that would entail pumping the water up to Area 3 only to then “waste” that hydraulic energy by running the water back down to the CMD turnout.

Area 2 storage = 2,681 AF

Area 3 storage accounts for the remaining 59 percent demand of the Monument-area participants. This serves as the Basis of Cost for purposes of this study, but another alternative would be to stage some of the storage need for Monument-area participants by upsizing Area 2 storage, and reduce the size of Area 3 storage.

Area 3 Storage = 3,859 AF

8.4 RAW WATER CONVEYANCE (Area 2 Storage to CMD Turnout)

The raw water conveyance facilities from Area 2 to the CMD turnout must function to meet participant maximum-month demands, plus fill Area 3 storage. The Area 3 fill pattern is based on the assumption of an eight-month fill period, with fill capacity spread equally over those eight months. Maximum-month demand is based on the monthly annual average demand multiplied by a peak-month factor. Based on current information, May is the maximum-month demand at 673 AF. The monthly Area 3 fill capacity needed is 514 AF. Therefore, the total monthly flow capacity that must be conveyed to the CMD turnout is 1,187 AF (20 cfs). Maximum pipe velocity was assumed to be 7 feet per second, requiring a 24-inch pipe.

Area 2 storage will be directly connected to Fountain Creek, so the Area 2 to Area 3 conveyance facilities do not need to account for capacity to fill this reservoir.

<u>Area 2 Conveyance to CMD Turnout</u>

- Capacity: 20 cfs
- Maximum velocity: 7 fps
- **Pipe size: 24-inch**

8.5 RAW WATER CONVEYANCE (CMD to Area 3 Storage)

The raw water conveyance facilities from the CMD turnout to Area 3 storage must function to meet ongoing participant demands, minus CMD and the Regional Participants, plus fill Area 3 storage. The maximum monthly participant demands occur in May. Deducting the CMD and Regional Participants demand, the remainder is 498 AF. The monthly Area 3 fill capacity is 514 AF. Therefore, the total monthly flow capacity that must be conveyed to Area 3 is 1,012 AF (16 cfs). Maximum pipe velocity was assumed to be 7 feet per second, also requiring a 24-inch pipe as for the section of this pipeline south of the CMD turnout.

Area 2 Conveyance to CMD Turnout

- Capacity: 16 cfs
- Maximum velocity: 7 fps
- **Pipe size: 24-inch**

8.6 SURFACE WATER TREATMENT FACILITY

A surface water treatment facility would likely include advanced treatment. It is assumed this advanced treatment would consist of nanofiltration and advanced oxidation. It is also assumed that the facility will be located in Area 3, and would only serve the Monument-area project participants. CMD and the Regional Participants are not included as part of this evaluation.

As a primary potable water supply point, the facility would be sized for the collective peak day demands of the Monument-area utilities. To improve operational efficiencies and account for potential disruptions in downstream supplies or the treatment plant itself, it is also recommended to provide some treated water storage. It is recommended to provide 4 hours of peak day demand. This will provide sufficient time to bring the facilities back online, or allow the utilities to activate an alternative source of supply, such as their Denver Basin groundwater wells. Each participant also has some potable water storage in their respective systems.

A 2.6 peaking factor on annual average demand was used to calculate peak day demand.

Table 8-1
Surface Water Treatment Plant Capacity

Utility	2050 Annual Demand (AFY)	2050 Annual Demand (mgd)	Peak Day Demand (mgd)
Palmer Lake	100	0.09	0.2
Monument	612	0.5	1.4
WWSD	2628	2.3	6.1
Triview	3100	2.8	7.2
DWSD	1480	1.3	3.4
		Total WTP Capacity	**18 mgd**

Potable Water Storage Tank

- Peak Day Demand: 18 mgd
- Potable Water Storage: 4 hours @ peak day
- Total Treated Water Storage: 3 MG

8.7 TREATED WATER CONVEYANCE

The treated water conveyance pipeline will deliver water from the potable water storage tank to the trunk line in the central Monument area. This facility will also need to be sized for peak day. Alternatively, for BF West storage, there could be separate lines to some of the participants.

- Peak Day Demand: 18 mgd (28 cfs)
- Maximum velocity: 7 fps
- Pipe Size: 30-inch

CHAPTER 9
CONCEPTUAL COSTS

9.1 GENERAL

This section provides conceptual costs for the collection of facilities that would make up the PPRWA regional infrastructure system. The purpose is to determine the financial feasibility of implementing the regional system. Based on the level of facility analysis at this stage of project development, this cost estimate is presented as an order-of-magnitude estimate, with an approximate accuracy range of +50 to -30 percent. This is a conceptual estimate made without detailed engineering data on the order of using cost-estimating curves, scale-up or scale-down factors, or an approximate ratio estimate.

Based on conceptual costs, the regional system is financially feasible if it is phased over a number of years, and the PPRWA participants work together on project funding. Under the worst case scenario of the accuracy range, it is assumed that the participants could still collectively fund the system, given the essential nature of adequate water supply.

Under any scenario, the ultimate decision will be weighing the costs and benefits of this project with other potential supply projects available to the participants. Factors in comparing this project to other projects include the reliability of other supplies, and the desire of participants to have more autonomy over supplies versus reliance on other entities (e.g., Colorado Springs Utilities).

The facilities evaluated to develop the costs are referred to as the "basis of cost alternative." Additional analysis is required to develop a "preferred alternative" that will be moved through the ensuing stages of development. That preferred alternative for the entire system may also be developed incrementally as the system is defined through a phased approach. This selection process should occur in the preliminary engineering phase(s) of study. At that point, a preferred alternative (or a partial preferred alternative) would be selected and developed to a 5 to 10 percent design level, along with the appropriate level of engineering analysis. Facility sizing would also be further refined. Budget cost estimates would be prepared during the preliminary engineering phase.

The facilities that comprise the basis of cost are presented below. The significant costs to acquire and convert water rights are not included in this infrastructure study, but must also be considered. It is recommended that an analysis of available water rights be conducted in coordination with the appropriate phase of preliminary engineering.

- **Soft Costs**
  - Preliminary engineering
  - Environmental compliance and permitting
  - Property acquisition (TBD, not included in costs shown)

- Water acquisition (TBD, not included in costs shown)
- Detailed design
- Construction engineering services

- **Capital Facilities**
  - Area 1 storage (~12,500 AF)
  - Area 2 storage (~2,700 AF)
  - Area 3 storage (~3,900 AF)
  - Raw Water Conveyance pipeline (44 miles of 24" DIP)
  - Treated Water Conveyance Pipeline (6 miles of 30" DIP)
  - Pump Stations (~6 pump stations at 1,200 to 1,400 HP each)
  - Surface Water Treatment and Potable Storage (18 mgd with nanofiltration and advanced oxidation)
  - Appurtenant Structures (air-vac/air-release, surge control, valves, etc.)
  - Power supply

- **Operations**
  - Power costs
  - WTP operation
  - Routine maintenance

9.2 SOFT COSTS

Soft costs include preliminary engineering, environmental compliance and permitting, detailed design, and construction engineering services. At this level of cost analysis, soft costs for the detailed design and construction management are presented as a percentage of the capital facilities construction costs. The assumptions for each component are as follows:

Table 9-1
Soft Costs Assumptions

Project Phase	Cost Assumptions
Preliminary Engineering	$500,000 (lump sum estimate)
Environmental Compliance/Permitting	$1,500,000 (lump sum estimate)
Property Acquisition	$15/foot
Water Acquisition	TBD
Detailed Design	8% of construction costs
Construction Engineering Services	5% of construction costs

9.3 CAPITAL COSTS

The capital costs consist of the costs to construct the physical facilities associated with the regional infrastructure system. Costs are shown for the complete project in 2015 dollars, not accounting for project phasing. However, phasing is likely, so total costs would be somewhat higher depending on the number and scope of those phases. Assumptions used as the basis of cost are as follows:

Table 9-2
Capital Costs Assumptions

Facility	Unit Cost	Basis of Unit Cost Assumption*	Notes
Area 1 storage	$3,600/AF	WWSD Feasibility Study (Tetra Tech, 2010)	Unit cost savings in economies of scale and cost share with gravel pit developer.
Area 2 storage	$6,410/AF	WWSD Feasibility Study (Tetra Tech, 2010)	Smaller size impacts unit cost. Cost share with gravel pit developer.
Area 3 storage	$10,000/AF	Water Infrastructure Planning Study (2008)	No cost share opportunities, proximal to developed area, likely designated as high hazard dam.
Raw water conveyance Pipeline	$200/ft	Calculated	Embedded in unit cost: property acquisition, installation, pipe material.
Treated water conveyance pipeline	$300/ft	Calculated	Embedded in unit cost: property acquisition, installation, pipe material, pavement restoration.
Pump Stations	$1,900,000	Calculated	
Water Treatment Facility	$4/gal	Estimated based on prior project information	Surface treatment facility with nanofiltration and advanced oxidation
Appurtenant Structures	2%	Estimated	Includes air-vac/air-release, surge control, and valving
Power supply infrastructure	$10,000,000	Lump Sum	Need to coordinate with power utility

*****Basis of cost assumption were generally guidelines. Certain modifications were made to adjust to current year pricing, facility sizing, and other project-specific issues.

9.4 OPERATING COSTS

The operational costs presented herein represent power costs for the pump stations, and the power, labor, and materials costs associated with the water treatment facility. A general lump sum value was used for routine maintenance costs of all facilities. Costs are shown in 2015 dollars for the annual operating costs that would be reached when the system is operating at its 2050 design capacity, simply to give participants a sense for the general scope of system operation. Costs would obviously ramp up to that level over the time it takes to reach that capacity.

Table 9-3
Operating Costs Assumptions

Facility	Unit Cost
Pump Station (1,200 HP, 900 KW)	$0.10/kwH
Pump Station (1,400 HP, 1,050 KW)	$0.10/kwH
Water Treatment Facility	$1,000/AF
Routine Maintenance	$1,000,000/year

9.5 COST SUMMARIES

The summaries of costs are shown in the tables below.

Table 9-4
Overall Summary of Cost – Soft and Capital Costs

SOFT COSTS	Unit Cost	Quantity	Total
Preliminary Engineering	LS	1	$500,000
Environmental Compliance/Permitting	LS	1	$1,500,000
Property Acquisition	$/LF	150,000 ft	$2,000,000
Detailed Design	8% of const cost	$242,000,000	$19,000,000
Construction Engineering Services	5% of const cost	$242,000,000	$12,000,000
		Subtotal	**$35,000,000**
CAPITAL COSTS	**Unit Cost**	**Quantity**	**Total**
Area 1 storage	$3,600/AF	12,500 AF	$45,000,000
Area 2 storage	$6,410/AF	2,700 AF	$17,000,000
Area 3 storage	$10,000/AF	3,900AF	$39,000,000
Raw Water conveyance Pipeline	$200/ft	232,000 ft	$46,000,000
Treated conveyance pipeline	$300/ft	32,000 ft	$10,000,000
Pump Stations	$1,900,000	6	$11,000,000
Water Treatment Facility	$3.50/gal	18,000,000 gal	$63,000,000
Appurtenant Structures	2%		$1,000,000
Power supply infrastructure	$10,000,000	Lump Sum	$10,000,000
		Subtotal	**$242,000,000**
TOTAL – CAPITAL AND SOFT COSTS			**$277,000,000**

Table 9-5
Estimated Annual Operating Costs (At 2050 Demands, In 2015 Dollars)

OPERATING COSTS	Unit Cost	Quantity	Total
1,200 HP Pump Stations	$0.10/kwh	7.9M Kwh/yr	$790,000
1,400 HP Pump Stations	$0.10/kwh	9.2M Kwh/yr	$920,000
Water Treatment Plant	$1,000/AF	7,920 AF	$7,920,000
Routine Maintenance	$1M/yr	$/year	$1,000,000
TOTAL			**$10,630,000**

CHAPTER 10
IMPLEMENTATION SCHEDULE

10.1 GENERAL

This chapter presents the proposed implementation schedule and the general scope of each task item. This schedule assumes that each subsequent task item is executed without delay. In other words, at the conclusion of each task, work begins on the next task. This would typically begin with project scoping and contractor solicitation, followed by execution of the task. Tasks and schedule are generally described in Figure 10-1.

10.2 AREA 3 CONVEYANCE AND STORAGE

The initial tasks generally contemplate completing the Area 3 facility design prior to implementing facilities in Area 1 and Area 2. This would give the northern area utilities access to a satellite well field; CMD's Sundance Ranch water supply project and other Denver Basin supplies in that area. It would also provide water storage with near-term benefits for optimizing water supply use, including storing reuse water for irrigation, and sharing of resources. This approach would benefit the participants by providing and extending interim supplies until the rest of the regional infrastructure facilities are constructed for access to renewable water. Facilities would be designed and constructed to be incorporated into the future regional facilities. It is also anticipated that following preliminary engineering, the governance structure for managing the regional project would be developed. That would allow the preliminary engineering work to better define at least a portion of the project, providing a tangible basis for the entities to determine the governance structure that would work best. The structure can generally be in place as design is initiated on the Area 3 facilities, and adjustments can be made as design continues.

It appears reasonable for the participants to proceed with Area 3 facilities prior to securing the anticipated exchange for multiple reasons. First, the objective of this regional system is to secure renewable water sources. The proposed Area 3 infrastructure is an essential part of the regional participants' ability to secure renewable water regardless of the source. Second, the study has outlined a possible exchange independent of other entities. However, if such an exchange does not prove economically feasible, there still remains the possibility of renewable water supply through the SDS. Additionally, as the participants seek to increase resilience of their water supply, the Area 3 infrastructure provides a mechanism for improving access to interim supply.

10.3 AREA 2 CONVEYANCE AND STORAGE

Once the governance is in place and design is initiated on Area 3 conveyance and storage, preliminary engineering can start on Area 2 conveyance and storage. The work anticipated includes a transmission line from the Fountain area to the Black Forest area for connection to

Area 3 facilities. Part of the preliminary engineering assessment will be to evaluate the potential use of the Sundance Pipeline in the regional system. Completing this phase of the project will facilitate significant flexibility in moving water supplies through the region. This phase of the project will also allow WWSD to be able to access their JV Ranch water for delivery to their customers, potentially, make arrangements with other regional entities for use of that water.

10.4 SECURING WATER RIGHTS

A critical component of this regional concept is to secure more renewable water to deliver through the regional system. The participants could acquire such water rights at any time, either individually or in partnership with each other. In fact, such acquisition has already begun with the JV Ranch purchase and DWSD's purchase of Willow Springs Ranch near Leadville. For purposes of this study, however, it is assumed that efforts to secure more renewable water would follow preliminary engineering for Area 3. A period of approximately seven years is anticipated from initial assessment of potential water rights to securing change decrees through Water Court. Presumably, the cost of renewable water rights will only go up, so it would be more cost-effective to acquire that water as soon as possible. But some water rights acquisition could continue throughout the time it takes to develop the regional system.

10.5 AREA 1 CONVEYANCE AND STORAGE

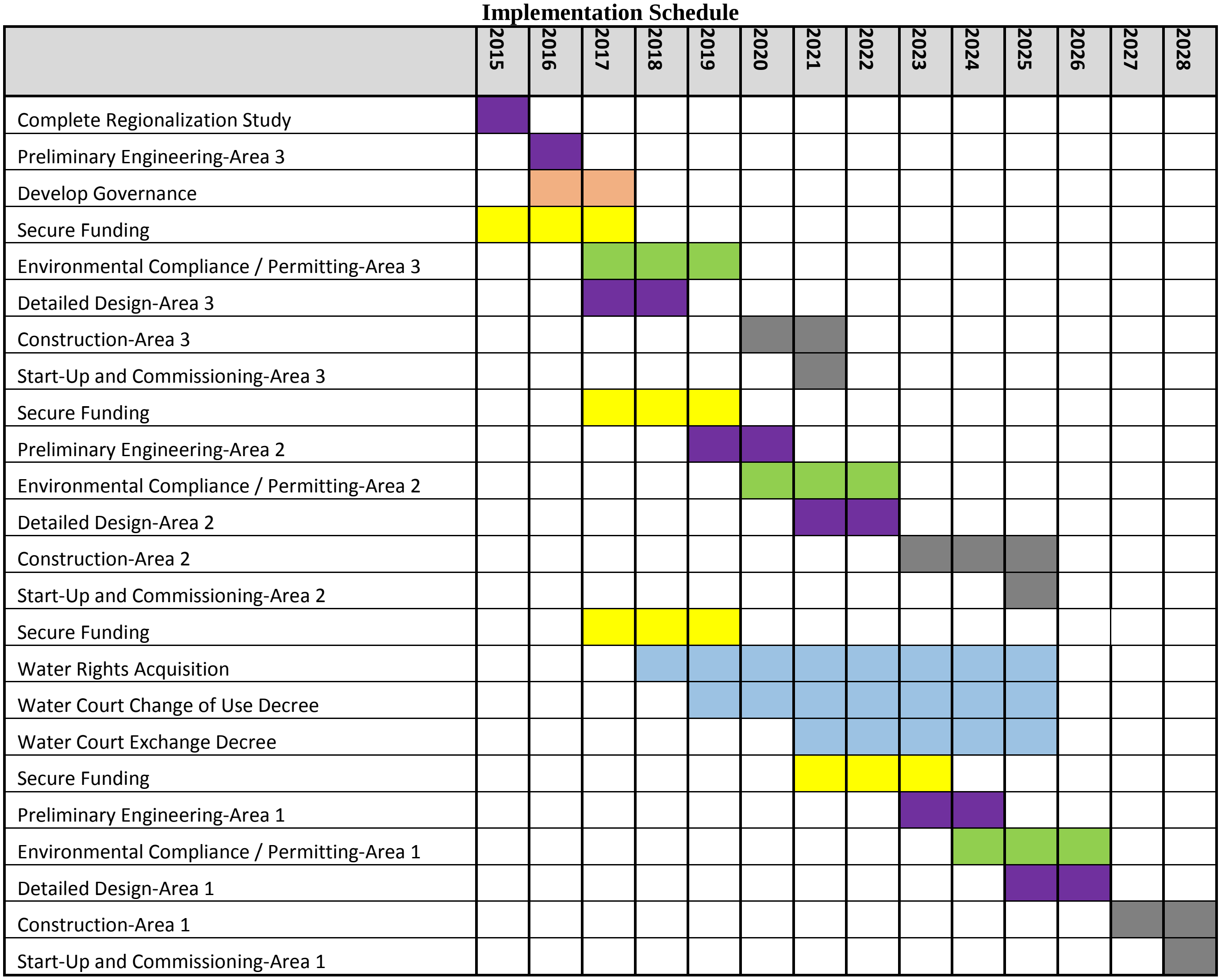
Initiation of Area 1 work will depend on the progress of securing water rights. The Area 1 work will include the development of diversion works and storage for the exchange at the Arkansas River. It is anticipated that some preliminary engineering may be necessary to support the water rights work. As progress is made, the compliance and permitting work will be initiated, followed by detailed design work. Completing this phase of the project will mark the completion of the primary objective of the participants to secure a mechanism to access a renewable water source.

