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ENERGY WATER INFORMATION GOVERNMENT

2006 Water Master Plan

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Abbreviations

ac-ft	acre feet
ac-ft/yr	are-feet per year
AD	average day
B&V	Black & Veatch
CIP	Capital Improvements Plan
City	City of Fountain
EPS	extended period simulation
Fountain	City of Fountain
Fry-Ark	Fryingpan Arkansas Project
FVA	Fountain Valley Authority
gpcd	gallons per capita per day
gpm	gallons per minute
hp	horsepower
ISO	Insurance Services Office
Master Plan	City of Fountain Water Master Plan
MD	maximum day
MF	microfiltration
MG	million gallons
mgd	million gallons per day
MH	maximum hour
O&M	operation and maintenance
PPACG	Pike's Peak Area Council of Governments
PRV	pressure reducing valve
psi	pounds per square inch
PVC	polyvinyl chloride
RO	reverse osmosis
rpm	revolutions per minute
SDS	Southern Delivery System
TDS	total dissolved solids
WS	water supply
WTP	water treatment plant
ZLD	zero liquid discharge

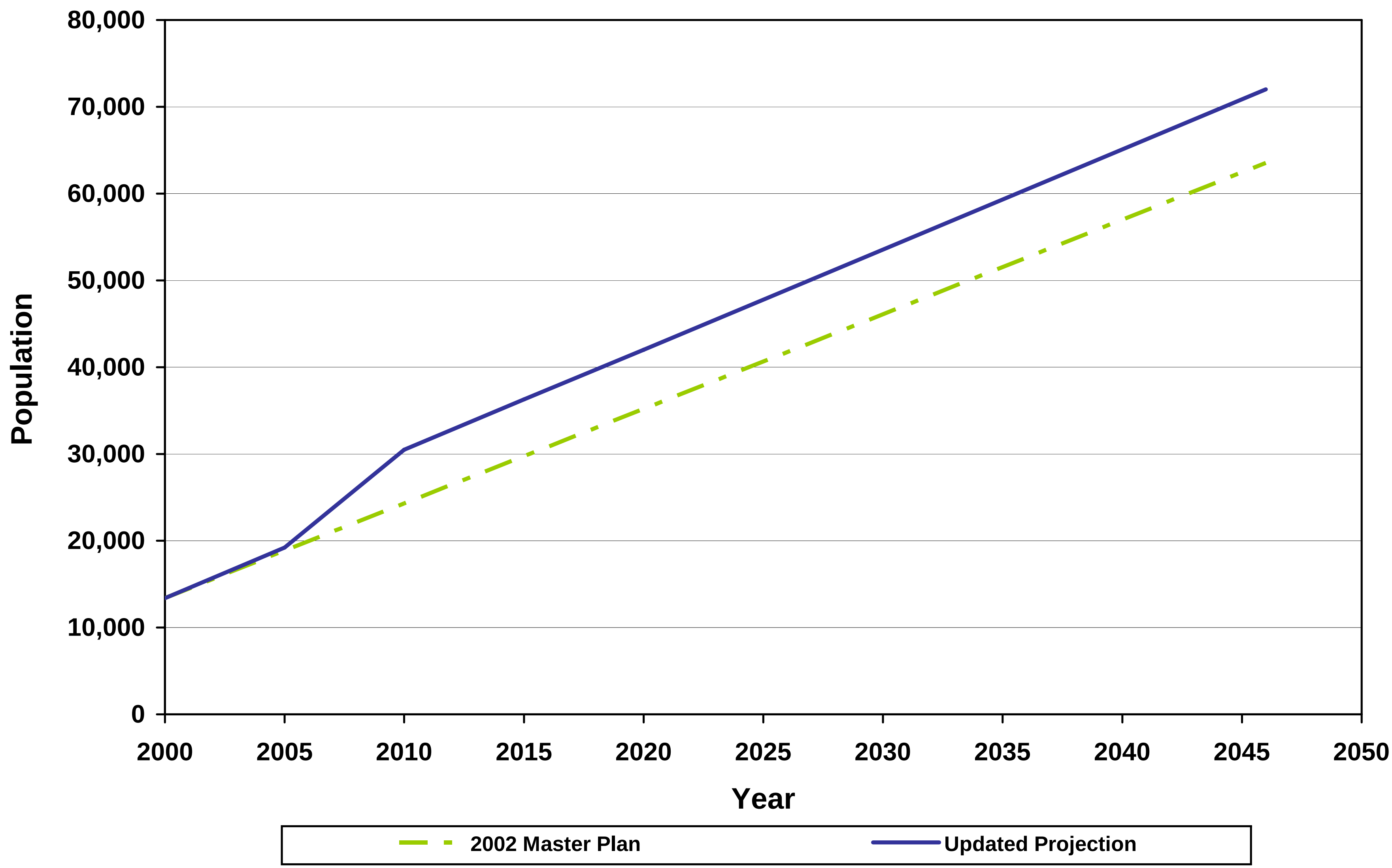
Executive Summary

This Water Master Plan (Master Plan) has been developed to assist the City of Fountain (City, Fountain) with the long-range planning of its water supply, treatment and distribution systems. The intent of this plan is to provide an assessment of the City's water supply needs through the year 2046. In addition, this plan identifies water supplies and treatment, as well as improvements to the distribution system to meet existing and future demands based on anticipated growth within the current service areas and surrounding areas that are likely to be served by the City in the future. This summary is organized by the following sections:

A. Population Projections
B. Future Water Requirements
C. Existing Water Supplies
D. SDS Participation Evaluation
E. Local Water Supply Alternatives
F. Distribution System Analyses
G. Recommended Capital Improvements Plan
H. Reduced Levels of Service
I. Next Steps

A. Population Projections

Development of an effective Master Plan begins with an evaluation of the historic population trends and projected growth patterns within the service area. Table ES-1 provides a summary of the population projections previously presented in the 2002 Water System Master Plan report and the adjustments made as a result of a report published in 2004 by Crowley Consulting and the announcement made by the United States government to station additional personnel at Fort Carson. Table ES-1 also shows the service area population projections that were used in this Master Plan to determine future water requirements within the City's service area. Both sets of projections are shown graphically on Figure ES-1.



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City of Fountain, Colorado – Water Supply Plan

Population Projections

Figure ES-1

Table ES-1

Service Area Population Projections

Year	City of Fountain		Adjustments		Water Service Area	
	2002 Master Plan	Crowley Consulting[1]	Baseline Revision[2]	Fort Carson[3]	2002 Master Plan[4]	Updated Projection[5]
2000	15,197	15,197	0	0	13,370	13,370
2005	20,650	21,000	350	0	18,850	19,200
2010	26,096	26,800	704	5,500	24,300	30,500
2015	31,548	32,591	1,043	5,500	29,750	36,300
2020	37,000	38,382	1,382	5,500	35,200	42,000
2046	65,350	68,495	3,145	5,500	63,540	72,000

(1) Year 2015 value from Oct 2004 Crowley report; other values interpolated and extrapolated accordingly.
(2) Difference between updated projection by Crowley Consulting and the 2002 Water System Master Plan value.
(3) Anticipated number of Fort Carson personnel and family members who will reside in Fountain.
(4) City of Fountain population minus residents receiving water service from Widefield or Security.
(5) 2002 Water System Master Plan projection adjusted to reflect baseline revision and Fort Carson effect.

B. Future Water Requirements

Although a 20-year planning period is generally adequate for sizing most water system facilities, it is often considered prudent to look more than 20 years into the future when planning major components such as water supply and treatment facilities, principal pumping stations and reservoirs, and large-diameter transmission mains. This longer-range view helps to ensure that the water supply will be adequate for the foreseeable future and also serves to minimize the possibility that major water system facilities will have to be duplicated or paralleled within a few years of their construction.

Table ES-2 presents water demand projections based on historic water usage through the year 2046. However, due to recent efforts by the City to encourage water conservation through public education and an inclining rate structure, current demands are lower than anticipated. The City also intends to implement additional measures in the near future to encourage water conservation. Based on this information, water demand projections were developed that consider the impact of current and future conservation. These projections are shown in Table ES-3 and assume a reduction in residential average day water demands of approximately 20 percent.