10.6 SECURE FUNDING

The implementation schedule is based on assuming that before each phase is initiated, there will be some effort to secure funding for the work. This may include working with boards or commissions to secure support, identifying and pursuing loan and grant programs, public meetings/public relations campaigns, and potentially, bonding processes. It is recognized that the funding mechanism can take many forms and will be highly dependent upon funding cycles, project progress, and economic conditions, given the timeframe of this endeavor. If funding is secured for muliple phases, we anticipate there will still be a funding/public relations effort at the beginning of each phase to maintain project support.

It should be noted that this timeline assumes completion of the regional system on a regular pace. The advantage of completing the system on such a timeline is the avoidance of project cost escalation associated with inflation. However, if funding is not available on the suggested timeline, the schedule can be extended as necessary. As noted, part of the advantage of the selected phases is that as each is completed, it can immediately benefit regional participants. The return on investment is not pending completion of future phases.

Figure 10-1
Implementation Schedule



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CHAPTER 11
RECOMMENDATIONS AND NEXT STEPS

11.1 SUMMARY OF FINDINGS

The work of this study provides updated projections of water demands with respect to supplies, and develops a proposed means for using existing resources more efficiently and meeting regional water supply needs. This study reports a potential deficit of approximately 12,000 AF for the project participants at the planning horizon of 2050. This deficit is based on assuming that Denver Basin groundwater is an unreliable long-term supply, and that its use for primary production will not be economical by 2050. In addition, two study participants have acquired approximately 3,700 AF of renewable water that requires conveyance infrastructure for delivery to their service areas; approximately 2,850 AF in dry years. The study describes a feasible and cost effective system that can be used to meet participants' supply delivery needs. The following summarizes project feasibility, cost-effectiveness, and a recommendation to proceed with a phased approach to the system, develop a governance structure, and initiate efforts to secure funding.

11.2 A REGIONAL SYSTEM IS FEASIBLE

At this level of study, a regional system is found to be feasible based on availability of water rights, and reasonable sites and corridors in which to construct the water system facilities. Results of this study suggest that the proposed system is feasible because these elements are available:

- Based on reviews conducted as part of this study, we have determined that there are water rights available to allow participants to obtain water for exchange from the Arkansas River sufficient to meet the PPRWA participant needs. There are, however, political challenges to moving water from the Arkansas River, and participants will need to carefully consider ways to minimize the impacts.
- The proposed project also depends on the feasibility of conducting the exchange. As reported, a reasonable exchange schedule can be conducted to utilize water rights on the Arkansas River to allow withdrawal of water from Fountain Creek near Fountain.
- There are properties along the Arkansas River that have the potential to be converted to exchange reservoirs.
- There appear to be reasonable sites identified for water storage.
- There do not appear to be any major impediments to completing the proposed pipelines. Much of the extent of pipeline alignments follows where others are planned, or have already been constructed. It is anticipated that the proposed pipelines from the Fountain area to the Black Forest area will follow an alignment similar to that of the SDS pipeline, and will either include repurposing or following the alignment of the Sundance pipeline.

11.3 A REGIONAL SYSTEM IS COST EFFECTIVE

In order to provide participants with a basis for determining if it is prudent to move forward with a regional system, we also assessed the cost effectiveness of the conceptual system. We utilized the following metrics to assess the cost effectiveness at this level of study:

- Comparison of regional system costs in $/AF compared to other water supply projects in the area
- Comparison of regional system costs against the potential costs for individual entities to deliver renewable water
- Potential for cost avoidance and recovery

11.3.1 Costs in $/AF Comparison

For the $/AF cost comparison, the proposed regional system is intended to address an 11,895 AF deficit and convey another 280 AF already acquired by Donala, and a portion of the system is intended to convey 3,443 AF (2,568 AF in dry years) already acquired by WWSD. Because the size and therefore, cost of project components varies based on the water being delivered at that portion, the representative yield is between approximately 11,895 AF and 15,618 AF. Therefore, at the conceptual total cost of $277M, the comparative cost equates to $17,700/AF to $23,300/AF.

This general metric shows the concept to be reasonably cost effective. Costs of $20,000-$30,000/AF are common capital costs for new water supply projects serving Front Range communities. A study completed by the University of Colorado's Natural Resources Law Center evaluated anticipated project costs for 28 Front Range projects from northern, central, and southern Front Range areas. These projects were large projects, like SDS, with firm yields between 40,000 and 75,000 AF/year. The report listed an average project cost for all options considered and an average for the lowest cost option for each project. The reported costs for the overall average and low option average (in 2010 dollars/AF) were $20,764 and $16,200, respectively. These values, converted to 2014 dollars would be $23,310 and $18,187. When considering that the project proposed in this study would deliver only 25 to 30 percent as much water as projects in the University of Colorado Study, the proposed project is reasonably priced relative to other projects in the area.

11.3.2 Regional Costs for Individual Entities to Deliver Renewable Water

We also determined how the costs of a regional project might compare to the total costs if each entity developed its own project to deliver the same quantity of renewable water that could be delivered through a regional system. Table 11-1 below documents our assumptions and estimated costs. Because of the preliminary nature of this assessment, the potential costs developed represent only a general comparison. Actual costs for each entity to convey the desired renewable water supply would obviously depend on the final design. Total costs reported here should only be considered as a general reference to assess the relative merit of the proposed regional system.

Table 11-1
Costs Summary for Individual Entity Projects

SOFT COSTS	Unit Cost	Quantity	Total	Discussion
Preliminary Engineering	LS	1	$1,050,000	Assume $150,000 preliminary engineering for each of 7 entities
Environmental Compliance/Permitting	LS	1	$6,000,000	Actual costs heavily dependent on project design and timing. No change from estimates for regional project.
Property Acquisition	$13/LF	150,000 ft	$2,000,000	
Detailed Design	10% const cost	$334,512,500	$33,451,000	Anticipate these costs will be a larger percentage of total cost because of inefficiency in completing the work within multiple corridors and at multiple sites
Construction Management	7% const cost	$334,512,500	$23,416,000	
		Subtotal	**$65,917,000**	
CAPITAL COSTS	**Unit Cost**	**Quantity**	**Total**	**Total**
Area 1 storage	$7,500/AF	8,700	$65,250,000	Increased unit cost for multiple smaller facilities
Area 2 storage	$7,500/AF	1,500	$11,250,000	
Area 3 storage	$10,000/AF	4,100	$41,000,000	No change since the unit cost is relatively high
Untreated conveyance Pipeline	$400/ft	232,000	$92,800,000	Estimated pipe installation cost per foot for multiple individual pipe sized for each entities anticipated delivery. Assumed associated property costs would at least double with each entity locating on different property.
Treated conveyance pipeline	$600/ft	32,000	$19,200,000	
Pump Stations	Unit costs and quantity of facilities would depend on design and are therefore not reported. Evaluated potential cost change on aggregate cost.		$13,750,000	Anticipate similar total capacity but applied 25% premium to complete individual project components
Water Treatment Facility			$78,750,000	
Appurtenant Structures			$12,500	
Power supply infrastructure			$12,500,000	
		Subtotal	**$334,512,500**	
TOTAL – CAPITAL AND SOFT COSTS			**$400,429,500**	

Table 11-2
Pipe Costs Summary

Entity	Percent of Anticipated Flow	Estimated Flow Rate (cfs)	Estimated Pipe Size (in)	Pipe Size Assumed (in)	Unit Cost ($/LF)
Town of Monument	5%	1.0	5.0	6	$ 26.00
Woodmoor Water and Sanitation District	25%	4.8	11.2	12	$ 45.00
Triview Metropolitan District	25%	4.8	11.2	12	$ 45.00
Donala Water and Sanitation District	10%	1.9	7.1	6	$ 26.00
Cherokee Metropolitan District	25%	4.8	11.2	12	$ 45.00
City of Fountain	0%		0.0		
Potential Participants	10%	1.9	7.1	6	$ 26.00
Regional Total	100%	19.0	22.3		$ 213.00

Notes:

Palmer Lake not listed. Assumed it would be impractical for Palmer Lake to complete a project on their own.

Pipe Size assumes maximum velocity of 7 fps.

Pipe unit cost includes installation and materials for ductile iron pipe

As noted in Table 11-1, the construction costs could increase on the order of $100M in the aggregate if each entity pursues a similar project to exchange renewable water from the Arkansas River and deliver water from Fountain Creek. It is simply not practical for each entity to "go it alone." Without a regional system, the water providers would have very limited, or no access to more renewable water supplies. A major contributor to the cost increase is the redundancy of installing multiple pipelines to convey water through the same corridor. Even though the pipes would be smaller, the cost to install pipe is not proportional to size.

The soft costs could also increase dramatically for individual project completion. Much of the change is related to increased construction costs, and would result from developing multiple sets of drawings for the same transmission corridor. It is also likely that the design and construction engineering costs would be higher as a percentage of construction cost because the completion of the work as multiple separate projects will not be as efficient. Although it has a limited impact on the overall budget, we assumed that with multiple separate projects, the preliminary engineering would be significantly more costly because the initial geotechnical, survey, and environmental data collection may potentially need to cover a much greater number of sites and pipeline corridors.

11.3.3 Potential Cost Avoidance or Recovery

Participation in the regional system also includes some important cost avoidance and recovery potential, especially when the regional participants look at incremental implementation of the project. A few examples include:

- WWSD in their Long Range Plan anticipates on the order of a $6M investment in new wells in the next 10 years, and over 20 new wells within the planning horizon of this study. With well costs ranging from $0.5M to $2.5M (not including treatment or conveyance costs), this represents a significant investment. The Long Range Plan therefore recommends that WWSD develop other projects that will allow them to avoid drilling new Denver Basin wells. The regional facility supports that recommendation. WWSD could connect to CMD's Black Forest well field and make arrangements with CMD to provide an interim supply instead of constructing their own new wells. WWSD could then put that savings toward the construction of a pipeline that would ultimately help deliver their JV Ranch water when Area 2 facilities are constructed.

- The City of Fountain has embarked on plans to develop gravel pit storage. By participating with regional partners, gravel pit development could be completed at a cost savings to the City because economy of scale may result in a lower unit cost for development.

- CMD has installed a water transmission line (Sundance Pipeline) from the Black Forest well field to its service area. This pipeline is large enough (24-inch) that it may be possible to incorporate this line into the regional system. If this pipeline can be incorporated into the project, it may help reduce the overall project cost and help CMD recover some of the cost invested in its construction.

- WWSD purchased Calhan Reservoir along with the JV Ranch. If this storage facility can be incorporated into the regional system, it may help reduce the overall project cost and help WWSD recover some of the cost invested in its purchase.

As shown, the proposed regional project is a feasible and cost-effective way for the participating entities to address the needs of the people they serve. It also gives them some measure of control over their future. Oher options leave them, at least to some degree, dependent on the objectives of other entities. The Denver Basin aquifer is affected by numerous other entities, and renewable sources are only feasible through a contract relationship with the owners of existing systems. By developing an independent regional system, the participants would be able to establish more control for their constituents.

11.4 RECOMMENDATION TO PROCEED

It is recommended that the study participants proceed with the proposed regional system. The next steps are to initiate a phased approach to the project, begin developing the framework for project governance, and initiate efforts to secure funding.

11.4.1 Phased Approach

As described in the implementation scheduled, it is proposed that the project move forward with preliminary engineering for Area 3 conveyance and storage, followed by design and construction of these facilities. Initiating this work allows the parties to take an incremental step toward completion of the larger project while meeting near-term needs to optimize use of current supplies. By so doing, the entities will obtain information to help them determine how best to move forward with project elements and governance without an overly taxing initial investment. Governance can be developed on the heels of the preliminary engineering, and that new partnership could be in place for construction of the initial project. Either concurrent with or following design of the first project phase, the regional entity will be able to move ahead with subsequent preliminary work, design, and implementation of subsequent phases. The proposed implementation schedule provides the following advantages:

- <u>Stand-alone functionality</u>. Each phase of the project provides for stand-alone functionality. The proposed Area 3 conveyance pipeline will provide a connection from the northern project participants to the wells developed by CMD in the Sundance Ranch area. This effort provides these entities with an alternative source of water in the near term as they work toward securing the desired renewable water portfolio. It will also facilitate water sharing between participants to make best use of existing supplies.

  The Area 3 storage facility will provide a means to potentially improve use of Denver Basin wells. For some entities, the increased demand during summer months requires heavy pumping of their Denver Basin wells. In some cases, the higher withdrawal rates require discontinuing use of certain wells. With storage, the entities could draw water at a lower, average rate and store it for use during the peak demand period. The storage facility could also be used to support plans for reuse irrigation, reducing the draw on Denver Basin wells for that demand segment.

  Subsequent phases of the project will provide for interconnection between northern participants and water supplies and storage facilities in the south. In particular, with Area 3 conveyance in place, completion of transmission through Area 2 will provide WWSD access to their JV Ranch water.

- <u>Efficient Use of Resources</u>. The proposed construction phasing will also facilitate efficient use of resources by participating entities. For example, by providing the connection to a satellite well field for joint development, participants will be able to meet near-term needs and apply the savings toward development of renewable water, rather than individually complete new wells for their near-term needs.

  In addition, the proposed project elements can be implemented over time to allow efficient use of funds. This project has been conceived well ahead of the potential deficit, allowing time to carefully plan for project investment. It also includes potential implementation of gravel pit storage which can allow a water purveyor and property owner to develop a strategy for development of storage capacity in conjunction with mining operations. The water purveyor can secure a storage facility without a large initial investment of capital, and then develop storage capacity as it becomes available.

- The entities involved in this study also understand the importance of making best use of the resources they already have. Developing a regional system is not just about finding new sources of water but about making the best use of the sources already in use. For example, shared use of available renewable sources may reduce stress on the Denver Basin supplies and prolong their economically useful life. In addition, there are entities that already have renewable water sources, but need the infrastructure to deliver that water.

11.5 GOVERNANCE STRUCTURE

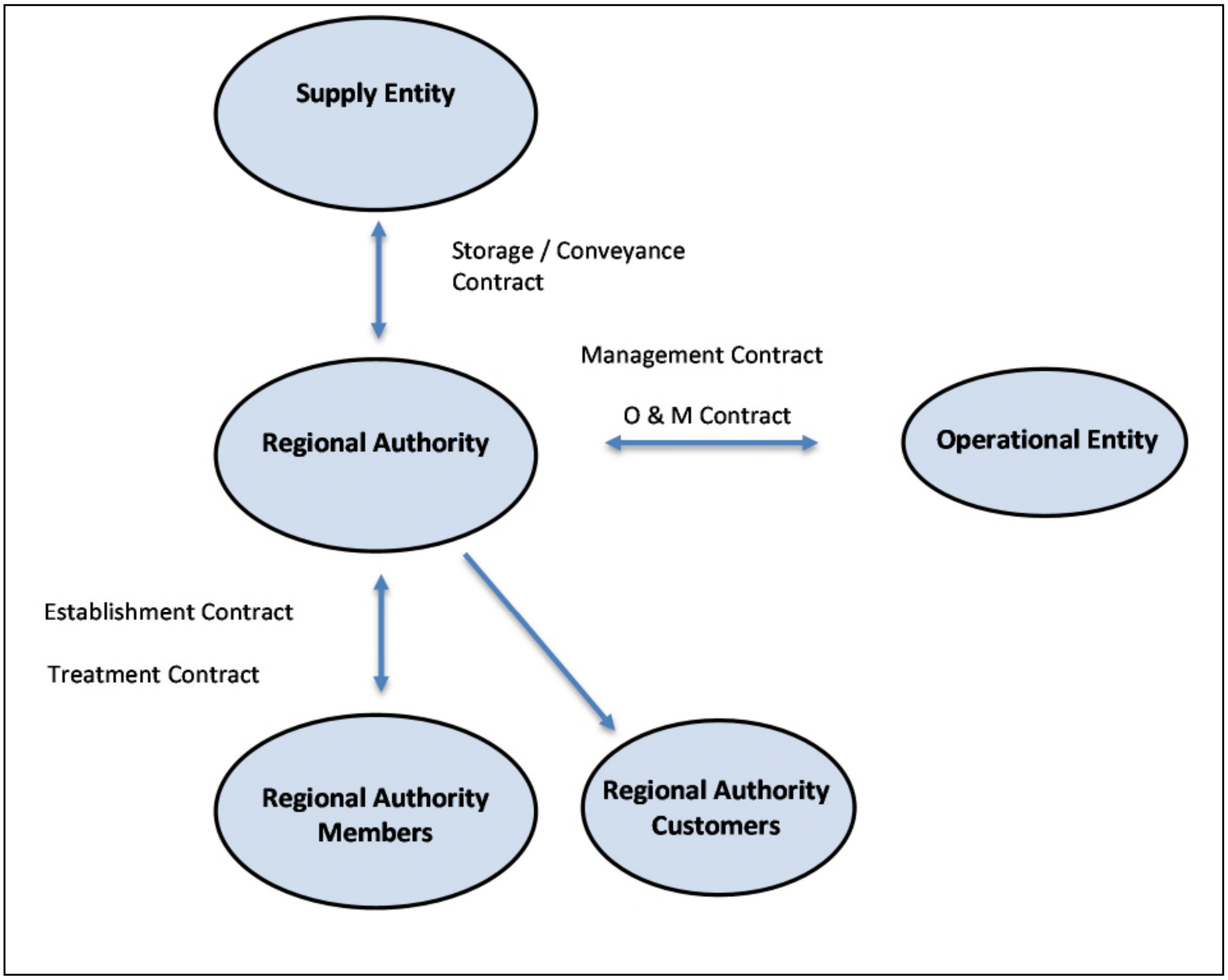
An important element of making this project work will be to establish a mechanism by which to govern construction and operation of the regional system. The following discusses briefly some options for proceeding, and provides a recommended governance structure for completing the project. The mechanism for governing the system should provide control commensurate with risk and flexibility to operate. Potential governance mechanisms could include:

- Utilization of the existing PPRWA framework. The regional system could be managed through the PPRWA framework by making the required modifications to bylaws and operation protocols. This regional entity already has a history of managing projects and working together to meet regional objectives. The advantage of utilizing this framework is that it already exists and has proven effective. The disadvantage is that the goal of the PPRWA includes a broad spectrum of project funding, advocacy, and representation. Setting the PPRWA as the project entity could interfere with efficient operation of both the PPRWA and the regional water entity. For example, there are PPRWA members who are not participants in the regional water project. There may be challenges to assuring these members that they are not funding the regional water entity. For the water entity, the PPRWA would not be focused on system operation which could introduce inefficiencies. In addition, PPRWA advocacy on particular issues may impact the regional entity's ability to obtain political support for project funding. It is therefore anticipated that close association with PPRWA will be maintained, but it is not recommended that the existing PPRWA organization be used to manage the regional water entity.