Table ES-2

Annual Water Demand Projections through 2046 (without Conservation)

Year	Annual Average Day		Maximum Day (mgd)
	(ac-ft/yr)	(mgd)	
2006	4,139	3.7	9.5
2011	6,594	5.9	15.1
2016	8,116	7.2	18.5
2021	9,540	8.5	21.8
2026	11,002	9.8	25.2
2031	12,464	11.1	28.5
2036	13,925	12.4	31.9
2041	15,327	13.7	35.1
2046	16,488	14.7	37.8

Table ES-3

Annual Water Demand Projections through 2046 (with Conservation)

Year	Annual Average		Maximum Day (mgd)
	(ac-ft/yr)	(mgd)	
2006	3,311	3.0	7.6
2011	5,276	4.7	12.1
2016	6,493	5.8	14.8
2021	7,632	6.8	17.5
2026	8,802	7.9	20.1
2031	9,971	8.9	22.8
2036	11,140	9.9	25.5
2041	12,262	10.9	28.1
2046	13,191	11.8	30.2

C. Existing Water Supplies

Water for the City's potable water system comes from two main sources; surface water and well water. In general, surface water is used as the City's primary supply, and the well water is used to supplement during periods of higher demand.

Surface water is obtained through participation in the Fountain Valley Authority (FVA) system. On an annual basis, this supply accounts for the majority (approximately 75 percent) of the City's water. Because the FVA water supply is not sufficient to meet all of Fountain's water needs, the City routinely supplements with water pumped from wells. The City owns and operates five wells located in the downtown area. In general, these wells are relatively small with capacities ranging from 350 to 750 gallons per minute (gpm). This is equivalent to a total pumping capacity of 4.3 mgd and a firm pumping capacity (largest well offline) of 3.2 mgd. However, in recent years, the City has experienced reduced yield from these wells due to lower groundwater levels. Water from these wells is disinfected before being pumped directly into the distribution system.

D. SDS Participation Evaluation

Previous studies have focused on the use of water from the proposed Southern Delivery System (SDS) to meet long-term projected increases in water demand. As currently envisioned, Fountain's level of participation in the SDS project will be 2,500 ac-ft per year, which is equivalent to an annual average delivery rate of 2.2 mgd. However, Fountain may be able to obtain up to 5.6 mgd of SDS water during periods of high demand.

Several studies to develop and evaluate water supply scenarios that utilize SDS water have been completed. Since the City's participation in and timing of SDS is uncertain, two scenarios (C and D) were carried forward for consideration in the report, as described below:

- **Scenario C:** Future water demands would be met by utilizing 2,500 ac-ft/yr of SDS water. The remaining demand would be met with local supplies (wells).

- **Scenario D:** Future water demands would be met by utilizing local supplies (wells). Under this scenario, the City would not participate in SDS.

An evaluation was completed to determine the financial impact of the City's participation in SDS versus developing additional local supplies. For this evaluation, it was assumed that if the City does not participate in SDS, it will need to develop 2.2 mgd of water with similar treated water quality utilizing local groundwater. This water will require treatment due to high total dissolved solids (TDS) concentrations. Costs for 2 mgd of additional reverse osmosis (RO) treatment and brine disposal were also included in the evaluation, which assumes low quality wells and therefore, a low RO bypass ratio. Three alternatives were developed for brine disposal. These alternatives include:

- Drying beds. Brine would be sent to lined drying beds for evaporation.
- Zero liquid discharge (ZLD) located near a power plant. Brine would be sent to concentrators to evaporate the water. The heat required for this process would be provided by the waste heat produced by the power plant. The concentrated salt would be sent to a landfill for disposal.
- ZLD not located near a power plant. Brine would be sent to concentrators to evaporate the water. The heat required for this process would be provided by electricity. The concentrated salt would be sent to a landfill for disposal.

Table ES-4 shows the cost comparison for the City's participation in SDS versus no participation for the years 2015 (when SDS is expected to come online) through 2046.

Table ES-4

Evaluation of City's Participation in SDS versus Developing Local Supplies

Cost Component	**Cost for 2.2 mgd of Treated Water**			
	SDS Participation	**Wells/RO Treatment w/ Drying Beds**	**Wells/RO Treatment w/ ZLD Near Power Plant**	**Wells/RO Treatment w/ ZLD Not Near Power Plant**
Capital cost opinion	$26,000,000	$20,000,000	$20,000,000	$20,000,000
O&M cost opinion[(1)]	$29,000,000	$28,000,000	$38,000,000	$69,000,000
Total cost opinion	$56,000,000	$48,000,000	$58,000,000	$88,000,000

[(1)]Total O&M for years 2015 – 2046.

The cost opinion for the City's participation in SDS is of the same order of magnitude as that for developing wells and RO treatment utilizing either drying beds or ZLD near a power plant for brine treatment. Therefore, it is recommended that the City continue to pursue participation in SDS and budget accordingly. If the SDS project does not move forward, the City can use those funds to develop additional local supplies.

E. Local Water Supply Alternatives

Three water supply alternatives and one sub-alternative were developed to meet interim and ultimate water demands. The alternatives developed as part of this Master Plan focus on utilizing additional wells to meet future water demands in addition to existing FVA and well supplies, and water from SDS.

It is recommended that the City acquire existing wells with demonstrated yields and re-drill them as necessary to meet municipal requirements. The northern part of the City has relatively high water quality wells that can be chlorinated and pumped directly into the distribution system without additional treatment. It is recommended that the City acquire and develop some of these northern wells, as identified below.

Since the number of wells required to meet future demands exceeds the expected supply associated with the available northern wells, it is recommended that the City acquire and/or develop additional wells in the southern part of the City. The quality of the well water in the southern portion of the City is poor with respect to TDS (average 700 to 1,500 mg/L). Consequently, these alternatives include treatment of the groundwater.

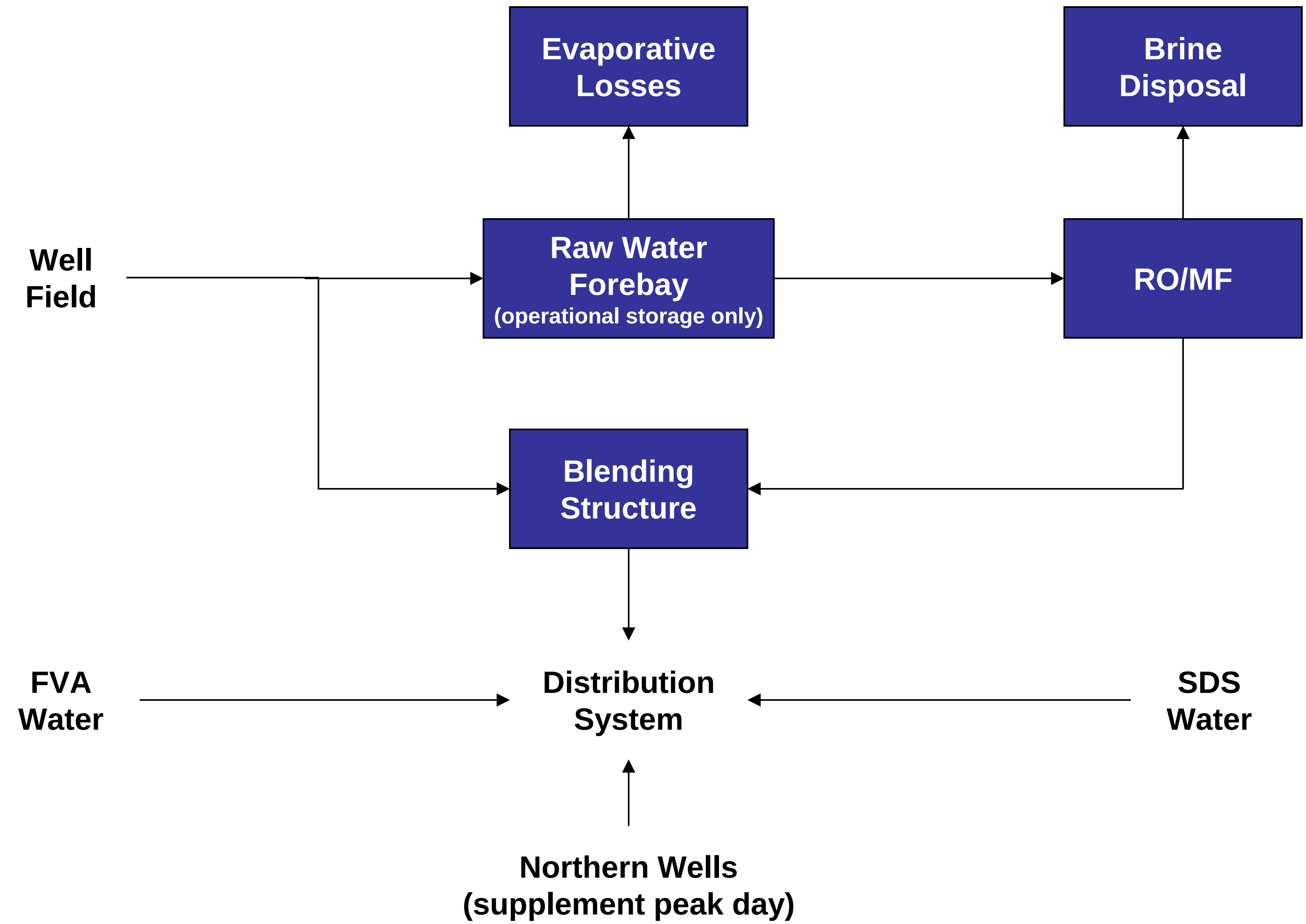
1. Alternative 1 – Pump Wells to Meet Maximum Day Demands