- Regional participation as a customer. The regional system could be managed by one participant with other interested parties as customers. The advantage would be avoiding the need to create a new governing body or modifying the operation of an existing regional organization (such as PPRWA). The disadvantage would be the subordination of most of the participants. As a system for the entire regional entity, this would undermine a key objective of some of the participants: to secure more control over water supply. It is therefore not recommended for the overall system. However, for some participants, functioning as a customer would have the advantage of limiting their risk, and they may be willing to lose some project control as a trade-off. For example, the incremental supply sought by Palmer Lake is small enough that they may not want to become an entity partner, but could negotiate a rate for water delivery from the regional entity. This method of participating could also apply to the unidentified additional participants for which the system is being planned.

- Creation of a new regional governing entity. The regional system could be managed through the creation of a new regional entity. The advantage of creating a regional entity to manage development of the system and follow-on operation is that it would be a focused entity, and the participants could establish a mutually acceptable mode of representation. The disadvantage would be the cost associated with creating a new entity. However, one unique advantage that the participants have is that many of them have already taken part in the creation of, or have functioned within the type of entity that would be created, so the group would not be breaking new ground. It is recommended that the participants consider forming a new regional entity to complete development of the new water supply system. A sample governance structure is shown and described in Figure 11-1.

Figure 11-1
Governance Structure



11.5.1 Regional Authority

The core entity would be the regional authority. This body would be responsible for, and have authority to purchase property, enter into contracts, employ staff, incur debt, and conduct business as an independent entity. As described below, the authority members would be able to direct the authority by establishing a voting or representation protocol. When seeking loans, the regional authority would be established such that it could utilize the bonding capacity of individual entities but as a stand-alone entity, it would not burden the entities with incorporating its capital and operations budget tracking. This type of system has worked effectively for the Fountain Valley Authority for many years.

11.5.2 Establishment Contract

This contract would be the document that would be initially negotiated to set up the working entity. It would include the protocol for representation, mechanisms for conducting business, and provisions for withdrawing from the authority or for selling/trading capacity in the system.

11.5.3 Treatment Contract

If treatment is developed regionally, a separate contract would be developed to address the obligations, costs, and delivery of treated water from the authority to the participants. Among other things, the benefit of separating this contract from the establishment contract is that costs associated with treatment can be more closely tied to a usage unit price than costs associated with system establishment.

11.5.4 Supply Entity

The authority may want to interact with a supply entity to establish use of a water source. Such an entity may be a regional authority member. For example, WWSD and DWSD both have renewable sources that need to be conveyed through the regional system. CMD also has a satellite well field that may be of use to regional participants during transition to renewable sources. There may be other entities from which a new source of water can be secured, either interim or long-term, as opposed to regional participants obtaining a new water right.

11.5.5 Storage/Conveyance Contract

In the event that the regional authority seeks to work with a Supply Entity, an agreement would be established that makes a water supply source available to the regional authority in return for compensation for its use.

11.5.6 Operation Entity

The regional authority could contemplate hiring and directing its own staff to manage, operate, and maintain the system, or could look to an outside entity or entities to complete these tasks. For example, with the SDS pipeline, multiple entities are participants in the project but the management and O&M are completed by CSU. At this stage, a recommendation regarding the operating entity is premature. A reasoned decision will require a more thorough investigation of management and operations preference, potential costs associated with different operations scenarios, and an understanding of entity's willingness to operate/manage, or allow another entity to do so. For example, we understand from review and discussion with participants that there is not a consistent SCADA control system used by all entities. Coordinating or adjusting such control parameters is likely just one element in the many that would need to be evaluated in order to arrive at a mutually acceptable operation plan.

11.5.7 Management and O&M Contracts

Regardless of the management and operations program implemented, the regional authority would develop a means for establishing the program and cost recovery for its operation.

11.5.8 Regional Authority Members

As discussed in this report, one of the key advantages of developing a regional system is placing regional authority members in positions of authority and control regarding decisions about water supply. The regional authority members' first order of business would be to establish a framework under which they are comfortable operating. This would include elements such as setting voting weight. This could be a "one member, one vote" arrangement or a vote in accordance to cost contributed. Other decision structure elements and meeting protocols would also be set by the members. Membership would involve the work and potential risk of overseeing the operation of a functional authority, but would carry the benefit of participating in decisions regarding water supply.

11.5.9 Regional Authority Customers

As an alternate, there may be entities that have neither the resources nor the desire to participate in the creation and maintenance of a regional authority, but may have an interest in utilizing a product or service of the authority. Such entities could participate in the regional system as a customer. This arrangement could be advantageous to the customer because the regional authority could function as an interim or long-term source, and customers could provide the entity with additional cash flow. Such arrangements would have to be carefully evaluated and may be limited by water rights use restrictions. For example, interbasin water rights use is typically not allowed. Whereas the project area includes or is adjacent to the Palmer Divide, customer agreements in the vicinity of the Divide would have to take into account the fact that the regional water system most likely would not be able to provide water outside of the Arkansas basin.

11.6 INITIATE EFFORTS TO SECURE FUNDING

We recommend that the study participants initiate efforts to secure funding for the next phase of work as soon as possible. The current focus on the 2050 water supply gap with Colorado's Water Plan makes this a great time to seek funding support for this regional system to address the largest share of the M&I gap in the Arkansas basin. The concept for this regional system has a prominent place in the Arkansas Basin Implementation Plan and is consistent with the goals of the state water plan.

This sets up well for obtaining Water Supply Reserve Account (WSRA) grant funding to support preliminary engineering for Area 3. The participants would provide some matching funds, and with support from the Arkansas Basin Roundtable, could apply for a WSRA grant from the Colorado Water Conservation Board (CWCB) to fund a substantial share of that next phase of work. Future phases could be eligible for additional grants through the CWCB, the State Department of Local Affairs (DOLA), or the US Bureau of Reclamation's Rural Water Supply program at a federal level. Water supply also connects with economic development, and that could present another avenue for grant funding.

Better project definition through preliminary engineering and establishment of a governance structure can set the stage for larger shares of funding and financing. The CWCB runs a low-interest loan program, and working within that program would be favorably received as an extension of any CWCB grant funding. The Colorado Water and Power Development Authority also facilitates low-interest loans through the State Revolving Fund (SRF) program. The federal Rural Water Supply program could also offer low-interest financing, and bond financing would be an option as well.

APPENDIX A
REFERENCE DOCUMENTS

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APPENDIX A
REFERENCE DOCUMENTS

SUMMARY OF REFERENCE DOCUMENTS

The following documents were reviewed as part of the preparation of this study. The reference list is followed by a summary of pertinent information from selected sources.

- Applegate, 2008. Arkansas Basin Consumptive Use Needs Assessment (Applegate Group, July 2008)
- Arkansas Basin Roundtable, 2008. Arkansas Basin Nonconsumptive Needs Assessment Mapping
- Arkansas Basin Roundtable, 2008. Considerations for Agriculture to Urban Water Transfers, September 2008.
- Arkansas Basin Roundtable, 2009. Projects & Methods to Meet the Needs of the Arkansas Basin, November 2009
- Bishop Brodgen, 2008. WIPS prepared for the PPRWA, February 2008.
- Black & Veatch, 1998. Draft Feasibility Study for Interconnection of the Monument and Palmer Lake Water System, January 1998.
- Boyle, 2008. Arkansas River Renewable Water Economic Feasibility Study Part 2 – Water Supply from the Arkansas River between Las Animas and La Junta. Prepared for Pikes Peak Regional Water Authority, October 2008.
- Brown and Caldwell, 2011. Arkansas River Decision Support System Feasibility Study, December 2011.
- CDM, 2007. Study of Alluvial Storage in the Arkansas Basin.
- CDM, 2009. Water Supply and Needs Report for the Arkansas Basin, Modified August 2009.
- CDM, 2010. Arkansas SWSI 2010 Basin Report.
- CDPHE, 2011. Arkansas River Basin Plan, Statewide Water Quality Management Plan
- Colorado Geological Survey, 2006. Upper Black Squirrel Creek Basin Study.
- El Paso County Water Authority, 2002. El Paso County Draft Final Water Report, September 2002.
- PPACG, 2010. Pikes Peak Area Water Quality Management Plan.
- Tetratech, 2012. Woodmoor Water and Sewer District Long Range Plan, 2012.
- USGS, 1985. Sources of Water and Nitrogen to the Widefield Aquifer, Southwestern El Paso County
- WW Wheeler & Assoc. Widefield Aquifer Management Program (Presentation by WW Wheeler & Assoc.).

Notes on Background Documents

- Applegate, 2008. Arkansas Basin Consumptive Use Needs Assessment (Applegate Group, July 2008)

  See Table A-1 for comparison of current study assessment to 2008 assessment.

- Bishop Brodgen, 2008. WIPS prepared for the PPRWA, February 2008.

  Document contains Water Infrastructure Planning Study (WIPS) report dated February, 2008. WIPS participants get majority of water from Denver Basin aquifers, primarily the Dawson aquifer, Denver aquifer, Arapahoe aquifer (accounting for approx. 65% of water supply for WIPS participants) and Laramie-Fox Hills aquifer. Currently, 5-10% of supply from reuse.

  Recommendations for addressing supply issues:
  1. Efficiency – All participants should optimize supply through efficiency programs or other methods.
  2. Well field optimization – All participants should evaluate system wells individually and determine optimization strategies.
  3. Interim supply planning – All participants should develop individual long range plan based on WIPS recommendations.
  4. WIPS II – Participants should conduct second WIPS to confirm conclusions.
  5. Backbone water line – Construct a common trunkline to connect participants.
  6. Interim supply – Begin planning for exchange and IPR for interim supply.
  7. Terminal storage – Begin process of establishing terminal storage.
  8. Renewable water supply – PPRWA should look into renewable alternatives.

- Black & Veatch, 1998. Draft Feasibility Study for Interconnection of the Monument and Palmer Lake Water System, January 1998.

  The assessment contemplated 7000 ft of 10 inch to connect Palmer Lake and Monument. $1.4M 1997. Lift from Monument to Palmer Lake ~600 ft. 3@ 500gpm, 50 hp

- Colorado Geological Survey, 2006. Upper Black Squirrel Creek Basin Study.

  <u>General Information Reported:</u> Study encompasses entire Upper Black Squirrel Creek drainage basin. Identifies location, area, topography, climate and other pertinent data related to the study area and details the geological features and structure of the basin. Also describes alluvium characteristics, well yield, groundwater levels and rate of aquifer decline, and estimated groundwater volume and available storage in the alluvium. Discusses possible complications with implementing an aquifer recharge project. Discusses zoning implications, existing infrastructure complications, and complications with existing utilities.

  <u>Document Summary and Conclusions:</u>
  - Basin area 350 sq miles and is located entirely in east-central El Paso County.
  - Water in basin used by Cherokee, Woodmen Hills, and Meridian Metropolitan Districts.

- Significant losses have been documented in the basin over the last century.
- Water within the alluvial aquifer in the basin is classified as either sodium calcium-mixed anion or sodium calcium bicarbonate type.
- Estimated remaining water in the basin is 475,000 acre-ft. Unsaturated portion of alluvium could hold 605,000 acre-ft of additional water storage.

- El Paso County Water Authority, 2002. El Paso County Draft Final Water Report, September 2002.

  Portion of study summarized water users by source:

  Denver Basin aquifer water users: Academy, DWSD, Forest Lakes, Monument, Palmer Lake, Park Forest, TMD, WWSD

  Upper Black Squirrel water users in the designated basin: Paint Brush Hills, CMD, Sunset, Woodmen Hills

  Fry/Ark Water and Widefield aquifer water users: Fountain, Stratmoor Hills, Security, Widefield

  Monument and Fountain Creek well and surface water users: Colorado Centre, Monument, Palmer Lake, WWSD

Table A-1: Comparison of Current Study with Ark Basin Needs Assessment 2008

Study Participant / Major Provider (1)		WATER SUPPLY GAP — Ark Basin Consumptive Use Needs Assessment (2): Demand Increase	Supply Reduction	2030 Gap	PPRWA Study (3): 2050 Gap (5)	Change (4)	Notes
Town of Palmer Lake / NR				0	**100**	100	(6)
Town of Monument			569	569	**795**	226	(7)
Unincorporated El Paso County							
WWSD			1,620	1,620		-1,620	(8)
TMD			2,992	2,992	**3,100**	108	(7)
DWSD			1,269	1,269	**1,480**	211	(7)
CMD			4,200	4,200	**3,098**	-1,102	(9)
City of Fountain/ Fountain sub-region		4,500		4,500	**822**	-3,678	(10)
Other Participants	Falcon sub-region	2,500	2,500	5,000	**2,500**	-4,950	(11)
	Forest Lakes Metro District		200	200			
	Monument sub-region	2,000		2,000			
	Other Individual GW Users	250		250			
TOTALS		9,250	13,350	22,600	**11,895**	-10,705	

Notes

1 For clarity when referring to each of the original documents, the water providing entities, referred to as "Study Participant" in this study and "Major Provider" in the Applegate, 2008 study, are both listed in the table. Different names were used or where an entity was not reported (NR) in either study, the names are listed separated by a forward slash (/). One name is shown where the same name was used

2 Date from Table 1. "Comparison of 2008 Update and SWSI Phase 1" from Applegate, 2008

3 Data from Table 3 of this study

4 Change = difference in projected Gap between studies. Positive values represent an increase in the gap

5 Estimated future gap compared to projected gap from Needs Assessment 2030 (Applegate 2008). Compared the gap against our 2050 estimate because it represents long term target which is what the Applegate study seemed to be targeting. Also, the 2030 estimates reflected very rapid growth, which is more likely to be seen in 2050, and the Applegate study projected a gap at the point in time when use of Denver Basin wells is no longer economically viable, which this study is estimating will occur in 2050.

6 The Applegate study did not project a gap for Palmer Lake. The Town expressed interest in having augmentation water because their SW supplies aren't always in priority. Although they currently meet their needs using DB GW, this study assumes that the supporting GW supply will eventually be replaced by new SW supply.

7 Estimated gap from this study similar to but slightly higher than estimated in the Applegate study.

8 WWSD has acquired 3442 AF of renewable water since the previous study was completed which eliminated the gap for the District

9 The previously reported gap projected a loss of 4,200 AF of GW supply capacity. This is consistent with the current study wherein we estimate that approximately 4,400 AF of GW supply may not be available to CMD in 2050. The reduction in the gap reported in this study is therefore likely associated with modified growth projections and additional supplies acquired by the District since the previous study was completed.

10 The previous study reported no gap for the City of Fountain, but included a 4,500 AF demand for recently annexed land near Fountain. This study uses demand projections provided by the City of Fountain to estimate the total potential demand to be met by the City. Comparison of the data shows that demand projections have changed dramatically. For example, the 2006 Fountain Master Plan projected demand between 11,000 and 14,000 AF by 2036. For this study the City has elected to plan for 10,000 AF demand by 2050. Therefore, the difference in projected gap is related to modified demand projections.

11

As study participants consider what to plan for, it was determined that planning for the inclusion of non-participating entities would be prudent, but the group did not want to skew cost projections by trying to incorporate all other entities within the county. Therefore, the study participants elected to include an unmet need for 3,500 AF to represent the portion of water demand for non-participating entities that could be supplied through this system. It was also assumed that the 1,000 AF of Upper Black Squirrel GW that CMD cannot export from that basin will likely be available to potential participants represented by this category. The estimated gap is not intended to represent the gap for the whole county. The Applegate study suggested potential for a 7,450 AF gap for all these entities. However the group felt that infrastructure planning for only a portion of the total gap was warranted.

APPENDIX B
MAPS

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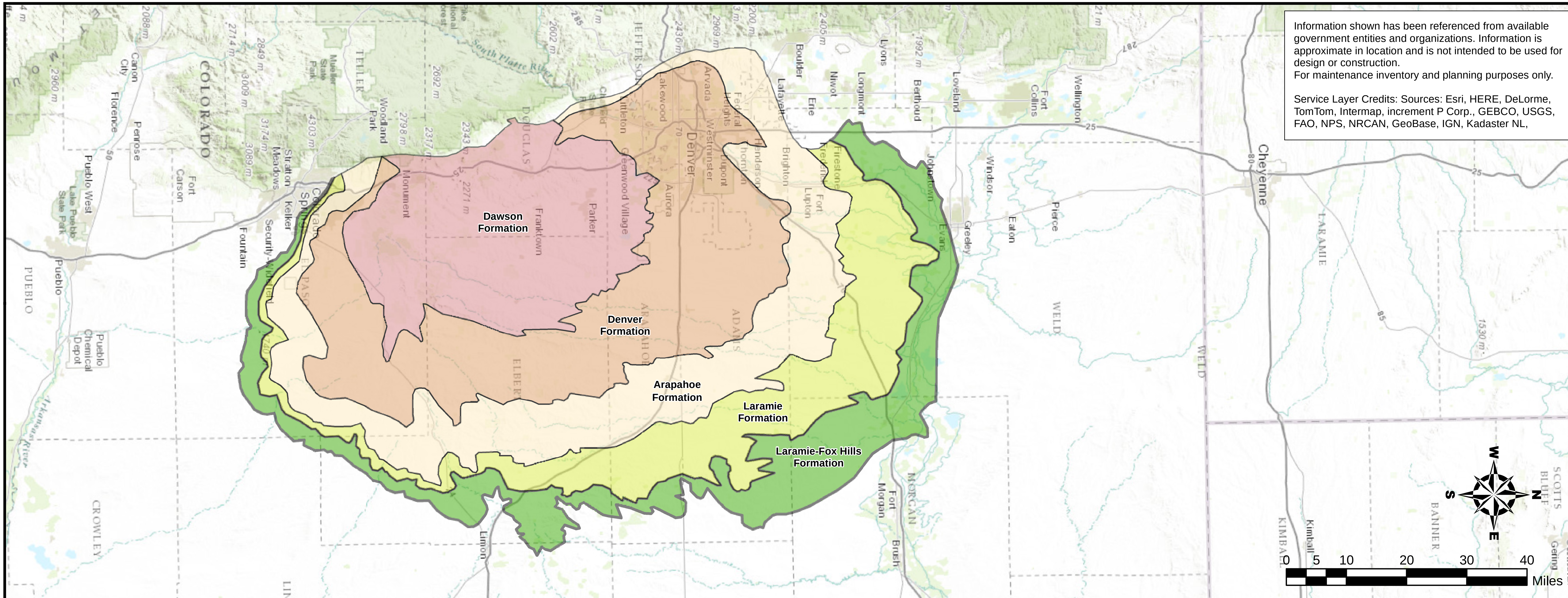
Legend
WWTP Return Flow
Existing Water Storage Tank
Existing Water Storage Tank
PS Pump Station
WTP Water Treatment Plant
SDS Pipeline
Sundance Pipeline
DOUGLAS
ELBERT
EL PASO
BLACK FOREST
MONUMENT CREEK
FOUNTAIN CREEK
UPPER BLACK SQUIRREL CREEK BASIN
WTP
PS
UPPER WILLIAMS CREEK RESERVOIR
WIDEFIELD AQUIFER
FMIC CANAL
CHILCOTT DITCH
WILLIAMS CREEK RESERVOIR
FOUNTAIN GRAVEL PIT
CALHAN RESERVOIR
TELLER
FREMONT
EL PASO
PUEBLO
FOUNTAIN CREEK
CHICO CREEK
ARKANSAS RIVER
PUEBLO RESERVOIR
PIKES PEAK REGIONAL WATER AUTHORITY
REGIONAL INFRASTRUCTURE STUDY
N
W
E
S
FIGURE 1:
PPRWA
FEATURE MAP
Date Printed: 4/27/2015
FORSGREN Associates Inc

DOUGLAS
ELBERT
EL PASO
MONUMENT
AREA 3
MONUMENT CREEK
FOUNTAIN CREEK
COLORADO SPRINGS
AREA 2
TELLER
FOUNTAIN
FREMONT
EL PASO
PUEBLO
FOUNTAIN CREEK
CHICO CREEK
AREA 1
ARKANSAS RIVER
PUEBLO RESERVOIR
PUEBLO
Legend
Town of Monument
Donala Water and Sanitation District
Woodmoor Water and Sanitation District
Triview Metropolitan District
Cherokee Metropolitan District
Colorado Springs Utilities Boundary
Town of Palmer Lake Boundary
City of Fountain Boundary
PIKES PEAK REGIONAL WATER AUTHORITY
REGIONAL INFRASTRUCTURE STUDY
N
W
E
S
FIGURE 2:
REGIONAL PROJECT
AREAS MAP
Date Printed: 4/27/2015
FORSGREN Associates Inc
Information as displayed on map is for Planning Purposes only. The data is approximate in terms of content and location and has been sourced from local, state, and national government agencies. Please contact Forsgren Associates Inc. with questions. 720.214.5884
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community



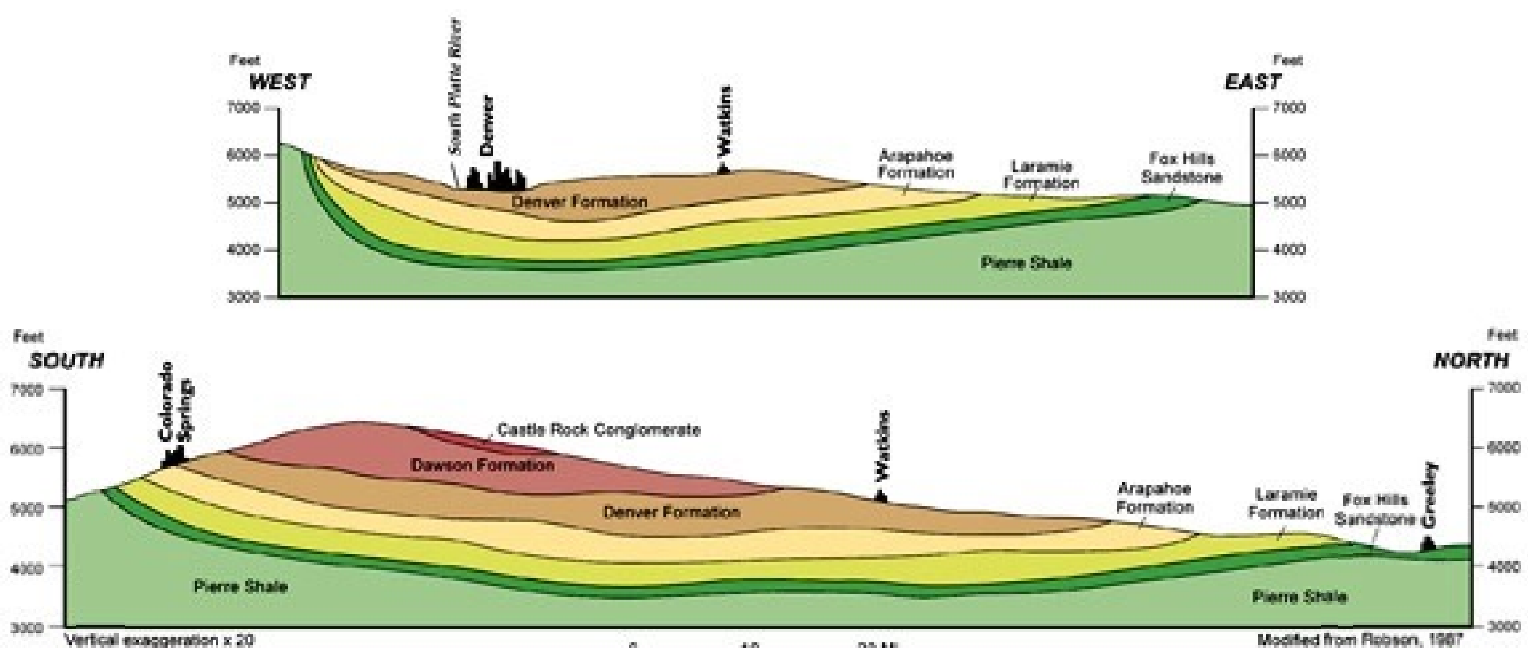


Image courtesy of Colorado Geological Survey

Date Printed: 1/12/2015

PIKES PEAK REGIONAL WATER AUTHORITY REGIONALIZATION STUDY

FIGURE 3:
DENVER BASIN AQUIFER
PLAN & SECTION

FORSGREN Associates Inc.

Information as displayed on map is for Planning Purposes only. The data is approximate in terms of content and location and has been sourced from local, state, and national government agencies. Please contact Forsgren Associates Inc. with questions. 720.214.5884

LEGEND

- Dawson Formation
- Denver Formation
- Arapahoe Formation
- Laramie Formation
- Laramie-Fox Hills Formation

APPENDIX C
PARTICIPANT MEETING NOTES

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FORSGREN Associates Inc.

Cherokee Metropolitan District

Preliminary Entity Meeting

February 13, 2014

Contact:

Sean Chambers
Phone: (719) 597-5080
Email: schambers@cherokeemetro.org

Meeting Notes:

Existing water supply system condition	
Planning Documents	Review current master plan documents. Cherokee is getting the first 1041 Permit in El Paso County for a large-scale pipeline, the Black Forest line. (CSU processed one for a ½-mile pipeline connection.) CMD only has about three more easements to get.
Pump / Treatment / Piping descriptions	
Storage capacity	
Water supply system controls	Controls are under contract to Timberline. John on staff at the WWTP came to CMD from Timberline. All controls are hosted at the District. Sean agreed that it is good to include SCADA discussion, and CMD will need a SCADA connection to Woodmen Hills and Falcon.
Power supply	Providers: MVEA and CSU. CMD doesn't currently manage for power demand. MVEA recently changed rate structure to minimize load demand charge and increases base charge, so the District is no longer charged heavily for load demands.
Current water supply system operations	
Operations summary	
Water Right summary	
Demands	
Critical delivery	Some industrial customers would be frustrated with service interruptions, but Schriever AFB is the only critical service customer.
Operational procedures to	The most significant procedural operation is for nitrate

meet demand and comply with regulations	management, requiring the District to blend supplies to meet water quality standards. Some wells always have to run in combination to blend nitrate to acceptable limit. Operation utilizing Black Squirrel well supplies must take into consideration non-exportable exchange. Every year the meaning of "non-exportable" is renegotiated.
Operational staffing	
Finances	Sean provided copies of audit and bond documents.
Water quality	
Regional Experience	
Water supply system maps	Forsgren is already working with District's GIS technician and has access to maps. We need to add the Tamlin Tank and Falcon waterline to the study map. Sean also drew an existing Drenin Rd waterline on the map that could be replaced for water delivery to the UBS Basin.
Entity objectives, concerns and plans for future changes in water supply delivery,	
Current limitations / upgrade needs	The pipeline to bring water from the east was constructed 50 years ago with salvaged pipe. That is CMD's only water supply pipeline until Sundance completed. It is a reliability problem, and they will need to rehab/parallel/replace that line.
Recent water supply acquisitions	Black Forest
Anticipated future service	
Water demand projections for 2035 and 2050	Review current water master plan
System objective	CMD is seeking an opportunity to get into the renewable water game. They have alluvial groundwater in the UBS Basin, and drought-proof Denver basin groundwater. What they don't have is renewable surface water. The District has not yet taken steps to get renewable water that some others have (delivery contract, storage). CMD is trying to get into the renewable water world, but the barrier to entry is really high. For rotational

	fallowing, flex water rights, and other measures to work, you have to have the infrastructure to deliver from farm to municipal customer; exchange, storage, federal contracts for storage, etc. There are tremendous hurdles for all those pieces. While rotational fallowing is a great idea, these ideas tend to only benefit the large systems with large pipes and storage, the muscle to fight the USBR, and be well represented in meetings. So how do those with no stock in FVA take advantage of rotational fallowing? This regional study needs to address the arduous red tape and difficult situations like: the USBR not giving storage until a conveyance contract in place. Also, CSU wants to see that an entity has water supply when considering a conveyance agreement, but the Water Court won't consider an incomplete application; therefore, water right decrees can be dependent upon having USBR and CSU contracts in place. It takes tremendous concurrent effort to try to get USBR storage, conveyance, and Water Court adjudication. Even with all the right pipe, there are significant institutional hurdles. CMD is interested in alternatives to SDS. This may be another pipeline, or may be in the form of exchange potential (like Jessie mentioned for Lower Fountain). CMD is interested in Upper Black Squirrel alluvial storage (2006 Colorado Geological Survey study should be available, maybe from CWCB). The USGS is currently studying water quality in the Basin to consider discharge/storage there without water quality problems. They have some good preliminary data, and Mike Rupert is the contact. Consider replacing an old 10-inch AC line on Drennan Road. That is one way to push return flow water to Black Squirrel. CMD probably owns the pipe.
Anticipated water supply acquisitions	CMD understands that there is a lot of capacity for exchange in Fountain Creek between JV Ranch and the Arkansas River.
Anticipated areas of water service expansion	
Need for other utility extensions (power, natural	

gas, etc.)	
Other	
Storage ideas	Consider the pit that Gary Barber has been evaluating; there are three cells in the Kiewit pit. Will has been in touch with Kevin Butcher on this. There are four different pits, and Sean requested zoomed in detail on our engineered overlay for those that could serve water supply needs. Sean is talking to Mark Morley about the Stonewall Springs pit as a potential storage and reuse bucket. He has a great aerial shot of vicinity with property boundary overlay, and overlay of water supply storage pits they have planned and where the good and bad aggregate is. They are under contract with the Division of Wildlife (DOW) for Stonewall Springs. DOW is looking to use it more passively. They can sell and lease storage for people who need it. CSU and State Parks return flow there, it is closer to Pueblo, and it benefits bird habitat. Sean suggested that Gary Barber should be able to provide the Boyle study on the Arkansas pipeline options. That study is important to what is going on with pits or storage at Arkansas River, and a key benchmark in defining alternative pipelines to SDS. It has a couple of alternate routes and notes the challenges and economics of pipeline points of origin from the Arkansas River. To go after river water, you need terminal storage and the ability to receive treated potable water 365 days a year.
Comments on Reuse Plan	
Other potential ideas	Another entity to check in with: Dan Higgins from the Rocky Ford Highline Canal. He is a vocal and "outside the box" thinker for an ag guy. He was involved when Rocky Ford Highline began working with Aurora, and ran an ag fallow dry-up program. They have a conceptual plan of how they would use ditch water to recharge alluvial wells below the ditch and run a pipe from there up. Will noted that Dan was who we had planned to contact for ag. review of our study plans. Sean suggested tapping **Reed Dils** for a recreational

	interest in study review. He was formerly on the SEWCD Board as well and from the upper Arkansas River area. We would not need to have them at every meeting, but could just send them a document to review. There is no real nexus with recreation unless there are plans for fishing in a water storage pond. Sean also strongly suggested talking to Scott Lorenz, manager of AGWUA and MAGWUA since he has good handle on how water moves around the Arkansas River, and opportunities for storage and exchange at Stonewall Springs and other Pueblo County Storage locations. He also knows what the farmers are dealing with, and is informed on operations and deal points with Stonewall Springs and Parks/Wildlife deal.

FORSGREN Associates Inc.

Colorado Springs Utilities

Preliminary Entity Meeting

April 2, 2014

Contact:

Jenny Bishop, P.E.
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Meeting Notes:

Existing water supply system condition	
Planning Documents	CSU is in the process of developing an Integrated Water Resource Plan (IWRP). The IWRP and related studies will be most relevant for this process.
Treatment Capacity	Current treatment capacity is such that there could be some opportunity to share treatment at existing water treatment plants and waste water treatment plants. Some of that opportunity could be with the new SDS water treatment facility. With additional specific information about the needs of regional water providers various approaches could be utilized, although the location of the existing water treatment plants would limit the opportunities to treat water other than CSU system water and convey that water to other entities.
Storage capacity	Utilities is actively pursuing storage opportunities along Fountain Creek and within the Arkansas Basin. Utilities is open to developing partnerships with other regional water providers to establish storage that benefits multiple stakeholders. Future storage is planned at Upper Williams Creek which has potential regional benefits. It is anticipated that Upper Williams Creek would have approximately 30,000 AF of storage
ASR Capacity	Over the past decade, CSU was actively involved in studying the feasibility of ASR in Denver Basin aquifers. Two wells at CSU's Northgate Well facility were equipped with ASR capabilities and CSU was able to store over 2,000 AF in Denver Basin aquifers between roughly 2005 and 2012. CSU has elected to discontinue its ASR Program as a result of numerous

	operational issues, high O&M costs and concerns with the ongoing EPA water quality requirements. CSU decommissioned its ASR system in 2013 and is currently extracting stored water from the Northgate Wells. Although CSU is no longer actively pursuing ASR as a water management tool, it remains actively engaged and interested in discussions regarding appropriate applications of ASR on a local, regional, and statewide level. Accordingly, CSU would be open to discussing conjunctive use of surface water and groundwater supplies on a regional level, which could include future ASR development, infrastructure sharing, or arrangements. The Northgate Water Treatment Plant is currently equipped to treat 2 MGD and could be upgraded to treat 3 MGD.
Supply Interconnections or Shared Transmission	CSU has interconnections or shares water transmission with Donala WSD, Cherokee MD (CMD), and Fountain, Widefield, Stratmoor Hills and Security (via the Fountain Valley Authority). There is also an additional connection with Security that will be used to deliver their SDS water. The Donala connection is fairly new. The interconnect has a daily flow limit of 1.2 mgd and cannot deliver more than 2,083 gpm. A hydraulic grade line at the connection is at or above 7,072 feet. The connection with CMD is older, but still in reasonable condition. The instantaneous flow rate cannot exceed 1,400 gpm, and the daily flow limit is 2 mgd. The pressure at the interconnect is not allowed to drop below 60 psi. Utilities and Fountain share water transmission and treatment facilities through the Fountain Valley Authority (FVA). FVA conveyance and treatment capacity is fully utilized by the project beneficiaries, and there is effectively no excess capacity available for other entities now or in the future. There may be near-term excess conveyance and treatment capacity available for regional partners in the Southern Delivery System, which is expected to be completed in 2016. There may be some peak capacity available in the SDS pipeline in the near-term, and greater opportunities for regional partners to potentially lease off-peak capacity for an extended

	period of time. It is anticipated that this capacity would be available on an "If and When" basis and opportunities for regional partners to utilize this excess capacity may become more limited in the future as Colorado Springs demands increase and it "grows" into the system.
Water supply system controls	Most of the information used to track water is transmitted via SCADA, although some information is transmitted via satellite. Limited structures are still read manually and then reported. Reports are then generated using either or the PI system or Water Information System (WIS). The control room monitors where the water is diverted and tracks the water from the treatment plant through the distribution system. Due to NERC regulations, CSU cannot allow others to access SCADA data or pull data from SCADA; however, some reports and information can be provided to others, upon request.
Power supply	The utility typically powers its own facilities within its service area. For facilities outside CSU's electric service territory (e.g. pump stations), CSU contracts with the power provider that services that area. CSU has the power generating capacity to meet all of the needs of its electric customers through the use of coal fired power plants, a natural gas fired power plant, and hydroelectric power generation. CSU does have the capability to buy and sell power on the grid.
Current water supply system operations	
Other water supply areas	CSU also provides water service for Fort Carson, Peterson AFB, USAF Academy, Green Mountain Falls, Chipita Park, and Cascade. There is a raw water emergency connection with Manitou Springs. Green Mountain Falls, Chipita Park, and Cascade have pretty static populations and they can be served via gravity. CSU is obligated to serve Green Mountain Falls and Chipita Park, while Cascade is sold water wholesale based on decades old agreements.
Demands	CSU's demands are proportionately much greater than those of the other participants of this study which is really focused on serving areas outside of CSU's service area. CSU typically delivers approximately 81,000 AF each year, or about 72.5 mgd. Build-out is currently estimated to be beyond 2060 and use anywhere from 125 – 150 mgd, depending on future city limits, growth, density, and other factors. Based

	on rough projections from the El Paso County Water Authority Study done in 2001, it was anticipated that surrounding areas will need 13 MGD.
Regional Experience	See discussion under Entity objectives, concerns…
Water supply system maps	To be provided.
Entity objectives, concerns and plans for future changes in water supply delivery,	CSU has a primary interest in avoiding a water crisis "on their doorstep." The potential exists that if there is a water crisis in the region, CSU would be asked to step in. That kind of condition isn't in the best interest of CSU or the region. By being involved and understanding what regional water providers need, they can be better prepared to help maintain water security for the region. It is anticipated that there will continue to be interactions between CSU and water providers within the region. CSU strongly prefers that any agreements would be with a single umbrella organization rather than several entities. This way regional efforts can be worked out together instead of through a piecemeal approach. With regard to selling or sharing water supplies: 1. According to city code and mandates, CSU can't sell any water rights or permanently allocate its water rights to outside entities. 2. There is limited potential for improved efficiency through shared use of their existing water supply. 3. There may be potential for CSU to sell water to other entities in wet years; however, in average and dry years opportunities for water sales are much more restricted. Typically surplus water is available on the Lower Arkansas so storage and transmission would need to be addressed. 4. CSU currently fully utilizes its wastewater return flows through non-potable reuse, augmentation, and exchange. The exchange program allows us to generate about 2 acre-feet of yield for every acre-foot of reusable water diverted. This program is an incredibly valuable resource and every drop is used to its full potential. If the water can't be directly used, it is exchanged to storage. 5. Alluvial wells do present some potential opportunities. CSU has some alluvial wells for augmentation and some others at Widefield and Pinello along Fountain Creek. Security has a long term lease for three of the Pinello Wells which are located in the Widefield Aquifer. There is some additional Widefield Aquifer capacity available. Use of the