Under Alternative 1, as summarized in Table ES-5, the City would utilize wells and reverse osmosis/microfiltration (RO/MF) treatment to meet maximum day demands. Figure ES-2 shows a schematic representation of Alternative 1.

Table ES-5

Alternative 1 Components

Year	Project Description
2007	Develop 4 northern wells and 1 southern well
2008	Develop 2 northern wells and 4 southern wells 1.5 mgd temporary RO/MF treatment facility online
2009	Develop 1 northern well and 1 southern well
2010	Develop 2 southern wells
2011	Develop 1 southern well 10 mgd permanent RO/MF treatment facility online Decommission temporary RO/MF treatment facility
2012	Develop 1 southern well
2013	Develop 3 southern wells Augmentation reservoir online
2014	Develop 1 southern well Turn over two Ventucci wells to Widefield and Security
2015	SDS online WTP forebay online
2019	Develop 3 southern wells
2021	Expand RO/MF treatment facility to 15 mgd
2022 – 2031	Develop 10 southern wells
2032	Expand RO/MF treatment facility to 20 mgd
2033 – 2046	Develop 13 southern wells



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City of Fountain, Colorado – Water Supply Plan	Figure ES-2
Alternative 1 Schematic – Pump Wells to Meet Maximum Day Demands	

2. Alternative 2 – Pump Wells to Meet Average Day Demands and Provide Single Pass Treatment

Under Alternative 2, as summarized in Table ES-6, the City would pump wells at a constant rate equal to the annual average day demand and utilize storage and RO/MF treatment to meet maximum day demands. Figure ES-3 shows a schematic representation of Alternative 2.

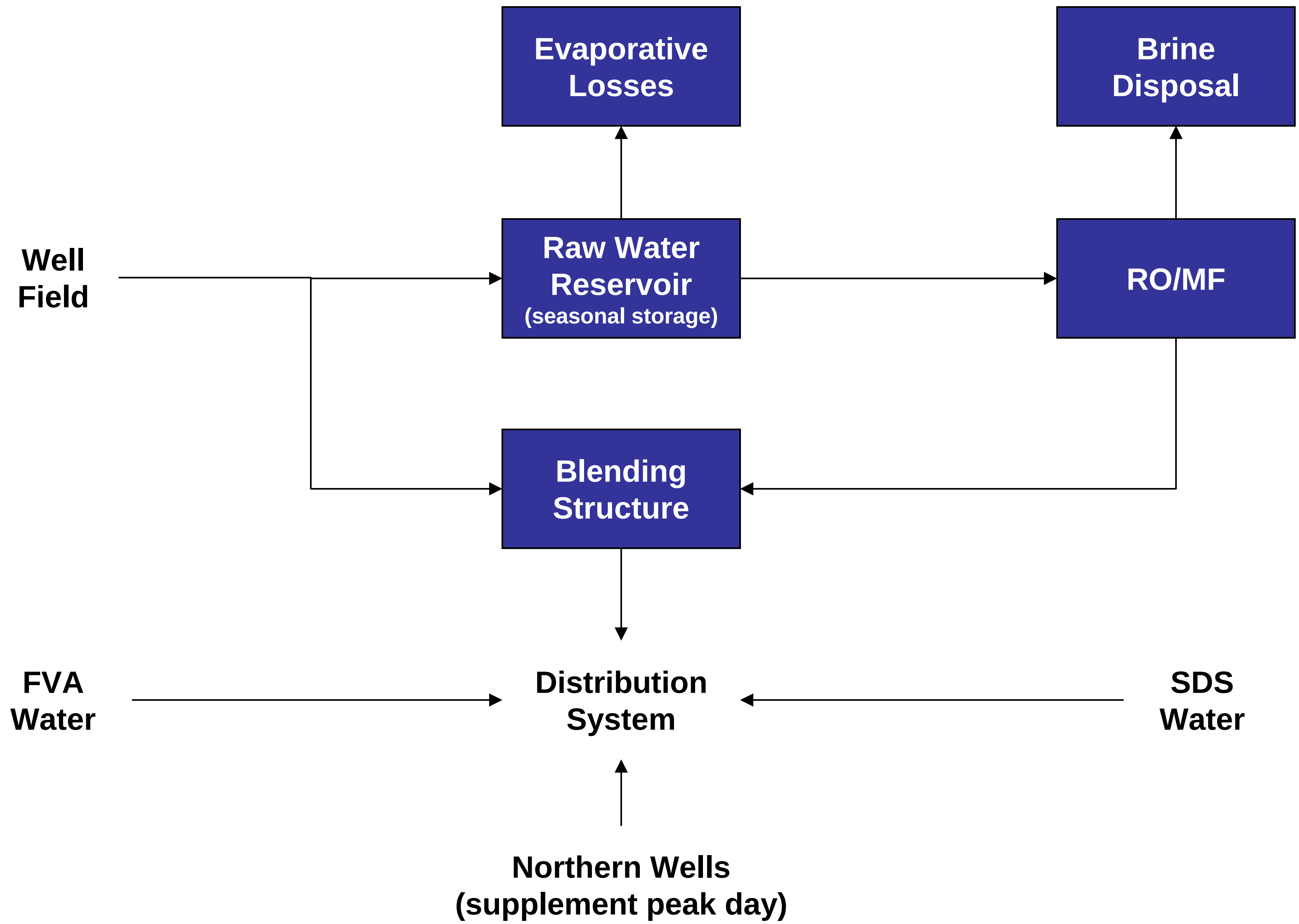
Table ES-6

Alternative 2 Components

Year	Project Description
2007	Develop 4 northern wells and 1 southern well
2008	Develop 2 northern wells and 4 southern wells 1.5 mgd temporary RO/MF treatment facility online
2009	Develop 1 northern well and 1 southern well
2010	Develop 2 southern wells
2011	Develop 1 southern well 10 mgd permanent RO/MF treatment facility online Decommission temporary RO/MF treatment facility
2012	Develop 1 southern well
2013	Develop 3 southern wells Augmentation reservoir online
2014	Develop 1 southern well Turn over two Ventucci wells to Widefield and Security
2015	SDS online Raw water storage reservoir online
2021	Expand RO/MF treatment facility to 15 mgd
2032	Expand RO/MF treatment facility to 20 mgd

3. Alternatives 3 and 3a – Pump Wells to Meet Average Day Demands and Provide Single Pass Treatment

Under Alternative 3, as summarized in Table ES-7, the City would pump wells and utilize RO/MF, all at a constant rate equal to the annual average day demand and utilize storage and additional microfiltration (MF) treatment to meet maximum day demands.