	Pinello Wells would require a significant infrastructure investment. CSU also has alluvial wells at Clear Spring Ranch, but all of the wells are fully utilized for power generation. 6. CSU is very much interested in going into storage acquisition and potentially water leasing with partners. 7. If the region could pursue agricultural leasing/fallowing under a collaborative process that would be of interest to CSU. With regard to current water service agreements with Donala and Cherokee, all current contracts end December 2015 which is when SDS comes on line. New contracts will require a new level of permitting. SDS was developed and permitted with specific sources named. Each entity that intends to utilize SDS will need to go through the permitting process for their specific project. It is anticipated that such permitting will include the Pueblo 1041 permit, a NEPA analysis and probably a USBR contract for storage in Pueblo Reservoir. Regional collaboration has benefits to CSU in the statewide conversations that are occurring around water supply. For instance, it is expected that regional water collaboration, infrastructure sharing, and development of multi-purpose projects will all be recommendations that are contained in the Colorado Water Plan and promoted in future statewide water planning efforts. The CWCB is keenly aware of the current and future water supply gap that exists in El Paso County and is supportive of projects and methods that encourage collaboration between Colorado Springs and its regional partners.
Anticipated future service	
Water demand projections for 2035 and 2050	Build-out is currently estimated to be beyond 2060 and use anywhere from 125 – 150 mgd, depending on future city limits, growth, density, and other factors.
System objective	See discussion under Entity objectives, concerns…
Anticipated water supply acquisitions	CSU is currently in the process of developing its IWRP, which will set the direction for future infrastructure investments, water supply acquisitions, and other projects and methods which will need to be implemented to meet Colorado Springs' future water supply needs. The IWRP will also provide high level recommendations for location, amount, and phasing for future water supply projects and acquisitions which address risks and vulnerabilities to the water system, meet customer demands, and provide a safe

	and reliable water supply to customers. It is anticipated that a broad and diverse group of water supply solutions will be identified in the IWRP. These include increased levels of conservation and reuse, additional terminal, regulatory, and effluent management storage, and development of its existing in-basin and transbasin conditional water rights. CSU will also likely pursue temporary and permanent agricultural transfers in the Arkansas Basin to diversify its water supply portfolio and reduce its reliance on Colorado River supplies. CSU continues due diligence on other potential water sources. Any coordination work with Pure Cycle? Not really. CSU has a very limited number of Denver Basin wells, but is not really interested in Denver Basin sources. Knowing it is nonrenewable and being that they are on the edge of the basin, that source is not very attractive. In addition, there are water quality issues with Denver basin water and customers notice a definite difference between Denver basin water and other water sources. It is not in CSU's strategy to rely on Denver Basin water right now. Bigger picture involvement / interest: 1. CSU has significant involvement in trans-mountain diversions and water rights, and they are engaged in 3 river basins and 10 counties. 2. They are interested in continued development of supplies and storage in any place that water would be beneficial to Colorado Springs. 3. CSU is also interested in lease and fallow projects. 4. They are looking for storage in various places to maximize water right and give more opportunities for exchange. 5. They have not been directly involved in the Flaming Gorge project. With regard to climate change, drought, etc., CSU wants a far-reaching water supply so that it has strong diversity and reliability. CSU is currently studying a wide range of hydrologic conditions, including climate change, to inform how future water supply needs will be met. CSU is looking to identify gaps and find opportunities so they know how best to invest.

Anticipated areas of water service expansion	Primary development will be infill. Discussed Banning Lewis Ranch. There has been some land sale, and discussion of potential sales. In short, CSU includes the area in its service planning boundaries and anticipates the area will eventually develop in a manner similar to that as originally planned. The time frame is unpredictable. Discussed if CSU would consider taking over any other systems. No such transaction is currently being pursued. Were it to be pursued, the economic benefits would be weighed against the potential issues / costs of accepting the system.

FORSGREN Associates Inc.

Donala Water and Sanitation District

Preliminary Entity Meeting

February 12, 2014

Contact:
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Roger Sams of GMS also attended.

Meeting Notes:

Existing water supply system condition	
Planning Documents Pump / Treatment / Piping descriptions Storage capacity	Study documents provided. The District noted that allowing use of the Leonard Rice report as part of this study should be recognized as a value added to the study. That report represents an investment on the part of the District, and they are allowing its use as a reference to improve this study. DWSD does some corrosion control treatment to minimize dissolution of copper. Have many older buildings with copper pipe. Have discouraged continued use of copper pipe but don't have enforcement authority.
Water supply system controls	Consider current system to be state of the art. Includes alarms, controls, intrusion alarms, minor changes can be made remotely (for anything major, they want staff on site). The system anticipates lightning and will shutdown to protect against damage when a strike occurs. System is the last version out from Motorolla. It is the successor to Moscad.
Power supply	Power provider is MVEA. (Although it is noted that some individuals/facilities receive gas and power through CSU) Donala was part of the power partner program which provided a little benefit. Rate schedule changed at end of 2012 and the program was discontinued. The system does not include fixed power generation.

	They just recently added portable power generation for treatment facilities and booster pumps. When power is out, they can move CSU water to the upper tank, but it only gets to the bottom of tank so portable generators boost it to provide normal system pressure. They are considering portable generators for wells, but many of the wells have power requirements of 250 HP. Portable generators for that size application can be can be challenging – cost, availability, O&M, etc.
Current water supply system operations	
Operations summary	
Water Right summary	See 2009 Facility Plan
Demands	
Critical delivery	Nothing really. Limited neighborhood commercial. Only major customers are Gleneagle Shopping Center and some office buildings. No major issues if water delivery is interrupted.
Operational procedures to meet demand and comply with regulations	Well discharge has to be managed to maintain compliance for radiological constituents. For example, the district has an Arapahoe well with 650 gpm capacity but use has to be tempered to meet water quality limitations. Thus far, blending and managed use have been more economical than treatment and disposal. Through real time communication to gaging stations, the Willow Creek Ranch operations can be managed from the District. Kip checks operation a few times a year. They are especially concerned about winter operation and maintaining creek stability and function through the spring runoff. They also have a good relationship with the local water commissioner who works with them to keep tabs on water use.
Operational staffing	District has 14 employees including four wastewater operators, 3 water operators, a superintendent, Kip, and admin support. There are no paid staff at the Willow Creek Ranch site.
Finances	Provided audit. System includes 2500 accounts. Two sources revenue: sales (water, sewer) and property taxes. Water rates were not covering cost of service. Property tax is set aside for large capital acquisition. Anticipated increases in water rates will be 20% now, 15% next year, 10% per year thereafter. Currently completing a rate

	analysis to document how rates compare.
Water quality	A consumer confidence report was provided.
Regional Experience	Donala was involved in the pilot of the Super Ditch, but that is done now. That was a total 500 AF annual commitment each year, but there were no deliveries off of Super Ditch. There were some deadlines from the State Engineer that weren't met and the project has stopped. For Donala, limitations of this project are similar to limitations on Flex Program. It provides temporary water. Looked at Flaming Gorge study, but at $45,000/AF it doesn't appear to be very feasible if they could even get any of that water. Venetucci Farms (with the big, green silos) is right on Fountain Creek. All their wells are junior rights so they are turned off early. They can't use CSU water because CSU can only serve water within their service area by decree. (CSU has defined service areas by utility.) The District is looking at Venetucci Farms as a leasing customer to get them through their near-term crisis. The District has the water rights now for the short term because of their biggest customer for reuse water (the golf course) is closing. Donala would put water in Fountain Creek so the Farm can pump wells.
Water supply system maps	We can work with Roger to obtain system layers. System maps are in AutoCAD, and not available on GIS.
Entity objectives, concerns and plans for future changes in water supply delivery,	
Current limitations / upgrade needs	Recommend reviewing interrelation from the WIP Study. Right now, existing gravity system is pressurized from a system of tanks. DSD doesn't have, and won't have any closed loop systems. Dealing with a closed loop system was a concern when they were considering moving water to Brown Ranch. That is no longer concern because they have now excluded Brown Ranch from the service area. Don't foresee near-term needs at WTPs. The District has been able to operate during winter using only one of the two plants. This regular, lengthy shutdown has allowed very good unit maintenance and the plants are operating well.

	Mechanical infrastructure is from the mid-1980s on. Transmission systems have been installed within last 25-30 years and are probably good for another 25-30 years. There are some older distribution lines (late 60s) and there are plans in place for their replacement. An additional storage tank in the lower zone is in the design development phase and is likely to be implemented in the next 5 years. It will be located next to a treatment facility on land that was set aside from a development and will be fairly accessible to a reuse water pipeline. It is likely to be initiated as a multiple use tank, and the District is evaluating whether to have it as part of a reuse system or as raw water storage.
Recent water supply acquisitions	Willow Creek Ranch. Purchased in 2008 and decreed in 2011. Donala delivers raw water to CSU for treatment via CSU's existing raw water system, and Donala takes delivery of treated water via CSU's system on a year-to-year contract. May 1 to September 30 is the only time can take water from the Ranch. Currently, they exchange with Pueblo on the winter return flows under a 20-year contract. Exchange follows a proportional replacement. For example, the District took the full 280 AF this year so they have to replace 90 AF. The District is moving toward a permanent agreement with CSU. The District is concurrently working through US Bureau of Reclamation (USBR) concerns to establish a storage right in Pueblo Reservoir. USBR was concerned about giving a right in the reservoir without a pipeline to deliver water. The District appears to be making progress with both CSU and USBR. CSU delivers water to DWSD at Northgate and Struthers Rd. That connection was put in 2 years ago. Cherokee and Donala are the only two participants that have connections to CSU. Through exchange, delivery is picked up at the Antero pump station. This reduces the 7% loss which is very important. It made up half of summer supply.
Anticipated future service	

	Water demand projections for 2035 and 2050	Add 20% to what is shown in the current facility plan and that will cover future expansion.
	System objective	In general, the District is supportive of this regional study concept. Primary goals from this project include: Improved Opportunities for Delivery. As it stands, CSU has the infrastructure to deliver and that offers more opportunities to manage DWSD's needs. CSU infrastructure is currently the only way to make use of the Willow Creek Ranch water. The water flows down the Arkansas to Pueblo Reservoir, and can then be pumped to Colorado Springs through either the FVA or SDS pipelines. DWSD must have a long-term storage contract in place by the time SDS is operational in 2016, and CSU does not want to re-open its SDS conditions. Donala is dependent on both CSU and USBR contracts. They hope to need only an environmental assessment (EA) with a finding of no significant impact (FONSI) for a long-term agreement. On a short-term basis, the USBR will charge $37,000 for one year of storage on 280 AF. For the short term, DWSD can wheel and deliver the water through CSU's system. CSU is willing to deliver water to Donala, contingent on (1) USBR contract, and (2) District's decision to buy into pipeline. District is interested in buying in. When SDS is operational, that should free up capacity in Fountain Valley pipeline. The problem is long term; if SDS is the only delivery option and CSU uses all capacity during heavy demand periods, then Donala would be back to wells. The District would be in a better position if there were other options. To be effective, this study should consider transportation beyond just limited corridors (such as the Sundance pipeline). In evaluation, should consider what the Sundance pipeline capacity is based on. The backbone from WIPS was sized on raw water delivery, with potable storage and potable delivery sized for max day demands. Second Key Item: terminal storage is a major need. Such storage could allow for use of off-peak capacity in the SDS pipeline. Also, there is a lack of exchange water in the area and without storage, moving water

	around the region may not help because entities may not be able to use water when they need it. Considerations: Terminal storage of potable water would have more constraints than terminal storage of raw water. Upper Black Squirrel aquifer storage, etc. can be useful but will have some management issues. There are difficult details in accounting for aquifer storage. Issues: the UBS area believes municipal users are causing issues, but there are 5,000 residential wells. Problems existed before municipal wells really started pumping. Bristlecone, or possible Bristlecone 2 reservoirs are still worth looking at. District looked at this back in 2007 or 2008. They looked at an embankment plan and made an offer, but that didn't go anywhere. District is looking at these potential sites again.
Anticipated water supply acquisitions	Continue to evaluate obtaining other ranches to increase portfolio of renewable replacement water sources. Only produced 150 AF off Willow Creek the first year, so additional supply is important. The District's Denver Basin wells will continue to service the system and provide drought reserve water supply. DEWSS project going on: Donala Extended Water Supply Study. At this point, participating in regional reuse study with Woodmoor and Monument to consider sending nonpotable water to their WTPs. District will provide copy of report for review.
Anticipated areas of water service expansion	Brown Ranch was eliminated from the service. Initially acquired because it looked like a promising site, but a portion of it lies across the Palmer Divide. To use Willow Creek water, cannot serve outside of the Arkansas Basin. It did not seem feasible to attempt to include the area. One area of potential infill is Chaparral Hills. This is a subdivided area with large (3-5 acre) lots within the district. The district has started limited service to a few lots in this area. More may want service over time, but this will not likely be significant. District has also seen Big R commercial added. District estimates it is 95% developed. Potential for expansion is very

	limited: 1. For Willow Creek, had to give USBR a defined service area. Expansion beyond that would be difficult. 2. Service area bounded by others (Academy WSD, CSU, County development, Triview MD, CDOT, Monument) The District has plenty of wastewater capacity. Annexation to Colorado Springs has been considered. Last fall, annexation was discussed at a community meeting as a possible long-term solution. CSU's annexation policy states that Donala WSD is not favorable for annexation, however. Long term, annexation could still be a viable option, and could be a good thing for Donala. If the community moves toward development of the golf course that's closing, Donala doesn't currently have the water to serve it. This development scenario was not included in the facility plan that was provided. It was noted that there is a section of 24-inch pipe running along Baptist Rd at the east side of the District that could allow for a large supply pipe connection. If it is potable water, it could go to the Zone 3 tanks and then sequence to the upper zones.
Need for other utility extensions (power, natural gas, etc.)	None anticipated. District generally has what is needed from MVEA. The District is on the north end of their service area. At the Upper Monument Creek WWTP, all space heating is run on propane and the District would like natural gas there. However, when the District approached the natural gas supplier and even offered to build the pipe, the supplier said they didn't have the capacity to service the facility.
Other	
Storage ideas	Looked at Bristlecone (hydraulics) and believe this site could service nearly everyone by gravity as a central storage facility.
Comments on Reuse Plan	Perspective on reuse: With golf course gone, Donala looking at indirect potable reuse. Reuse has its place but it is important to keep in mind that it is not a perpetual motion machine. There are losses. In the long term, it is not the same as new water. Careful consideration needs to be given to investing effort in developing reuse or seeking to acquire new renewable sources.

Other potential ideas / perspective	If raw water is delivered, Donala anticipates it can adapt existing systems to treat it. Don't see that as a regional project. However, if regional terminal storage is developed, then maybe regional treatment works. Considerations regarding some state programs: Flex Program: This is a state effort to avoid buy and dry but it is not what is needed. Donala needs a permanent source and infrastructure in place to supply the water. The program only provides temporary water and that is insufficient. A key aspect missing from discussion of the state water plan is addressing the Western Slope. The Front Range is now to the point where water rates going up and there are no more alternatives except true reuse. Dana Duthie did great job of prepping this district financially for the DEWSS Project. Why didn't WIPS recommendations happen? No one had water to put in the proposed structures so there wasn't the motivation to move the projects forward. Another reason that the proposals are not currently being considered is that most (all but one) alternatives would have brought Arkansas water over the Palmer Divide. As noted in other locations, the District dropped the Brown Ranch site for that reason. Exchange: dry-year exchange won't work because there just isn't enough water in this area. Discussing opportunities with FMIC. How might that work? 1. Ability to expand Big Johnson reservoir 2. Potential expansion of capacity through FMIC delivery to Big Johnson Suggested an important concept would be a management tool for return flows. The District is very interested in participating in a study that results in action, and doesn't want another study on the shelf. To that end, the water sources need to be well defined and that appears to be happening with the participants. This should provide momentum for the projects.

	The District noted that it will be important to consider the yield of these new sources. What are expectations on conversion from ag to municipal, and what will be the priority and availability of water? The District believes regionalization is important. The water suppliers are in need of options but can't do it on their own. Regional efforts allow districts to benefit from economy of scale. However, the process can be frustrating because it moves so slow, and demands are growing faster than we can react. We are having issues now and need renewable water. To help with momentum, we could start with small things. If the District went with neighbors and tried to take first step to establish emergency response connections, that would allow shared water use. Donala could send water to neighboring districts. As an example, at the south end of the study area, CSU, Security, Widefield, and Fountain can share water. Donala initiated an effort and can now provide water to Triview (Denver Basin water only). Woodmoor and Monument could connect, Forest Lakes and Monument could connect on Old Denver Hwy.

FORSGREN Associates Inc.