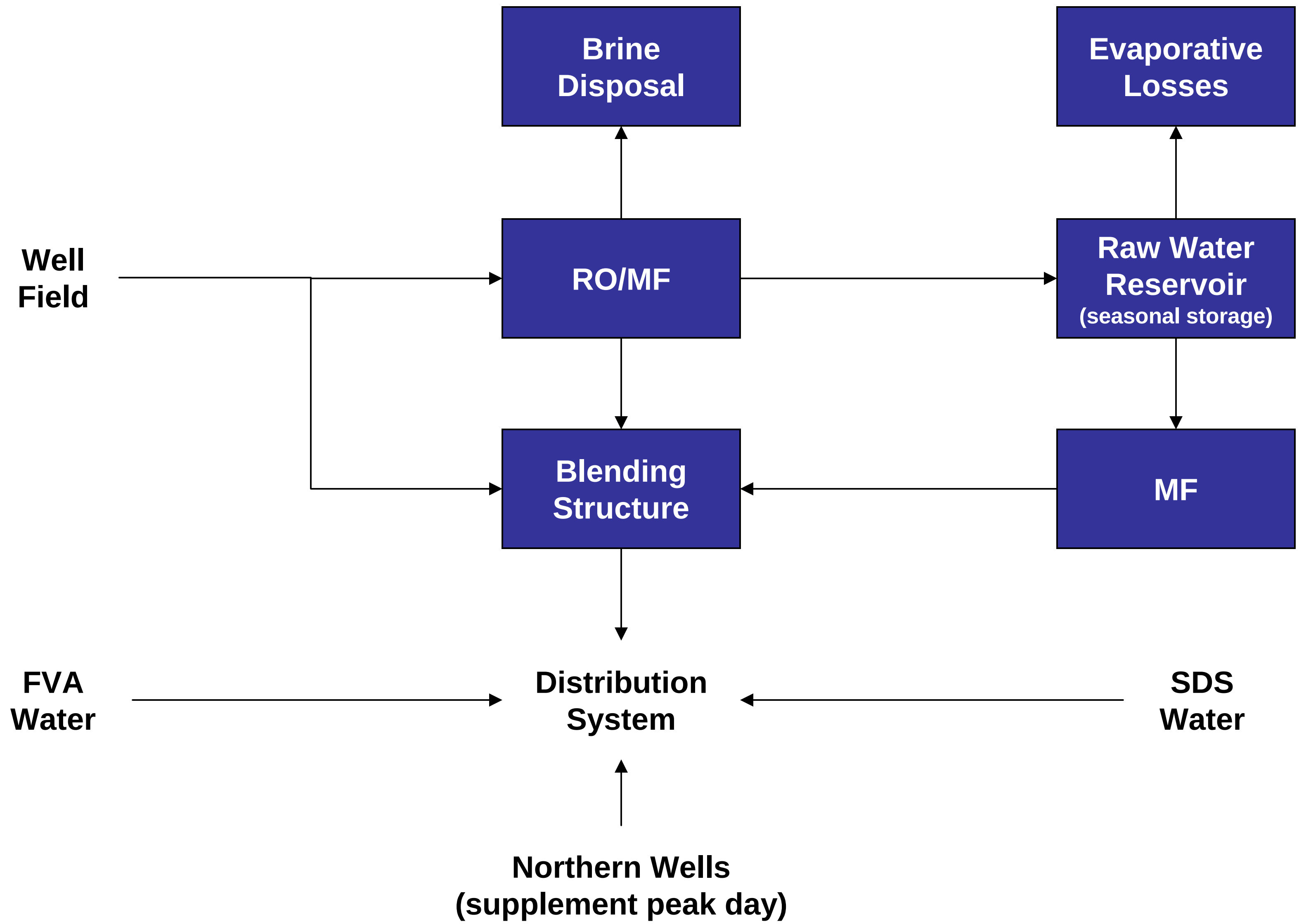
BLACK & VEATCH building a world of difference™ ENERGY WATER INFORMATION GOVERNMENT	City of Fountain, Colorado – Water Supply Plan	Figure ES-3
	Alternative 2 Schematic – Pump Wells to Meet Average Day Demands and Provide Single Pass Treatment	

Table ES-7

Alternative 3 Components

Year	Project Description
2007	Develop 4 northern wells and 1 southern well
2008	Develop 2 northern wells and 4 southern wells 1.5 mgd temporary RO/MF treatment facility online
2009	Develop 1 northern well and 1 southern well
2010	Develop 2 southern wells
2011	Develop 1 southern well 4.0 mgd permanent RO/MF treatment facility online
2012	Develop 1 southern well
2013	Develop 3 southern wells Augmentation reservoir online
2014	Develop 1 southern well Turn over two Ventucci wells to Widefield and Security
2015	SDS online Raw water storage reservoir online
2018	15 mgd MF treatment facility online Decommission temporary RO/MF treatment facility
2029	Expand RO/MF treatment facility to 6.5 mgd
2031	Expand MF treatment facility to 20 mgd

A sub-alternative of Alternative 3 was also developed. This alternative has the same components as Alternative 3, but considers the impact of conservation on average day and maximum day demand projections. If the City opts to implement conservation measures, it can downsize the capacity of some water supply and treatment infrastructure. A reduction of 20 percent in average day and maximum day demands was assumed in developing this alternative. Table ES-8 provides a summary of the components associated with Alternative 3a. Figure ES-4 shows a schematic representation of Alternatives 3 and 3a.



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City of Fountain, Colorado – Water Supply Plan

Alternatives 3 and 3a Schematic – Pump Wells to Meet Average Day Demands and Provide Double Pass Treatment

Figure ES-4

Table ES-8

Alternative 3a Components

Year	Project Description
2007	Develop 4 northern wells and 1 southern well
2008	Develop 2 northern wells and 4 southern wells 1.5 mgd temporary RO/MF treatment facility online
2009	Develop 1 northern well and 1 southern well
2010	Develop 2 southern wells
2011	Develop 1 southern well 4.0 mgd permanent RO/MF treatment facility online
2012	Develop 1 southern well
2013	Augmentation reservoir online
2014	Turn over two Ventucci wells to Widefield and Security
2015	SDS online Raw water storage reservoir online
2018	Expand RO/MF treatment facility to 5.0 mgd 10 mgd MF treatment facility online Decommission temporary RO/MF treatment facility
2029	Expand MF treatment facility to 15 mgd

4. Evaluation of Water Supply Alternatives

Unit costs were utilized to develop both capital and operation and maintenance (O&M) cost opinions for each alternative. Capital costs associated with each of the alternatives were divided into the following categories:

- Wells and Pump Stations
- Wellfield Pipelines
- Storage Reservoirs
- Water Rights
- Water Treatment
- SDS Participation

Table ES-9 provides a side-by-side comparison of the capital cost opinions for each water supply alternative.

Table ES-9

Capital Cost Comparison of the Proposed Water Supply Alternatives

Component	**Capital Cost Opinion**			
	Alternative 1	**Alternative 2**	**Alternative 3**	**Alternative 3a**
Wells and Pump Stations	$21,884,000	$11,484,000	$11,484,000	$9,884,000
Wellfield Pipelines	$21,170,000	$10,400,000	$10,400,000	$10,400,000
Storage Reservoirs	$6,750,000	$21,112,000	$21,112,000	$21,112,000
Augmentation Water Rights	$63,000,000	$53,600,000	$53,600,000	$42,900,000
Water Treatment and Brine Handling	$117,312,000	$117,312,000	$84,011,000	$65,224,000
SDS Participation	$26,447,000	$26,447,000	$26,447,000	$26,447,000
Total Capital Cost Opinion	**$256,563,000**	**$240,355,000**	**$207,054,000**	**$175,967,000**

O&M cost opinions were developed for each water supply alternative for the planning period 2006 through 2046. It is important to note that these costs are above and beyond the O&M costs that the City is currently experiencing. These costs have been developed based on the following categories:

- SDS
- Well Electricity
- Raw Water Pump Station Electricity and Maintenance
- Water Treatment and Brine Handling
- Pipeline Maintenance
- Storage Reservoir Maintenance

Table ES-10 summarizes the total O&M costs for years 2006 through 2046 associated with each of the alternatives. Annual O&M costs vary by year and generally increase with the addition of new facilities.

Table ES-10

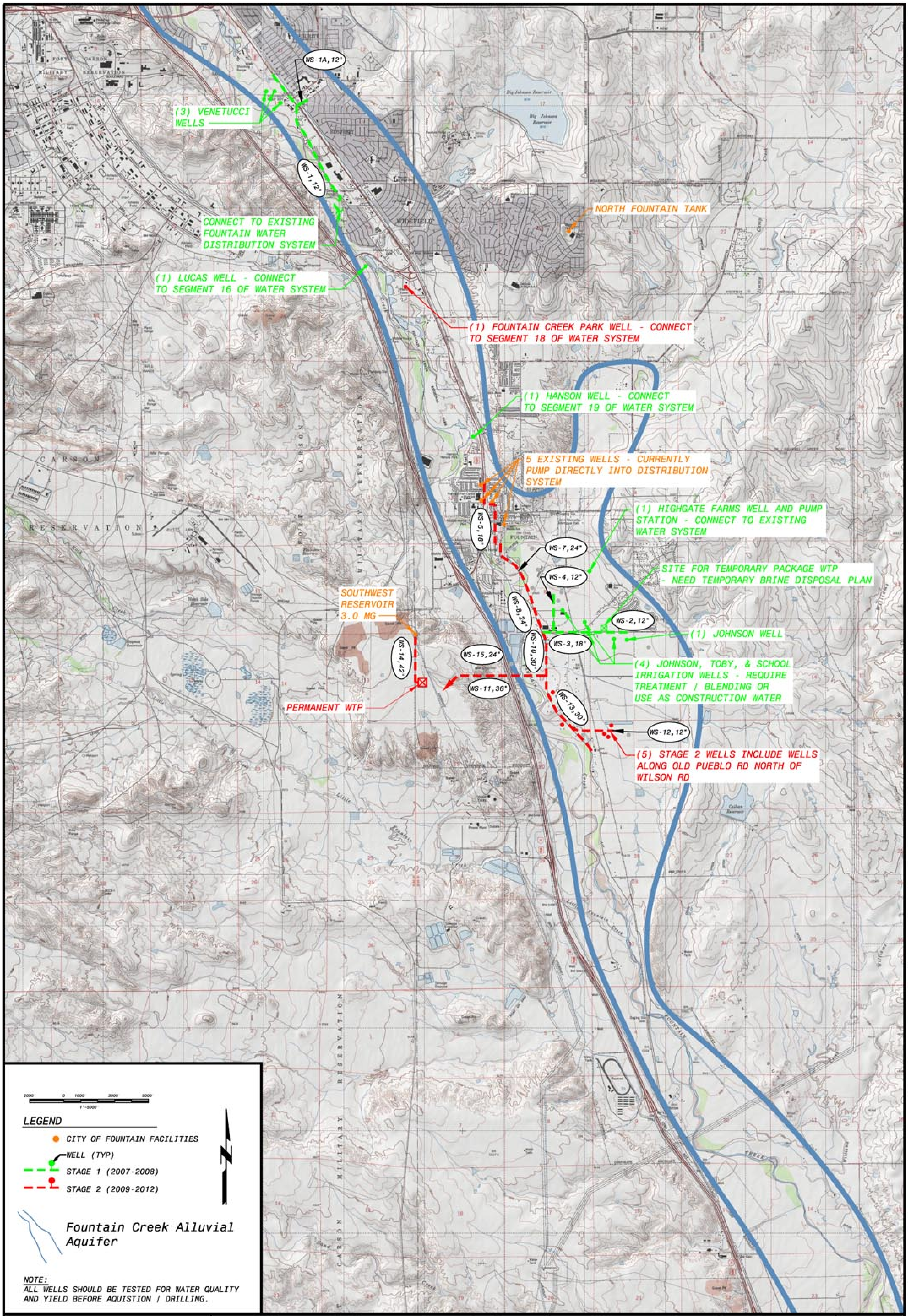
O&M Cost Comparison of the Proposed Water Supply Alternatives

Category	Total Cost (Years 2006 – 2046)			
	Alternative 1	Alternative 2	Alternative 3	Alternative 3a
SDS	$29,466,000	$29,466,000	$29,466,000	$29,466,000
Well Electricity	$19,481,000	$18,416,000	$18,907,000	$14,170,000
Pump Station Electricity and Maintenance	$25,627,000	$23,124,000	$13,596,000	$10,795,000
Water Treatment and Brine Handling	$244,659,000	$246,039,000	$142,028,000	$103,808,000
Pipeline Maintenance	$1,287,000	$767,000	$767,000	$767,000
Storage Reservoir Maintenance	$338,000	$871,000	$871,000	$871,000
Total	**$320,858,000**	**$318,683,000**	**$205,635,000**	**$159,877,000**

Based on the financial evaluation, it is recommended that the City implement Alternative 3a. Alternative 3a has the lowest capital cost opinion as well as the lowest projected O&M costs. Under this alternative, the City would implement conservation measures to reduce future water demands. The City would pump wells and utilize RO/MF at a constant rate equal to the annual average day demand and utilize storage and additional MF treatment to meet maximum day demands. Infrastructure improvements associated with Alternative 3a are shown on Figure ES-5.

F. Distribution System Analyses

In addition to evaluating the City's water supply, a hydraulic model was developed to analyze and evaluate the performance of the water distribution network under various demand and operating conditions. A series of analyses were conducted to identify potential deficiencies in the Fountain distribution



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City of Fountain, Colorado - Water Supply Plan

Infrastructure Improvements Associated with Alternatives 3a

Figure ES-5

system, evaluate various combinations of improvements and modifications, and establish a recommended long-range capital improvement program to reinforce and expand the system as necessary to meet projected water demands and enhance operational flexibility. Deficiencies within the distribution system were identified, and a recommended long-range capital improvement program was developed, as described below and shown on Figure ES-6.

1. Pressure Zones

The existing pressure zones within the Fountain distribution system should be expanded as necessary to accommodate the projected growth areas. It is recommended that the operating gradient within the Little Ranches Zone be increased to about 5,820 feet so that it will be more nearly at the midpoint between the High and Low Zone gradients.