City of Fountain

Preliminary Entity Meeting

February 13, 2014

Contact:

Curtis Mitchell
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Meeting Notes:

Existing water supply system condition	
Planning Documents	2006 water master plan. (Black & Veatch). We will copy and return the document.
Pump / Treatment / Piping descriptions	System includes no treatment facilities.
Storage capacity	70% of water for the City is supplied through Fountain Valley Authority. Physical delivery of water to the City of Fountain is through the FVA pipeline. There are two physical connections to the City's system; at the Southwest Water Tank and the Goldfield Tank Farm.
Water supply system controls	The SCADA system is fairly simple. IT does not include a manned control center nor does it involve 24/7 operations. The system registers problems and alarms to standby personnel.
Power supply	Supplier is City of Fountain. Rate structure and similar information available on line.
Current water supply system operations	
Operations summary	
Water Right summary	Review 2004 Water Resource Study.
Demands	City is seeing a steady decline in per capita use from 210 gpcd pre-2000 to a recent low use period of 80 gpcd. This trend is likely related to the increased water rates. Because of costs associated with involvement in SDS, the City has doubled rates in the last 5 years. Have the water rights to keep full, and City is buying transmission capacity in the SDS that will actually be exchanged for FVA capacity. The City is "in a good

	place." and came into this year at 84% storage.
Critical delivery	NA. Primarily residential
Operational procedures to meet demand and comply with regulations	The City is connected to the FVA system, and owns 10% of that system. Operation is to base load from FVA and peak off of wells; have operated that way since mid-1980s. FVA has always had challenge of yield. City has 4 large alluvial wells with capacities of 600-900 gpm each. Wells are fully augmented. What the City does not use to augment, they release to confluence of Fountain Creek and the Arkansas River, and exchange that into Pueblo Reservoir. FMIC augmentation water goes to Fountain Creek via the Cruise Gulch aug station. The Las Vegas WWTP and Fountain Mutual headgate and diversion are on the same property. In the 1980s, discharge of plant went to the ditch. A splitter was added so some goes to ditch and some to stream. Gary Steen would be the one to describe how that works.
Operational staffing	9 operators dedicated to water plus customer service. Curtis has his Class A license in both water and wastewater.
Finances	Rates are available online and a summary of the current rate analysis was provided at the meeting. City water rates are in the upper 2/3 compared to other area utilities. The City has an open house coming up on rates and is doing a rate case right now. The City has an A rating with Standard and Poors. They have had to do a lot of borrowing ($43M for SDS). They do not have a sod buy-out program, but do offer washing machine and toilet efficiency incentives. They also provide training resources as part of Water Returns Program to support small utilities.
Water quality	Comply with typical State sampling. FVA is under own PWSID number. FVA is only responsible for water quality at the tank. No lead and copper compliance is required of FVA. Current operation includes disinfection with sodium

	hypochlorite at the wells. Iron concentration has started to increase at one well, so they are not using it right now.
Regional Experience	Worked with Widefield and Security on the Venetucci water supply and interconnect. This is a bridge project to provide supply capacity prior to SDS. Agreement was to have the participants put up capital to build the line and then they would buy it back. Fountain's participation in the first phase of SDS does not include a physical connection; will take delivery via FVA. When contemplating SDS part 2 (probably 2040) which may include building the Upper Williams Creek and Williams Creek Reservoirs and adding pumps, Fountain will likely build their own plant. They have a planned turn-out in the SDS line that can connect to that future plant at the Kane Ranch site. It is more cost-effective for the City to build its own treatment plant rather than treat at CSU's plant further north and pipe it back down to Fountain. The City's participation in SDS is based on current demand, and will give them capacity far into the future. Interests in regional project: the City is interested in leading regional cooperation. It is of great benefit to everyone in the area and they want to see it happen. There is great value in better management of limited resources. Currently, Fountain has interconnections with Security and Widefield. When in tight spot, they support each other and help meet demands. They have accounting in place to make each other whole. 1979 FVA agreement: Fountain participated along with Widefield, Security, Stratmoor Hills, and CSU. As part of the USBR Fry-Ark project, the Fountain Valley conduit was proposed and built. The Arkansas Valley conduit was also proposed at that time, but its construction was deferred. The FVA members bonded and formed the authorizing entity that got the treatment plant and pipeline built. Those attempting to organize the Arkansas conduit couldn't get it done, so that project was deferred.

	Recent Senate Bill 9-22 may help with that. It allows the SE Water Conservancy District to move money to help pay off FVA (outlet works, conduit, etc.) They can then use revenue to build the Arkansas conduit. Challenge has been that 70% of water supply comes via a single pipe. Redundancy through SDS will fix that. The City has had a few times when an emergency outage put them in jam. Fountain was involved with the Super Ditch pilot program until it went away, but will have interest when it comes back.
Water supply system maps	Curtis introduced us to the City's GIS coordinator to obtain needed mapping.
Entity objectives, concerns and plans for future changes in water supply delivery,	
Current limitations / upgrade needs	Limitation: ability to maximize the City's usable return flows. They need to be able to manage what they have more effectively. Storage is a big need; that could allow the City to divert into storage and make exchange releases. Without storage and the ability to exchange, the City loses use of its return flows. Terminal storage is what Lafarge's Fountain Gravel Pit will provide in the future. This will offer system flexibility by providing a bucket for (1)exchangeable water, (2) water through a treatment plant, and/or (3) brine from RO treatment.
Recent water supply acquisitions	
Anticipated future service	
Water demand projections for 2035 and 2050	See 2006 Water Master Plan Fort Carson is big question either way; they are currently growing, but could contract in the future. The City is planning on 2-4% growth per year. Planning must allow flexibility, however, because demand could increase because of population growth, or reduce if soldiers relocate outside the Fountain service area.
System objective	Currently, 70% of City's water comes through FVA. As they move forward, they anticipate more reliance on SDS capacity and on additional high-capacity

	alluvial wells. Would like to plan for unconstrained growth. Because of its position in the valley, there does not appear to be a limit to the buildout for Fountain. Have annexed Kane Ranch (2,254 acres to the east) and all the way to the race track (south). It is a great distance in all directions from Fountain's jurisdiction to the next water providing entity. Long-range plan for the water system: Provide treatment (with possible RO side stream) and distribution from the gravel pit to the west, blending brackish well water with FVA water. With future phasing, will take water delivery from SDS line to the east.
Anticipated water supply acquisitions	With its FVA swap for peaking, City will have a 2,000 AF base load in FVA. They are buying another 2500 AF for peaking (showed a hydrograph). It will be driven by FVA keeping the tanks full, responding to Fountain's demands. The water will be delivered to two tanks that provide some demand buffer. The water runs through accumulators, and the City is billed monthly on a conveyance service contract. The City is looking at purchasing another 160 AF this year, and continues to look at water supply primarily from ag transfers. Although looking ahead, feel very confident that the City has sufficient water rights for next 14 years.
Anticipated areas of water service expansion	
Need for other utility extensions (power, natural gas, etc.)	Utility extensions are currently being planned for the City electric utility, concurrently with rebidding power supply wholesaler. Originally, CSU was the wholesale power provider, but went to bid to confirm rates were competitive. Municipal Energy Agency of Nebraska won that previous bid and currently supplies power. They will be installing a new electrical transmission line and substation to the east. They are saving now, have $9M, and are close to being able to cash pay for the project. SDS follows same corridor as power lines.

FORSGREN Associates Inc.

Fountain Mutual Irrigation Company

Preliminary Entity Meeting

February 12, 2014

Contact:

Gary Steen, P.E.
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Meeting Notes:

- Fountain Mutual Irrigation Company (FMIC) conducts daily accounting and year-round tracking of water diversions.
- Chilcott Ditch is used only as a summer diversion. It is about 10 miles long.
- Diversion No. 4 is the most senior water right on Fountain Cr.
- The Spring Creek Augmentation Station is located ½ mile from the headgate. It is located west of Circle Dr. and runs year round.
- Water volume (acre-ft) per share varies from year to year
    - Conversion: 0.7 acre-ft per share consumptive use from Water Court.
    - In 2002, because of drought conditions, FMIC delivered 0.4 acre-ft per share.
    - In the past, conversion has been as high as 1.3 acre-ft per share.

- The Big Johnson Reservoir has a potential total storage volume of 10,000 acre-ft, but a current active storage volume of 5,000 acre-ft. Sediment has accumulated in the Big Johnson. Sediment removal and raising the dam could add 5,000 acre-ft of storage volume. The decreed storage capacity of the Big Johnson is 10,000 acre-ft.
    - Improvements to be made:
        - Gate valves (Pipes and valves from 1975, consider either valve replacement, or pipe and valve replacement). To replace the pipe, the dam could be breached.
        - Enlarged storage
        - Hydroelectric power (Approximately 45ft of head in Big Johnson)
        - Recreation
    - Planning:
        - Questions asked: Are there potential users? Will there be a user to lease the space? Can FMIC afford to have the reservoir out of service for 1-2 years if it goes offline for maintenance? This is a good point of discussion to bring up with the regional group. Maybe there are ways that partners could effect a work-around.
        - Goal is to increase storage capacity

        - Gary Thompson at W.W. Wheeler has been working on an original appraisal of the reservoir. He is struggling with updating the appraisal, as it is difficult to price the reservoir.
        - Big Johnson Reservoir is a tremendous asset that is underutilized.
        - FMIC not looking to sell the reservoir. They want to maintain control, but would lease the storage.
    - Currently, the approximate agricultural usage from the reservoir is between 35% and 40%.
    - In the 1980's, the agricultural usage from the reservoir was approximately 70%.
    - In the future, agricultural use will need to be utilized to balance augmentation and decrees.
        - Agricultural use should not dip below 25%, as it would create problems with future Water Court decrees.
        - A large private school, large ranches, or potentially a golf course could increase the agricultural use.
    - The following are some of the problems discussed:
        - The cost to move water, in general.
        - Small operations – it is difficult to deliver water to a few small shareholders.
        - Very large transit losses.
        - Could not fill reservoir last year.
    - Potential Transit Loss Saving
        - Would likely have to make up on diversions and replace lost underflow to adjacent properties if seepage is fixed.
        - The tradeoff would not affect annual diversion.
    - Canals experience approximately 25% transit loss.
        - There are currently a few miles of lined and piped channels.
            - FMIC does not like the lined channels, as cracking and heaving have been a problem with the lining.
    - Discussions have been held with the state regarding efficiency rules that went into effect around 2010.
        - It was discussed that anytime lining or pipe is used, the state engineer must be notified to review and determine the effect of seepage on return flow. (Reference to Kansas lawsuit)
- Recently, there has been a project to develop a mile of ditch at Highway 21 crossing.
- In the next 5 to 10 years, the potential exists for the last mile of FMIC delivery ditch (ditch length ~ 35 mi) will dry up. There are only a few irrigators left using the ditch.
- There is no current document for the proposed long range plan for the FMIC. It was discussed that this will be written in the next few years.
- In the last 5 to 15 years, FMIC has shifted from a "Mom and Pop" type of operation to more sophistication due to city interests, state requirements, and augmentation decrees.
- Doug Hollister (the water commissioner) requires of FMIC a daily water administration speadsheet. These spreadsheets include records from their headgate and augmentation stations 1,2 and 3. FMIC also takes daily reservoir staff gauge readings, daily reservoir weir discharge readings, and weekly

piezometer readings on the dam. The staff gauge readings and weir discharge readings are taken daily and put in a weekly report.

  - This data is also used (by Gary Thompson at WW Wheeler) in the augmentation plans for Security, Widefleld and the City of Fountain.
  - Gary discussed the transit loss model that is used to track water accounting along Fountain Creek. Because of the time it takes to collect data, submit to the water commissioner, and update the model, it is on a 2-day lag.

- A transit loss map was developed in 2007. At this point, this may not be useful for anything except documentation. Doug Hollister may have a model that can be used for predictive modeling.
  - The possibility of using this for analysis was discussed. Mapping is to be obtained from the City of Fountain for the FMIC and Chilcott.
- Chilcott –
  - Typically start diverting water for irrigation and augmentation in April
  - Diverting irrigation to JV Ranch (approximately 98%)
  - Augmentation water for Fountain and Security in months of April through October. Pending a water case decision for Woodmoor, this could change.
  - Chilcott owns # 27 & # 39 water rights.
  - Security owns 25% interest in Lock Ditch priorities (#15 and #22) and has an existing carriage agreement to divert this water thru Chilcott's aug. station.
  - Water right is not as senior; have been called often due to drought in the last few years.
  - The diversion headgate for Chilcott is very near the I-25 & KOA campground, about ½ mile south of the Loves exit at Fountain.
  - JV Ranch acquired #14, Liston and Lowe, #15, #22, & #45 Lock Ditch. Glen Ermel (at Chilcott) had majority interest in #16 Miller, presently being diverted by Chilcott at the aug. station, but owned by the City of Fountain. Carriage agreements were established for these ditch rights to be diverted thru the Chilcott Ditch system. Total ~67 cfs and in excess of 2,000 acre-ft. Can do some winter diversions.
- Marlboro Reservoir and Ranch
  - Bob and Steve Norris' property. This is the same property Colorado Springs Utilities (CSU) claimed for the Upper Williams Creek Reservoir with the intent to condemn if necessary.
  - Bob and Steve approached the FMIC a year ago and asked if FMIC wanted to put some water rights in the new reservoir. The FMIC board had no interest in this proposition.
- CSU proposes to use Chilcott for return flow from Lower Williams Creek Reservoir back to Fountain Creek.
- FMIC Board Sensitivities:
  - Outside Water – Have carriage agreement to Spring Cr, but that is as far as it has gotten. The board is concerned about having more carriage agreements and running it in the ditch upstream of Spring Creek. The board sees the potential additional complexities of managing the delivery with more water from outside users.

- Interested in adding a diversion structure. The system has a siphon at Jimmy Camp Cr. But there is no diversion. However, there is an existing decree that has a provision for return at Jimmy Camp Cr. and it would be advantageous to be able to utilize that provision.
- Another current carriage is the Jimmy Cr Diversion. Currently, the exchange is structured so there is a return at Spring Cr. and the water is pumped at Jimmy Cr.

- Work to be completed in the reservoir in the near future are valve fixes. The rest of the proposed work has no set date to begin or complete. FMIC is unsure if they would like to pick up a grant, breach the dam, etc. next few years valve fix. The rest, don't know when. Don't know if want to pickup grant and breach dam
- It is estimated that the costs associated with dredging and raising the dam would be in the range of 5-6 million dollars.
- Main goal in this region is to cooperate on infrastructure, use, supply, and planning. Working together on this makes sense.
    - Key value items – Big Johnson Reservoir (currently underutilized) and augmentation stations.
- Gary later sent a transit loss model map with the nodes identified, and referred us to Doug Hollister for a flow diagram.

FORSGREN Associates Inc.

Town of Monument

Preliminary Entity Meeting

February 13, 2014

Contact:

Tom Tharnish
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Meeting Notes:

Existing water supply system condition	
Planning Documents	
Pump / Treatment / Piping descriptions	
Storage capacity	
Water supply system controls	System: Signet, commonly used in oil and gas industry. Monument is probably the first water utility to install this system. Several years ago, considered changing but after reviewing other systems and discussions with SCADA reps, stayed with Signet. Primary advantages are that we can add on and grow the system without having to purchase point packages that Timberline sells with iFIX. Just have to add terminal panel at each site. Sent Chris (Monument employee and electrician) to Signet factory so he can do programming now (99% of SCADA needs). After last year's upgrade to Windows 7, found that Signet upgrade was required. After that, couldn't get pagers to work and went to direct-dial second phone for operators. Pay about $2000 per year maintenance fee for ~100 hours of trouble-shooting service. Think that this is a test case so get good response. History capability is extensive. Have used Mtn Peak Controls to install some touch flat screens in two WTPs. Seemed ok with Signet. Actively looking for SCADA providers to see if they want to take on this type of system.
Power supply	Provider is MVEA. They get power from Tri-State Generation. Operate 9 wells and 3 treatment plants.

	Average annual electrical expenditure $150-$160k/year. Went through large rate adjustment a few years ago. After Monument and other customers complained about the demand charge, structure was modified; smaller plants cost more, bigger plants cost less. It looked like they found a way to reduce costs by changing internal bill method. Monument has considered installing the lightning anticipator (similar to what Donala described). In the program Monument described, if the system sees a peak coming MVEA has some control to shut down plants. Dividing line between MVEA and IREA is Well 4-5 treatment plant. All west of there goes to IREA. Monument not likely to expand into IREA. Only new future facility planned is the Well 10 expansion, but that would still be served by MVEA.
Current water supply system operations	
Operations summary	
Water Right summary	
Demands	
Critical delivery	Synthes – Manufacturer of medical joints owned by Johnson and Johnson. Process water is supplied by Monument. Interruption to service costs them multiple thousands of dollars for a single day shut down. A project on for this year is a secondary loop to help maintain their supply. Facility is located across from Tri Lakes WWTP. Water quality is not a concern; they have their own filtration system clean room. Average water use ~750,000 gal/month. Other big users: trailer park 300-400,000 gal/month; Conoco with car wash 300,000 per month; apartment bldg. 250,000/month.
Operational procedures to meet demand and comply with regulations	Have been seeking water right for storage in Monument Lake. Currently, remaining objector is the State Engineer and objection is claim to 1891 priority. Though many objectors initially, have satisfied all the other objectors. Monument assured Woodmoor that it will be able to continue operating as they currently operate. The reservoir embankment toe drains consistently leak to Monument Creek, but that is not counted as a release. The Town performs the following functions for the

	dam: Regular piezometer readings. Keep weeds out of the rock. Keep public off of the dam. Watches for bulges in the dam. Measures drainage from toe drain. Currently operating lake on substitute supply plan. Maintenance in 2000-2001: had to drain, dredge and refill. To fill, closed the valve down and started filling lake. Water commissioner came down with concern about priority when depth reached 18 ft. From there, had to fill only during spring runoff and do several exchanges. Now, have to release little by little to keep Woodmoor happy. Town operates its water tank between 13 and 18.5 feet. In winter, need to keep water moving to prevent freezing problems. If don't keep water moving, will get ice layer on top, and that can falsely signal that there is no water in the tank. With winter operation to keep water moving, will cycle from all wells on to all wells off. If wells pump to within 50 ft of uncovering the screens, they will shut off. Try to keep 100 ft depth over the well pumps. To keep out of trouble in summer, pull up trend on SCADA and if seeing ft drop/hour, it's time to rest the well. Rule of thumb – best to let it rest as long as it was running. In dry stretch, the Town changes plants at least every day. Extreme measures: If they get into a real bind, can shut off all park irrigation. Normally stagger park irrigation to manage peak demand. Parks and water foreman discuss adjusting times. If it rains really good, they shut off irrigation for a day or so. One advantage over other disticts is that the system is decentralized. All wells feed into distribution at different places. Have enough wells at various pressure zones and pumping that would maintain pressure with some redundancy. That could mean chasing pressure with well cycling in a particular zone, but provides reliability.

	Operations related to water right: don't have any wells that approach being overdrawn compared to water right. Have spreadsheet that compares what pump has run and what they can pump. If really dry and there are calls on river, if not watching, wells could end up negative at the end of a month. Arapahoe wells help on augmentation. Summer runs of Wells 1, 2, and 3 (Dawson and Denver wells) require augmentation, and that is provided primarily by the Arapahoe wells with a little from the WWTP. In the future, could pipe return flows up into Monument Creek for pumping from Wells 4 and 5. During the summer, might produce 19 MG of water in a month; 6 MG is returned, 2 MG goes to parks, and there are some losses. A separate sanitation district provides wastewater treatment, but the Town retains the return flow credits. Aug. water: use surface water rights on Beaver Creek. The Town has rights in 4-5 ditches (Welty, Shiler, Southside, Keno) coming out of the valley. Steve Sheffield with the Town does a report accounting for total production out of all wells, along with info. from gaging station upstream of Beaver Creek. DNR runs that station, gets a satellite feed, allowing daily log on to get data. Monthly average is shown in aug. report. The Town does not currently get credit for lawn irrigation return flows, but will have Bruce Lytle evaluate for future credit. That will involve drilling some monitoring wells and getting hard number for water coming back to Monument Creek. Also, the Town has to add a number from the Air Force Academy's Ferris Wells, which was about 4,000 gals last year—a very small share. The Town also owns a few water shares in Twin Lakes (near Buena Vista), purchased 6 years ago. Typically, the Town wants to run its bigger wells in summer. When a water call comes, it comes from state engineer's office and they send shutoff dates (priority).
Operational staffing	Water operators: 5 including water superintendent. Treatment A, Dist 4, Collection 4
Finances	Pam and Monica would have more detailed information, but Tom discussed the following.