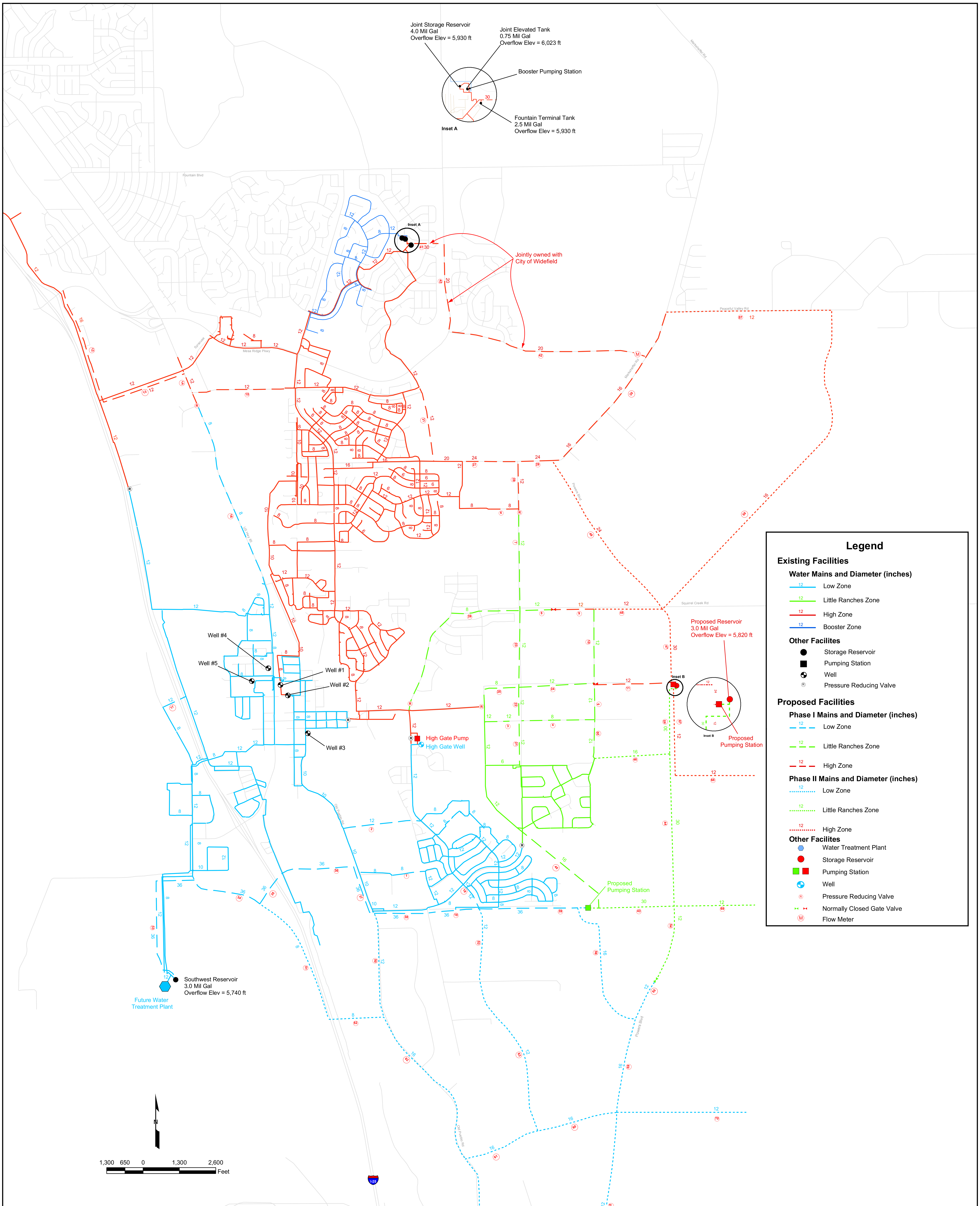
2. Storage Facilities

The existing storage facilities are adequate to meet the future requirements within the Low, High, and Booster pressure zones through the year 2020. It is recommended that a new 3.0 million gallon (MG) reservoir with an overflow elevation of 5,820 feet be constructed to serve the Little Ranches Zone. This reservoir should be located on the high ground near the intersection of Kane Road and the proposed Powers Boulevard extension. It is recommended that the reservoir be constructed by 2010 to provide peaking and emergency storage for customers in the Little Ranches Zone.

3. Pumping Stations

It is recommended that two new pumping stations be constructed; one along Wilson Road and one at the site of the proposed Kane Ranch Reservoir. These stations will be essential for transferring water from the proposed WTP into the higher service areas.

The proposed Wilson Road pumping station should be constructed by year 2011 at the boundary between the Low Zone and the Little Ranches Zone. Although the station should be designed to have an ultimate firm pumping capacity of about 16 mgd, it can initially be constructed with a capacity of about 6 mgd. The proposed Kane Ranch pumping station should be constructed by year 2017, and should be with a firm pumping capacity of about 11 mgd.



Fountain, Colorado
Water System Master Plan

Recommended Distribution System Improvements

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Figure ES-6

4. Distribution Mains

In order to facilitate the budgeting and planning process, the recommended distribution system facilities have been grouped into two phases. Phase 1 facilities are recommended for construction by 2015 and Phase 2 facilities are recommended for construction after 2015.

The Phase 1 Improvements include major transmission mains in the Low Zone and a number of additional mains to reinforce the existing distribution network and to extend service into future growth areas. The Phase 1 transmission mains are needed to enhance the ability to convey water from the Southwest Reservoir to existing and future customers in future growth areas. The principle proposed Phase 1 transmission main is the 36-inch main in the Low Zone between the Southwest Reservoir and the site of the future booster pumping station along Wilson Road.

The Phase 2 Improvements include a number of mains to reinforce the existing distribution network and extend service to projected growth areas. It is recommended that a 30-inch main be constructed in the Little Ranches Zone along Wilson Road and the Powers Boulevard corridor between the Wilson Road booster pumping station and the Kane reservoir. In the High Zone, it is recommended that a 24-inch transmission main along the Powers Boulevard corridor be constructed between the Kane Ranch pumping station and C&S Road. These improvements will complete the sequence of mains needed to convey water from the proposed WTP into the Little Ranches and High Zones.

Because it is not possible to accurately predict the layout of the numerous local distribution mains within future developments and subdivisions, local main improvements were not identified as part of this study. However, in order to assist the City in sizing and laying out the local distribution mains within future developments, the following guidelines are provided:

- Install 12-inch mains as a minimum size on a mile grid.
- Use a minimum pipe size of 8-inches for any main extending more than 500 feet without cross-ties.
- Use minimum pipe sizes of 8 inches in commercial areas and 6-inches in residential areas.

- Wherever possible, eliminate dead-end mains to provide a more reliable looped network.

5. Fire Flow Considerations

A comprehensive fire protection evaluation was not included as part of this study. However, fire flow requirements were considered while performing the hydraulic analyses and the recommended distribution system facilities were sized to provide a reasonable degree of fire protection. Fire flow rates greater than 1,000 gpm will be generally obtainable throughout the distribution network, with significantly higher fire flow rates being available along the primary development corridors, where the larger-diameter distribution mains are located.

6. Capital Cost Opinion

Table ES-11 provides a summary of probable costs for the proposed Phase 1 and Phase 2 recommended distribution system improvements, including water mains, storage reservoirs, and flow control valves.

Table ES-11

Summary of Probable Costs for Distribution System Improvements

Phase	Recommended Improvements	Probable Cost ($)
Phase 1 (by 2015)	Water Transmission and Distribution Mains	13,370,000
	Fire Protection Upgrade (Upsize Ohio Ave with 8 inch main)	200,000
	Wilson Road Pumping Station	1,200,000
	3.0 mil gal ground storage reservoir	2,000,000
	PRVs and Flow control valves	350,000
	Phase 1 Total	**$ 17,120,000**
Phase 2 (after 2015)	Water Transmission and Distribution Mains	11,370,000
	Wilson Road Pumping Station Expansion	500,000
	Kane Ranch Pumping Station	1,000,000
	PRVs and Flow control valves	230,000
	Phase 2 Total	**$ 13,100,000**

G. Recommended Capital Improvements Plan

The capital and O&M costs associated with the recommended water supply and distribution system improvements were used to develop a staged CIP, as shown in Table ES-12.

Table ES-12

Staged CIP for the City's Recommended Water System Improvements[(1)]

Year	Capital Cost	O&M Cost[(2)]
2006	$4,885,000	$0
2007	$11,998,000	$93,000
2008	$13,577,000	$1,227,000
2009	$37,926,000	$1,319,000
2010	$16,995,000	$1,371,000
2011	$15,848,000	$2,644,000
2012	$13,386,000	$2,907,000
2013	$14,773,000	$3,172,000
2014	$3,601,000	$4,314,000
2015	$6,044,000	$4,862,000
2006 - 2015 Subtotal	**$139,033,000**	**$21,909,000**
2016 - 2020	$39,950,000	$19,458,000
2021 - 2030	$22,153,000	$38,072,000
2031 - 2046	$9,073,000	$85,615,000
2016 - 2046 Subtotal	**$71,176,000**	**$143,145,000**
Total	**$210,209,000**	**$165,054,000**

[(1)]Cost reflect 20 percent reduction in average and maximum day demand due to conservation.
[(2)]O&M costs are in addition to the City's current O&M costs.

H. Reduced Levels of Service

The recommended plan described above provides the City with a reliable water system capable of meeting anticipated water demands through the planning period. However, these recommendations require over 60 percent of the total capital improvements to be funded and constructed between 2007 and

2015 and the financial impacts may not be acceptable to the City. If the City cannot implement these recommendations due to financial limitations, reduced level of service alternatives could be considered.