	Have a 2A Fund for ASD: acquisition, storage, and delivery of any renewable or new water. The fund was approved by voters in 2005. Percentage of revenue goes directly to that fund, and it can only be used for specific projects. At the same time that fund was approved, a loan from the fund was approved to build town hall. In next 2-3 years, the building will be paid off, and borrowed money will go back into the 2A Fund. The 2A Fund has about $2.5M and grows ~$200K per year. Once the building is paid off, the 2A Fund could grow at ~$400 to $500K/yr. The Town has not taken on large-scale debt in the last few years. Recent equipment has been purchased through lease/purchase agreements. Only thing on lease now is the new bulk fill station. Last major expenditure was Well 8 WTP in the 1990s. The 2A Fund is appropriate to pay for this regional study, any water purchases that Gary Barber identifies, and a new reuse water plant. Rate structure: 0-6000 gal = $4.99/thousand; 6-12 kgal = $5.99/thou; 12-24 kgal = $6.99/thou; >24 kgal = $7.99/thou (set in 2013). This was the first rate increase since 1998. Tom proposed much higher, but plans to propose another increase in 2015. Typical use: 48% no change for use of less than 6,000 gal/mo. Under $30/mo +8.80 service fee for residential tap. Larger taps have a larger payment. Residential and commercial rate structures are the same now. The Town is considering an industrial rate structure.
Water quality	
Regional Experience	
Water supply system maps	
Entity objectives, concerns and plans for future changes in water supply delivery,	
Current limitations / upgrade needs	
Recent water supply acquisitions	Gary Barber is helping the Town look for renewable water purchases now. Also, return flow credits from the WWTP aren't being used. The Town has been approached by others with interests in those credits. The Town needs to be at study level on any opportunity that might be there.

	Tom has heard about rotational fallowing, but not clear whether such an arrangement would serve the Town's long-term interests.
Anticipated future service	
Water demand projections for 2035 and 2050	
System objective	
Anticipated water supply acquisitions	Well 10 is planned, an Arapahoe well in the Wakonda area in north part of town. When that development came, they had to dedicate some land for a well.
Anticipated areas of water service expansion	Synthes expansion: they own a lot of land around the plant. There has not been any discussion on this, but expansion is possible. Capacity: Have some ability to expand. Looking at subdivisions that could happen within the next 20 years. Currently use only about half of decreed capacity. Have 900 AF, and currently use about 450 AF.
Need for other utility extensions (power, natural gas, etc.)	
Other	
Storage ideas	
Comments on Reuse Plan	
Other potential ideas	Ultimately need renewable water delivery as a primary interest, but there is no specific project in mind.

Town of Palmer Lake

Preliminary Entity Meeting

February 13, 2014

Contact:

Tara Berreth
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Ms. Berreth is unavailable for some time. We met with Steve Orcutt, the Town's water operator.

Meeting Notes:

Existing water supply system condition	
Planning Documents	Copy of Study that was updated in 2000 was provided.
Pump / Treatment / Piping descriptions (	Surface water WTP (Pall membranes), phases brought online 2011 (phase 1) and 2012 (phase 2). Capacity at this location is 750 gpm. Groundwater plant (Filtronics) was built in 2004. Targets Fe, Mn, and can treat Radium (but isn't required), and can process 1000 gpm with both filters going. System dates to early 1900s. Still some pipe in ground from 1934. On summary sheet, the well labeled D-3 was drilled, but only produced 60gpm. It was not considered worth developing further and there is no equipment in it. Palmer Lake is right on edge of aquifer at this location. Glen Park Reservoir was originally built for the railroad. The Town bought it and no one else shares in it. All winter, the reservoir provides sufficient water, but when out of priority on the creek, they have to augment and the wells pick up the slack.
Storage capacity	

	Installed a 300HP pump at A-2 in 2004. It is typically off 6 months out of the year. Installed a 200HP pump at D-2. Originally installed in 2002 and replaced in 2012. Had less than 1000 hours run time.
Water supply system controls	Timberline services the SCADA. It is Motorola equipment using the iFIX program.
Power supply	IREA is the power provider, and there is nothing notable about the rate structure. There is an availability charge associated with equipment size and max. power draw. We can check with Tara for details. The only site with backup power is the Southwest WTP.
Current water supply system operations	
Operations summary	
Water Right summary	Data provided.
Demands	Used to be able to run the town entirely off of Glen Park Reservoir. Palmer Lake Population: 2,450 and almost built out. Current use: 90 gpm (winter) 350 gpm (peak summer). Typical summer daily use 300,000 gpd with peaks as high as 550,000 gpd. Last 24 years, the Town has been replacing some pipe every year. Have seen usage drop after replacing pipe. Reduction in usage likely due to pipe replacement and restrictions on use.
Critical delivery	Not really. Elementary School would be closest thing, but would not be a crisis if no water delivery
Operational procedures to meet demand and comply with regulations	System is required to pump to augment reservoir (makeup for evaporation off reservoir). Not required in winter since it ices over. From reservoir, can use 90% of the winter average (November to March) when out of priority on the creek. In the recent past, this has been the norm. The system is usually out of priority on the creek. It used to run years ago. Now it will dry up. For Wells A-2, D-2, Town uses 98% of production. Must give up 2% for augmentation.
Operational staffing	Steve and 1 helper
Finances	Audit provided
Water quality	Look online (Colorado department of public health

	and environment Wqcdcompliance.com) for consumer confidence report Palmer Lake System # CO 121575 Currently use chlorine dioxide for disinfection. Great for THM, HAA5. Operation has to carefully manage dosage since high dose causes problems with membranes. Before installing the membrane plant, he could keep TTHM, HAA5 concentrations between 10-20 ppb. Now concentration in the 50s because of need to lower the dosage. Not a compliance problem. Just have to keep below 60 and 80 ppb.
Regional Experience	Numerous regional studies but nothing has come of it. With the Palmer Divide Group, Gary Barber looked at shared water with Palmer, Monument etc. When looked before at sharing with Monument, it was unclear how water would get back up to Palmer Lake which tends to be last on the list.
Water supply system maps	Provided with study
Entity objectives, concerns and plans for future changes in water supply delivery,	
Current limitations / upgrade needs	Booster rarely used, small pump. Not user friendly. Pump from the big tank over to small tank then from small tank back to big tank. Would be nice to arrange the tanks better. Large tank would be better if at same elevation as small tank. Will have Timberline come down and do set points so he can pump out of tank to keep moving that water. It has manual valve. Steve provided us a wish list of repairs.
Recent water supply acquisitions	Not seeking any. Current water sources are adequate.
Anticipated future service	
Water demand projections for 2035 and 2050	Could probably add 50 more homes. Last facility planning study estimated 1000 taps maximum for the system. Current list shows 953 taps. (Study was last updated in 2002)
System objective	The main interest for Palmer Lake in this study is adding a source for augmentation water.

Anticipated water supply acquisitions	
Anticipated areas of water service expansion	Anticipate very limited expansion. The only area could expand would be down Hwy 105 to the trailer court, but that is not likely to happen. At one point a developer was proposing installation of 40 homes, but nothing has happened with that proposal for a number of years. There is also a small commercial area that could develop but that would require very little water.
Need for other utility extensions (power, natural gas, etc.)	No needs identified. The generators at the SW WTP run on natural gas
Other	
Storage ideas	
Comments on Reuse Plan	
Other potential ideas	Would downstream replacement help? Don't think so. If out of priority, the creek is dry and can't physically take from creek. Need to keep the creek water up in storage since the Town's use exceeds the storage up there.

FORSGREN Associates Inc.

Triview Metropolitan District

Preliminary Entity Meeting

February 14, 2014

Contact:

Valerie Remington
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Meeting Notes:

Existing water supply system condition	
Planning Documents Pump / Treatment / Piping descriptions Storage capacity	Triview is interested in a direct reuse project for irrigation, and is currently studying. There are pumps available to complete this, purple pipe in the ground, etc. Still needed are some valves and additional infrastructure such as meters and pipeline. Storage was looked at in the past. An open pond was considered, but was scrapped. Reuse tank storage was looked into for irrigation. The booster pump station at Water Plant B is now completed. This will provide greater pressure to the properties near the water plant. Testing is now being completed. The electrical systems in place required a new SCADA system to work effectively. District has two water tanks (A and B); one is near the school off Kitchner. The one at the east part of the District (Tank B), which is the larger of the two at 1.5 MGal.
Water supply system controls	Current SCADA system is in need of an upgrade. The board has approved a new SCADA system to be developed soon. Valerie got the board's okay on Tuesday, 02/11/14. She discussed moving from Timberline (Motorola) to a Rockwell IFIX software. KEPserver is also to be used. The upgrade will be more user-friendly and easier to maintain. It will allow for collaboration with multiple companies so problems can be fixed more efficiently. The work is to be

	completed by Mountain Peak Controls.
Power supply	Power supply is by MVEA, and the rate structure is available online.
Current water supply system operations	
Operations summary	
Water Right summary	Current information on this is located in the Master Plan, which Valerie will provide.
Demands	
Critical delivery	Not any known entities. Mostly retail, gas stations etc. that are not necessarily critical.
Operational procedures to meet demand and comply with regulations	Blending is performed for radionuclides, but nothing out of the ordinary. One is run when other is off to manage levels, but this is typical. The main Arapahoe well (A7) is near Tank 2. If this goes offline, others will go off as well. This is major critical well in the system, and this well drives the rest. It must be in service at all times to effectively run the system.
Operational staffing	Two water operators are staffed now and another full-time position will be the lead, and will be hired soon. This would be at least a B or C license. Three staff can run the system.
Finances	The finances are geared toward a governance structure for the overall system. The most current audit is posted on the DOLA website. (Need to look on the DOLA site under special districts for audits of applicable entities.) Valerie will provide the budget for 2014. Triview does not have much additional room available with respect to bonding capacity.
Water quality	Radionuclides, iron, and manganese are the main concerns. The CCR is available online on both the CDPHE and Triview websites.
Regional Experience	The only known past regional experience was the WIPS study.

Water supply system maps	GIS information will be provided.
Entity objectives, concerns and plans for future changes in water supply delivery,	The District would like to improve reliability when there is a water emergency affecting supply and delivery. When flooding, fire, etc. occurs, where would be the best place to get water from other entities? Interconnection throughout the region could be effective in addressing this need. Would development be different with additional water supply? The need for supply affects Woodmoor, Monument, and Triview. Water supply limits land development; this limitation be averted with developing additional water supplies.
Current limitations / upgrade needs	Main limitation discussed was water supply. A booster pump station for water service will be required and developed in the next 18-24 months. Any upgrade needs of the District are driven by new development.
Recent water supply acquisitions	There are no recent supply acquisitions.
Anticipated future service	
Water demand projections for 2035 and 2050	Projections can be made based on population growth. Monument growth projections will be used. The majority of open commercial land in the town will be served by Triview. Center has a large share of the buildout numbers for the District, most notably for the commercial land east of I-25.
System objective	
Anticipated water supply acquisitions	
Anticipated areas of water service expansion	Triview will begin serving further to the east first. A water tank will need to be developed near this expansion in the future. Infrastructure will already be required, so that could help with delivery of a new supply. Infrastructure in Promontory Point will be completed

	soon, and once completed, development can begin.
Need for other utility extensions (power, natural gas, etc.)	Utility extensions will be driven by new development. Utility extensions will be required in the future for undeveloped (but annexed) areas for development.
Other	Approximately 630 single family units will be built on the east side of Triview, but that number is not confirmed. Recent conservation efforts by Triview have reduced demands significantly. Approximately 50 houses have been added, but demands have decreased overall. A new Denver well has been permitted, and the well will be completed ASAP. The site is the D4 Well. It will be located near the existing Arapahoe well, but will extend into the Denver aquifer.
Storage ideas	
Comments on Reuse Plan	A reuse project is already under consideration; Triview will implement reuse.
Other potential ideas	Valerie discussed developing a pipeline to the east and described the idea as "interesting." There is the potential for new supply to be delivered from the Sundance Pipeline to the Donala/Triview area, and interconnections could be added.

FORSGREN Associates Inc.

Woodmoor Water and Sanitation District

Preliminary Entity Meeting

February 12, 2014

Contact:

Jessie Shaffer
Phone: (719) 488-2525 x14
Email: jessies@woodmoorwater.com

Meeting Notes:

Existing water supply system condition	
Planning Documents	*See Woodmoor 2012 LRP*
Pump / Treatment / Piping descriptions	
Storage capacity	*DISCUSSION:* According to WIPS, no one's system in the Monument area had transmission capacity to convey water through to others to any degree. WIPS showed that the most efficient way to connect the systems is to construct a new backbone line, then gives a terminal point at the south extent of the users systems. What we are interested in now is what projects can bring water to that point. Question: Is there new information since WIPS that we should incorporate? No significant updates to WIPS. It was pretty detailed. Treatment: standard for surface water: polymer to tie up particulate, floc/sed/clarifier South WTP has trident filters, mixed multimedia
Water supply system controls	Fairly automated compared to most. Software for RTU. Used to have Mystic. Have used Timberline for setting up automation. Current system is Prophecy Ifix. RTUs are at almost every site. Don't allow operators to have remote operation. Philosophy: go to site and see what's up. Can automate both treatment facilities. Wells automated by tank level. North booster that feeds zone 1 automated off discharge pressure.

Power supply	MVEA is supplier – wholesales from Tri-State. Check with MVEA on their rates. North tank has onsite backup power. Have a portable diesel generator. Not big enough for WTP, but works for lift stations. All lift stations have overflow tanks. Rate structure: MVEA through 2012 offered load shed program. Allowed them to shut down facilities that they could shutoff when they wanted. They would calc. a rebate based on value of reallocating. That was a $150k savings annually, but cut that in 2013; no breaks now. Peaking power is the most expensive. Started thinking about in-district power management. One big cost is demand charge. Example: based on system HP, MVEA takes a snapshot during peak hours (6am – 8pm). They track your single largest HP pull, and apply rate to that. District has tried to manage draws during that peak demand period, but there is no way to guarantee that high demands will not be needed. District would like to save power costs, but there is no clear way to reduce at this point.
Current water supply system operations	
Operations summary	Wells 9, 12, 17, 20 and Lake Woodmoor are all plumbed to the south treatment plant. From there they are boosted to south tank. South tank gravity feeds zone 3, North tank gravity feeds zone 2. Zone 1 is fed from a booster pump station. Each zone has PRVs. In automated mode, whenever tank hits certain elevation (varies in summer vs winter), tank signals plants to kick on, then wells line up and kick according to a predetermined order (first pump manages until it can't keep up, second added, etc.) Operations at Lake Woodmoor are the least automated. **Wells baseload summer demands, then peaks come from Lake Woodmoor.** Zone 4 (east) is a boosted system. Can pump out of south tank into distribution system, and any excess can go up to north tank. Valve in Briarhaven (manual) can feed through District and fill south tank. Central water treatment plant treats Wells 7, 15, 16, 18. Water from Central plant boosts to north tank. Well 8 and 11 have on-site treatment, and pump to north tank. Wells 1, 2, 3, 4, and 6 (Dawson well) don't have iron or manganese treatment, just chlorination.

	System includes Denver and Arapahoe wells, but no Laramie-Fox Hills wells (only paper rights). Currently using Lake Woodmoor to take peaks in summer to reduce the number of wells they need to drill. Lake Woodmoor has 600 AF of active capacity, and is typically filled in the winter off exchange from Monument Creek. Sometimes Denver Basin wells are pumped to Lake Woodmoor to get desired storage. Water is discharged from the Lake by gravity to a certain level, then through a pump station to the south treatment facility (which treats either ground or surface water). Treatment is a conventional facility.
Water Right summary	*See Woodmoor 2012 LRP* LRP gives all the demands, all system capacities, and an idea (conceptually) how to roll JV Ranch into the system. It includes some timing and some big picture ideas.
Demands	
Critical delivery	*None identified*
Operational procedures to meet demand and comply with regulations	*They are often stream flow limited on their reuse.*
Operational staffing	
Finances	Financial audit provided. Get rates from website.
Water quality	
Regional Experience	Currently looking at regional reclamation to include indirect potable use for wastewater. Woodmoor, Donala, and Monument are working together. Triview didn't participate in this study since they are doing their own study. Also, Triview is looking at irrigation reuse, but the WDM group is looking at potable reuse. Triview is able to use treated effluent from the Upper Monument Creek WWTP and use "as is" with appropriate warnings. Woodmoor and the others are looking at sophisticated treatment for potable reuse. They are halfway through study, and it should be done in April. Forsgren hopes to incorporate findings from that study in the regional study. Response question from Woodmoor: As far as scope of this regional study, didn't think we were getting down that detail (as in why are we discussing details of reuse). Jessie had thought this

	study would end at transmission to everyone. Will responded that the study includes how to support regional water supply opportunities, and that touch on reuse, but at a higher level than the reuse study. Does this shift magnitude of scope? Forsgren clarified that we are not trying to get into the details of reuse, but if reuse study results in another source, it would be prudent to consider that in our look at getting water to the different entities. Reuse becomes a new source to consider. Concept of connecting Woodmoor and Monument Lakes: A joint study was completed (Woodmoor can dig out if necessary) to see if a connection could be used to enhance exchange and allow both Woodmoor and Monument to not be so flow-limited. During big storm events, water could be transferred to Lake Monument to increase the amount of water stored. A primary issue would be in water rights accounting. When idea was first considered, they were doing monthly accounting, which allowed some water shuffling during the month as long as it came back whole by end of accounting period. Now that accounting is daily, it would be difficult because of the lack of flexibility. It wasn't very feasible when first evaluated, and probably has less benefit now. The most value to expect out of a connection would be to use it as an emergency backup connection. It's probably better to have potable water interconnects through water delivery system though.
Water supply system maps	
Entity objectives, concerns and plans for future changes in water supply delivery,	
Current limitations / upgrade needs	
Recent water supply acquisitions	JV Ranch Ideas for incorporating JV Ranch Store water in Calhan Reservoir. Woodmoor needs approximately 3,500 AF for their uses.

	The reservoir could be expanded, feasibly, to 10,000 AF. JV Ranch covers 2500 acres. It may be possible for CSU to enlarge Calhan Res. with Woodmoor instead of both entities building separate reservoirs. Woodmoor is less concerned about its controlling interest in the Reservoir than about satisfying supply, storage, delivery needs. One option would be to deliver through a new transmission line to a terminal point at Lake Woodmoor. JV Ranch water would be treated to a point (not potable) at JV Ranch, then sent to Lake Woodmoor. From there, water would be sent to and treated at the South WTP, and to future Central WTP retrofit, to be polished for potable use. This option was considered because it may be more economical to treat at the source (with the Ranch there is a great deal of space for treatment options such as evaporation ponds). The economics of other treatment options (complete all treatment at Woodmoor, or complete all treatment at JV Ranch) could be explored to confirm economics. Another option could be to deliver as described above except to deliver through SDS to Upper Williams Creek Reservoir, then through new infrastructure to Lake Woodmoor. Could also deliver via SDS to CSU's new treatment plant, then deliver to the Woodmoor system. The new transmission main could be common with the line CMD is anticipating for delivery from Black Forest. JV Ranch water could also be treated by CSU, put through their distribution system, and then picked up by Woodmoor at Northgate. This would be similar to how Donala can currently takes delivery of its Mt. Massive water via CSU's system. JV Ranch water could also be delivered to and treated (either partially or to potable water) by Cherokee MD, then conveyed through their pipeline. Woodmoor could connect at Hodgen and Black Forest.
Anticipated future service	
Water demand projections for 2035	

and 2050	
System objective	Paper water: if some can be further developed, need to point out ways to get more out of the system. (review potential ways in LRP) Woodmoor's main interest in the Study: Find the most cost- effective means of delivering JV Ranch water. With JV Ranch, there is limited interest in further work south. North of JV Ranch, Woodmoor is looking at an intermediate storage reservoir in Fountain area. It would not be intended for exchange, but for direct use. Woodmoor has found that there doesn't appear to be a feasible way to exchange up Fountain or Monument Creeks other than real short exchange reaches. There is not a way to get much water out of Monument Creek in particular.
Anticipated water supply acquisitions	Woodmoor provided information on previous water supply evaluations
Anticipated areas of water service expansion	Currently, District is at about 50% built out for water demands and about 80% on land use, but more intensive water uses are expected with that additional development. Buildout is anticipated by 2035. There are two scenarios: (1) build out to boundary as it exists today, or (2) ultimate buildout that could include new land annexations into the District. Whistler Ranch, one example, is on the SE corner of the District, could add 140 acres. Also, Homeplace Ranch approached Woodmoor in 2006, but then talked to Triview—not clear where they will end up.
Need for other utility extensions (power, natural gas, etc.)	
Other	The ROY (Return on Yield) Group runs gravel pit storage at the confluence of Fountain Creek and the Arkansas. They are in no hurry to get storage further down on Arkansas River, and are interested in what happens on the Morely property at Stonewall Springs.
Storage ideas	Stonewall Springs has been considered for lined gravel pit storage, but may not work for aquifer

	storage. Could try but it would all be alluvial. There is no void space not already filled by the groundwater table. Discussed the idea of porosity storage reservoir with a clay cutoff wall around an aquifer storage area. [An idea purportedly patented by Don Summers' group and loosely imitated with Aurora's Prairie Waters project. Would need to show how clay wall is keyed into a hard pan. Potential aquifer storage study in the Upper Black Squirrel Basin—need to check on study with Cherokee MD or Gary Barber.
Comments on Reuse Plan	Reuse plan: do some tertiary treatment at Upper Monument Creek or Tri-Lakes WWTP, or in between, peel off effluent credits out of the WWTP discharges of WWTP, pump above Monument Lake, let it run back through Monument Creek (sounds good politically), then pull back out of the creek and send back to each entity. Monument has a WTP with filters for its alluvial Monument Creek wells. The reuse study is looking at centralized tertiary treatment. Monument has wells 4 and 5 by the river. That is one way Monument may be able to take reclaimed effluent, by pumping alluvial wells for treatment. If they have to retrofit, they could also consider plumbing a plant to Monument Lake. Donala was looking at some riverbank filtration and alluvial wells to pull their share out just north of Monument. They have a pipeline over to Jake's Lake? Don't know the alignment; it may run to the golf course, but it is closing. Could that pipeline be turned into a transmission facility? Next evolution of reuse study: what would a joint potable treatment plant look like? Will Monument be able to pull water somewhere else? Woodmoor doesn't think reuse will require RO treatment. Nano- and microfiltration should be able to do what they need.
Other potential ideas	Could allow use of Chilcott (Woodmoor is 58% owner in Chilcott) to get to CSU's planned Williams Creek Reservoir. Construction of that new reservoir is anticipated around 2020-2030 which would be good

	timing for Woodmoor since they hope to have JV Ranch delivering about then. Could use existing infrastructure to shave costs. Williams Creek Res. could function as a timing reservoir. Timed releases through a pump station from Williams Creek Reservoir to Fountain Creek could be exchanged for Pueblo Reservoir water, brought up through Fountain Valley or SDS. If supply could involve some use of Pueblo reservoir water, less treatment would be required. When planning, be aware of RICD (Recreational In-Channel Diversion) set up by a 6-party IGA to maintain flows in the Arkansas between Pueblo Res. and the Fountain Creek confluence. The parties, same ones as in the ROY group, agreed not to dry up that stretch of river to allow for kayaking and essentially forego any exchange potential. Would be interested in a regional group that includes CSU as an equal participant.

APPENDIX D
WHEELER REPORT

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MEMORANDUM

October 10, 2014

To: Will Koger and Steve Simon
Forsgren Associates Inc.

From: Gary B. Thompson, P.E.

No: 1828 – Pikes Peak Regional Water Authority

Re: Fountain Creek Water Exchange Analysis

This memorandum presents our preliminary evaluation of Arkansas River water supplies and Fountain Creek exchange capacity for potential use by the Pikes Peak Regional Water Authority. It is our understanding that the potential project would include acquisition of fully consumable water rights along the Arkansas River for delivery to a reservoir in the vicinity of Stonewall Springs and the Excelsior Ditch, located downstream of Pueblo. Water would be exchanged from that location upstream along the Arkansas River and Fountain Creek to an off-channel storage site in the Fountain area or at the Fountain Mutual Ditch. The target municipal water supply for the Pikes Peak water users would be roughly 10,000 acre-feet per year.

Consumptive Use Credits and Return Flow Obligations. We have estimated a representative monthly pattern of typical consumptive use credits that would be available after changing senior irrigation water rights along the Arkansas River to allow municipal use by the Pikes Peak water users. Such a change of water rights would be subject to Water Court approval. This pattern would also apply to consumptive use credits that might be acquired under a lease or fallowing arrangement. Upon a change of water rights, the monthly pattern typically includes a winter return flow requirement to replicate the lagged groundwater return flows that accrued to the river from the irrigated fields. Based on these concepts, we estimate that the representative monthly pattern of water deliverable into the Arkansas River reservoir would be the following:

Water Deliverable to the Arkansas River Reservoir Expressed as a Percentage of the Annual Total
(Negative numbers indicate winter return flow release requirement)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
-2	-1	0	6	18	26	26	19	12	3	-4	-3	100

As an example from the table above, if the water rights portfolio yielded 100 acre-feet per year of consumptive use credit, the storable amount during May would be 18 acre-feet and there would be a release requirement of 4 acre-feet during November.

Percentage Reduction during Drought Years. Typical irrigation water rights along the Arkansas River have a reduced yield during dry years, based on the overall competition among water rights for the reduced amount of streamflow. We have estimated a typical reduction in the yield of such water rights, based on analysis of diversion records for the Bessemer Ditch and the Catlin Canal, two large irrigation systems along the Arkansas River that may have a representative portfolio of senior and moderately senior water rights. Diversion records for these two ditches during the most recent 50 years indicate that the most critical period for irrigation water supply probably occurred during 2002-2006. For those two ditches combined, the diversions as a percentage of average were the following:

Diversions as a Percentage of the 50-Year Average Annual Total

2002	2003	2004	2005	2006
46%	63%	76%	98%	89%

For example, if the long-term average yield of the water rights portfolio was 100 acre-feet, the consumptive use credit during 2002 would have been roughly 46 acre-feet.

Exchanges - General. Under the concept of "exchange", water is diverted at an upstream location, and an equal amount of substitute supply is released at a downstream location to meet the needs of other water users on the stream. In order to prevent injury to other water users, there must be at surface streamflow at all locations within the exchange reach between the upstream diversion point and the point where the substitute supply is released. Exchanges can only be operated with the prior consent of the Water Commissioner, and he will not allow the exchange to be exercised if he is concerned that it may result in injury. For the purposes of this analysis, we have assumed a proposed maximum daily exchange rate of 20 cfs (20 cfs x 365 days per year = 14,500 ac-ft) for the Pikes Peak water users. The average daily exchange rate would be substantially less for an annual municipal demand of 10,000 acre-feet.

The proposed exchange would consist of two component parts. For the first component, water would be exchanged from the Stonewall Springs area upstream along the Arkansas River to the confluence with Fountain Creek. The exchange-from point would be the area of the Stonewall Springs and Excelsior Ditch, and the exchange-to point would be the confluence with Fountain Creek. For the second component, this water would continue to be exchanged upstream along Fountain Creek to the City of Fountain area or the Fountain Mutual Ditch. Although these two component parts are discussed separately for the purposes of this analysis, both components would actually operate as a single exchange from the Stonewall Springs area to the City of Fountain area or Fountain Mutual Ditch.

Reliability of the Proposed Exchange along the Arkansas River. This component of the exchange would include the Arkansas River from the Stonewall Springs and Excelsior Ditch area, upstream to the confluence of the Arkansas River with Fountain Creek. Our analysis indicates that this component of the exchange could be exercised on a continuous and reliable year-round basis, including all drought periods.

As background information, there are numerous decreed exchange appropriations along the Arkansas River, mostly designed for the exchange of water to Pueblo Reservoir, which is located on the Arkansas River approximately seven miles upstream of the confluence with Fountain Creek. The controlling stream reach for those exchanges is the seven-mile segment along the Arkansas River upstream of Fountain Creek to Pueblo Reservoir. That segment includes numerous exchange limitations associated with:

- A Recreational In-Channel Diversion (RICD) water right by the City of Pueblo, on the Arkansas River upstream of Fountain Creek.
- A multi-party Flow Management Agreement for maintenance of river flows in the Arkansas River upstream of Fountain Creek.
- Relatively less river flow because that segment is upstream of the flow contributions to the Arkansas River from Fountain Creek.

- Relatively less river flow upstream of because that segment is upstream of the Pueblo wastewater discharge point.

Our preliminary analysis indicates that the constraints listed above, in the segment along the Arkansas River upstream of Fountain Creek, are the limiting factors in the exercise of the numerous decreed Arkansas River exchanges. River flow in the segment from Stonewall Springs to the confluence with Fountain Creek is never the limiting constraint. Therefore, the numerous decreed exchanges along the Arkansas River are effectively not in competition with the proposed exchange for the Pikes Peak water users. For the Arkansas River downstream of Fountain Creek, the USGS gage records at the Avondale gage provide data about the available river flows. Such gage records reflect the remaining river flows after operation of all upstream diversions and exchanges that were in operation. Review of this data during the most recent 20 years indicates that the minimum day flow rate at the nearby Avondale gage was 87 cfs in 2002. Daily flows at the Avondale have almost always at least 180 cfs during the most recent 20 years. There are no significant diversions, RICD, of Flow Management Agreements within this downstream segment. Therefore, we conclude that a proposed exchange of 20 cfs within this segment of the Arkansas River would be reliable at all times.

Reliability of the Proposed Exchange along Fountain Creek. This component of the exchange would include Fountain Creek from its confluence with the Arkansas River, upstream to a point where water would be diverted at the Chilcott Ditch, the Fountain Mutual Ditch, or other similar location. Our analysis indicates that this component of the exchange could be exercised on a regular basis, but subject to interruptions during low-flow conditions. In a critical drought year, the exchange opportunity would be completely curtailed during one month – typically July, and somewhat restricted during an additional three months during summer.

As background information, Fountain Creek was historically an intermittent stream, with dry stream conditions caused by relatively limited natural streamflow during drought periods, diversions for irrigation and municipal uses, and a stream channel that is very sandy in some locations resulting in subsurface underflow. With the growth of Colorado Springs and other communities in the Fountain Creek drainage basin during recent decades, wastewater flows and urban runoff have caused Fountain Creek to become an almost perennially flowing stream. Based on review of gaging data and phone interview with Doug Hollister (Water Commissioner), the area of the lowest streamflow along Fountain Creek has consistently occurred near its confluence with the Arkansas River at Pueblo, apparently because of the extremely sandy channel in that area. In other words, Fountain Creek is a "losing stream" during periods of low streamflow. The "Fountain Creek at Pueblo" gage provides a reasonable estimate of flows in that critical area.

The following is a summary of sample daily flows at various times to illustrate the general "losing stream" nature of Fountain Creek, indicating that streamflow generally declines from the Security and Fountain areas:

(Flow Rate in cfs)

	July 4, 2010	**July 4, 2011**	**July 4, 2012**	**July 4, 2013**
Fountain Creek at Security	60	108	58	44
Fountain Creek near Fountain	62	155	64	33
Fountain Creek near Pinon	28	34	33	17
Fountain Creek at Pueblo	30	27	22	22

For the purposes of this analysis and in consultation with the Water Commissioner, we have estimated that daily streamflow of 15 cfs or less at the "Fountain Creek at Pueblo" gage represents periods when the flows would be too low to allow any exchange to be operated. If the daily streamflow is in the range of 15 to 35 cfs, the exchange rate would be limited to an average rate of 10 cfs (i.e. the average of 15 cfs and 35 cfs (25 cfs) minus 15 cfs). Based on these criteria, gage records for the most recent 20 years indicate the following periods when the exchange would probably be limited as discussed above:

Year	**No. of Days of Zero Exchange**	**No. of Days of 10 cfs Exchange**	**Year**	**No. of Days of Zero Exchange**	**No. of Days of 10 cfs Exchange**
1994	8	31	2004	0	16
1995	0	0	2005	14	53
1996	0	10	2006	5	42
1997	0	1	2007	0	2
1998	0	4	2008	24	29
1999	0	0	2009	0	7
2000	0	5	2010	3	54
2001	1	19	2011	24	58
2002	2	45	2012	23	93
2003	2	25	2013	13	43

The full 20 cfs exchange could be operated during all other periods.

For general planning purposes, we recommend the following idealized pattern of exchange operations:

Year	Period of Zero Exchange	Period of 10 cfs Exchange	Period of Full 20 cfs Exchange
Extreme Drought Year 1	July	June, Aug, Sept	Oct - May
Extreme Drought Year 2	July	Aug, Sept	Oct - June
All Other Years		Aug	Sept - July

Transit Loss. Transit losses are seldom assessed as a "loss" against operation of exchanges in Colorado. Based on consultation with the Water Commissioner, we are not aware of any reason why any transit loss would be assessed against the proposed exchanges.

Streamflow Availability in Fountain Creek at the Proposed Diversion Points. None of the diversions along Fountain Creek within the reach from the Fountain Mutual Ditch to the confluence with the Arkansas River result in a physical sweep all of the flow of the stream, except perhaps during periods extremely low flows at the lower end of Fountain Creek. Therefore, the exchange limitations described above are the limiting criteria for the proposed exchanges, and there are no intervening diversions that cause additional reductions in those exchange opportunities.

Colorado Springs Utilities (CSU) usually delivers large rates of fully consumable return flows down Fountain Creek to the confluence with the Arkansas River, for exchange on the Arkansas River upstream to Pueblo Reservoir, or for other disposition. We are not aware of any water rights or other institutional limitations that would prevent the Pikes Peak water users from operating an exchange against the CSU return flows.

During periods of relatively high natural streamflows in the Fountain Creek Basin, CSU sometimes utilizes all of its fully consumable return flows for a local exchange to its upstream diversion and storage facilities within the Fountain Creek basin (i.e. the CSU "local exchange"). During such periods when the local exchange is fully operated, the Pikes Peak water users would not be able to operate an exchange against CSU fully consumable return flows because CSU's wastewater return flows would be classified instead as "native water". However, we have confirmed (and CSU staff concurs) that full operation of CSU's local exchange can only occur during periods of relatively high natural streamflows in Fountain

Creek, so there would continue to be ample native streamflow that would allow operation of the proposed Pikes Peak water users' exchange to continue unabated at such times.

Key Assumptions, Risks, and Limitations.

1. The Pikes Peak water users would obviously need to acquire easements and agreements for use of any diversion and storage facilities required for the exchange.

2. For many decades, the Fountain Mutual Ditch and CSU wastewater return flows at the Las Vegas Street WWTP have been operated in conjunction with each other. The Fountain Mutual Ditch typically sweeps Fountain Creek at its diversion point, then CSU treated wastewater commingles with the diversions, and the combined surplus is turned back to Fountain Creek from a point up-ditch of the Fountain Mutual measuring flume. This conjunctive operation effectively creates the conditions that would enable the potential Pikes Peak water users' exchange to the Fountain Mutual Ditch. In the future, if CSU moves its wastewater return flow point to some different location, the potential for exchanges by the Pikes Peak water users group to the Fountain Mutual Ditch would be severely impacted. We are not aware of any current plans by CSU to relocate its wastewater discharge point, but this is a potential long-term risk.

3. Similarly, if CSU relocates its wastewater discharge point to some location downstream of the Chilcott Ditch, the proposed exchanges to the Chilcott and City of Fountain area would be impacted.

4. It is our preliminary understanding that no agreements or other institutional arrangements are required to allow exchanges against CSU fully consumable return flows, but it may be appropriate to obtain legal advice concerning this matter.

5. Large-scale purchase and change of Arkansas River water rights for delivery to the Stonewall Springs and Excelsior Ditch area would include numerous hurdles, all of which are beyond the scope of this analysis. In our analysis, we have not considered transit losses or exchange constraints for delivery of such water to the Stonewall Springs area. The actual monthly and annual yield of the portfolio of water rights will vary from the estimates provided above.

6. The effects of rapid climate change will likely reduce the future yield of Arkansas River water rights.

7. Future drought conditions that affect operation of exchanges in the Fountain Creek basin could be more severe than the estimates provided above.

8. The analysis described in this memo is preliminary. Before investment decisions are made, the water availability and exchange analysis described herein should be expanded and reviewed by other knowledgeable legal, engineering, and regulatory experts.