The reduced level of service alternatives (Alternatives 3b and 3c) presented herein are based on the following criteria:

- Sufficient water supplies are provided to meet the same estimated maximum day water demands as for Alterative 3a.
- Water treatment facilities provided under the reduced level of service will enable the City to produce a blended water quality in the distribution system of less than 750 mg/L for TDS, instead of the Environmental Protection Agency (EPA) Secondary Guideline (recommended by not required) value of 500 mg/L.
- The blended water quality of 750 mg/L or less for TDS will be met for all demands equal to or less than 80 percent of the projected maximum day demand condition. During the highest demand periods, additional wells would be operated but the water treatment facilities would be by-passed resulting in slightly poorer water quality. Alternatively, water curtailment measures could be implemented to reduce the peak demands associated with dry summer days and meet the water quality target of 750 mg/L.
- After year 2020, facilities will be in place to meet the recommended target service levels (Alternative 3a).

Alternative 3b includes a revised implementation plan for water treatment and brine handling facilities assuming SDS participation. Alternative 3c includes a revised implementation plan for water treatment and brine handling facilities assuming no participation in SDS. Alternative 3c requires approximately $19.5 million in treatment between years 2006 and Years 2015.

Tables ES-13 and ES-14 provide a comparison of capital and O&M costs associated with the reduced service level alternatives compared to the recommended alternative, respectively.

Table ES-13

Comparison of Capital Costs For Recommended and Reduced Service Level Alternatives

Year	Alternative 3a	Alternative 3b	Alternative 3c
2006	$4,885,000	$4,885,000	$4,885,000
2007	$11,998,000	$9,875,000	$9,875,000
2008	$13,577,000	$13,070,000	$12,534,000
2009	$37,926,000	$13,308,000	$11,866,000
2010	$16,995,000	$14,791,000	$14,136,000
2011	$15,848,000	$14,528,000	$9,790,000
2012	$13,386,000	$13,386,000	$3,267,000
2013	$13,023,000	$14,773,000	$8,253,000
2014	$1,851,000	$3,601,000	$2,814,000
2015	$4,044,000	$6,044,000	$13,544,000
2006 - 2015 Subtotal	**$133,533,000**	**$108,261,000**	**$90,964,000**
2016 - 2020	$39,950,000	$53,405,000	$49,738,000
2021 - 2030	$22,153,000	$32,503,000	$47,803,000
2031 - 2046	$9,073,000	$9,073,000	$9,073,000
2016 - 2046 Subtotal	**$71,176,000**	**$94,981,000**	**$106,614,000**
Total	**$210,209,000**	**$203,242,000**	**$197,578,000**

Comments:

1. Alternative 3a provides a robust system that meets recommended EPA guidelines.
2. Alternative 3b provides reduced levels of service while Fountain continues to participate in SDS.
3. Alternative 3c provides reduced levels of service and no SDS participation.

Table ES-14

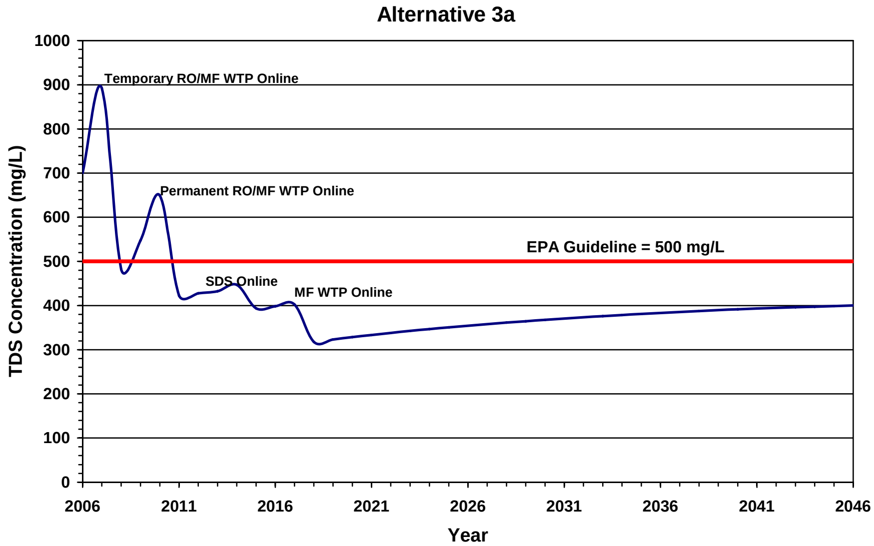
Comparison of O&M Costs For Recommended and Reduced Service Level Alternatives[(1)]

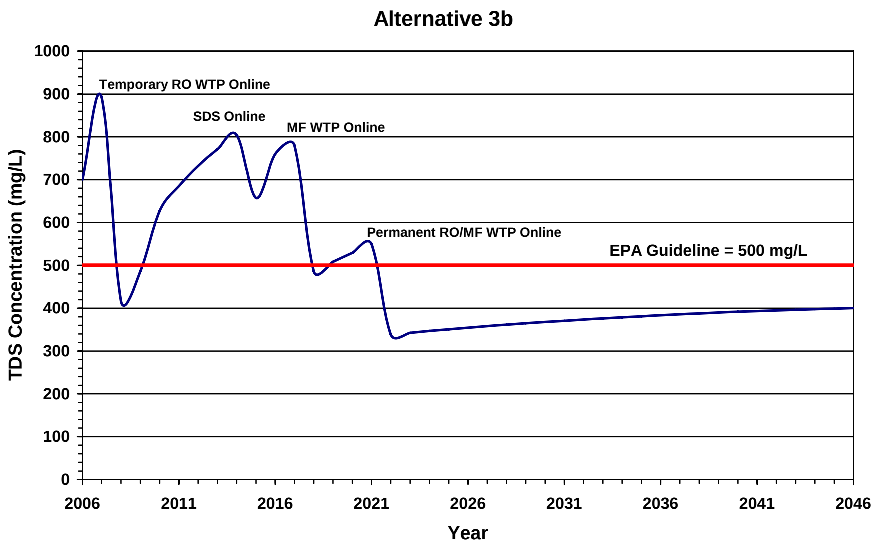
Year	Alternative 3a	Alternative 3b	Alternative 3c
2006	$0	$0	$0
2007	$93,000	$93,000	$93,000
2008	$1,227,000	$712,000	$712,000
2009	$1,319,000	$799,000	$799,000
2010	$1,371,000	$846,000	$846,000
2011	$2,644,000	$985,000	$985,000
2012	$2,907,000	$1,013,000	$1,013,000
2013	$3,172,000	$1,042,000	$1,042,000
2014	$4,314,000	$946,000	$1,403,000
2015	$4,862,000	$2,139,000	$2,011,000
2006 - 2015 Subtotal	**$21,909,000**	**$8,575,000**	**$8,904,000**
2016 - 2020	$19,458,000	$12,010,000	$12,034,000
2021 - 2030	$38,072,000	$37,199,000	$40,106,000
2031 - 2046	$85,615,000	$85,615,000	$88,869,000
2016 - 2046 Subtotal	**$143,145,000**	**$134,824,000**	**$141,009,000**
Total	**$165,054,000**	**$143,399,000**	**$149,913,000**

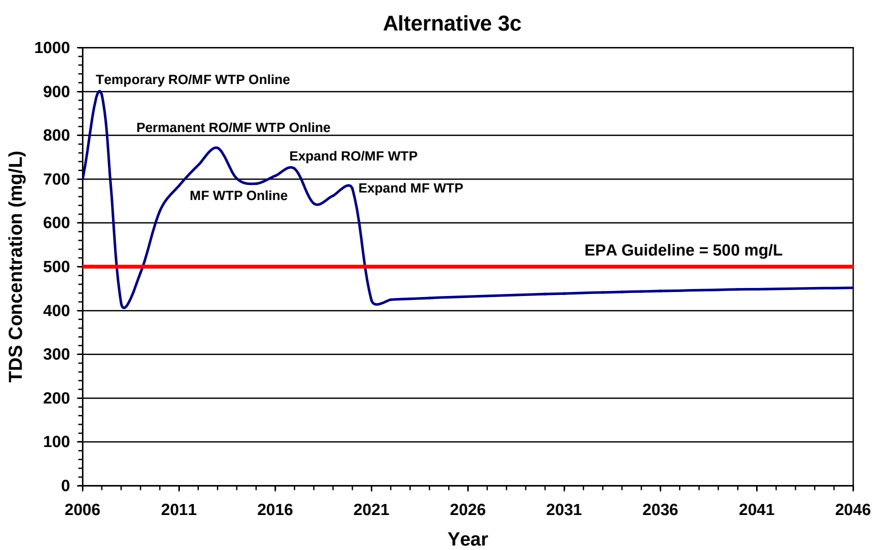
(1) O&M costs are in addition to the City's current O&M costs.

Table ES-14 shows that the O&M costs for Alternatives 3b and 3c are lower that 3a in early years. However, after year 2020, Alternative 3c has the highest O&M cost because it does not realize the benefits of the high quality SDS water.

Figure ES-7 shows the predicted distribution system water quality with respect to TDS concentrations throughout the planning period for Alternatives 3a, 3b, and 3c, respectively. For Alternative 3a, once the permanent RO/MF WTP is online, finished water TDS concentrations are expected to stay below EPA's Guideline of 500 mg/L. For Alternatives 3b and 3c, finished water TDS







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Predicted TDS Concentrations in the Distribution System for Alternatives 3a, 3b and 3c

Figure ES-7

concentrations are not expected to drop below EPA's Guideline of 500 mg/L until after 2020.

I. Next Steps

Assuming conservation measures are implemented, Fountain may utilize groundwater to meet as much as 90 percent of maximum day demands and 65 percent of annual demands by 2020 if the City does not participate in SDS. If the City elects to participate in SDS, its reliance on groundwater could still be as much as 77 percent during maximum day demand periods and 41 percent during average day demand periods. Therefore, it is imperative that an alluvium study be performed to confirm sufficient water is available to meet groundwater demands. In the fall of 2006, Harvey Economics evaluated the City's ability to fund the water plans presented herein and recommended the City implement Alternative 3b.

As discussed previously, RO treatment of the groundwater is required in order to meet water quality standards. RO treatment produces a brine stream that must be disposed of. The Colorado Department of Public Health and Environment requires the development of a Brine Management Plan to evaluate options for brine disposal prior to permitting. In addition, the brine handling costs discussed in this Master Plan are rough order-of-magnitude costs and should be defined further. Therefore, it is recommended that the City perform a treatability/brine handling study. These studies are scheduled to be completed the first half of 2007.

Chapter 1
Introduction and Background

This chapter discusses the purpose and need for this Water Master Plan (Master Plan) and provides pertinent background information.

A. Purpose

This Master Plan has been developed to assist the City of Fountain (City, Fountain) with the long-range planning of its water supply, treatment and distribution systems. In 2004, a comprehensive Water Resource Study was completed for the City by Black & Veatch (B&V). Since that time, new information has come to light regarding population projections as well as changes to the proposed Southern Delivery System (SDS) water supply project. These aspects could have a significant impact on the City's water supply portfolio and infrastructure requirements, and as a result, it is appropriate to reevaluate the City's long-term planning based on this new information.

Therefore, the intent of this plan is to provide an assessment of the City's water supply needs through the year 2046. In addition, this plan identifies water supplies and treatment, as well as improvements to the distribution system to meet existing and future demands based on anticipated growth within the current service areas and surrounding areas that are likely to be served by the City in the future. The recommendations described in this report are designed to provide the City with an adequate and dependable water system.

B. Scope

The principal tasks of this study include the following:

- Evaluate historic trends of population growth, development, and water use.
- Prepare projections of future service area population and water requirements.
- Evaluate the adequacy of existing water supply, storage, and distribution facilities.

- Develop alternatives to provide the City with an adequate supply of water of sufficient quality to meet future demands.

- Evaluate water supply alternatives and develop a phased capital improvements program (CIP) for the recommended facilities.

- Develop a distribution system hydraulic model and perform hydraulic analyses to determine the ability of the distribution system to meet present and future water demands.

- Identify water distribution system improvements and develop a phased CIP with opinions of probable cost.

Chapter 2
Population

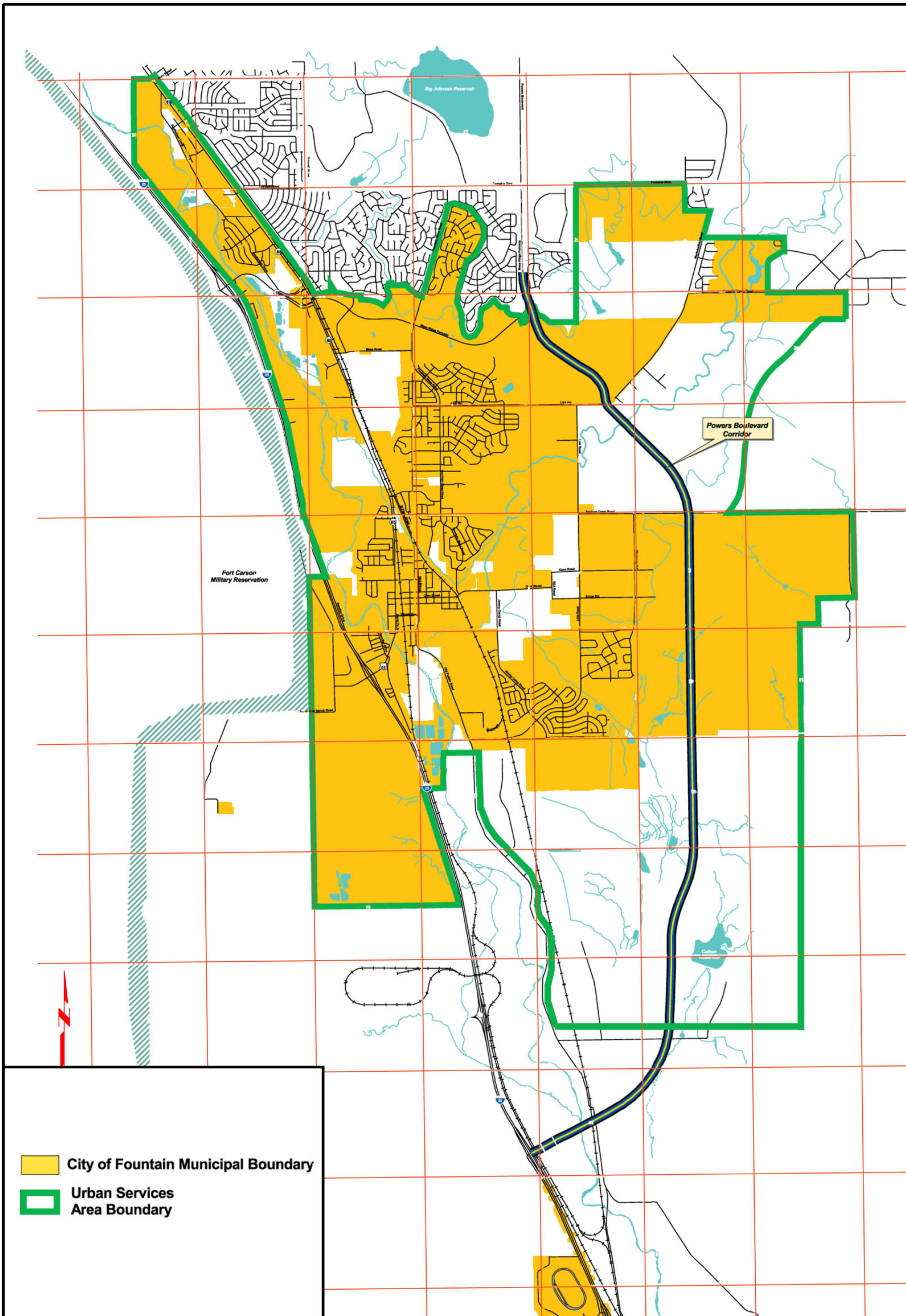
Development of an effective Master Plan begins with an evaluation of the historic population trends and projected growth patterns within the service area. Figure 2-1 presents the planning boundary of the City's water service area.

A. Historic Population

Population projections were developed for the City's previous master plans using population data for El Paso County and the City of Fountain, obtained from the United States Bureau of the Census. Table 2-1 shows the year 2000 population for the City of Fountain and for the City's service area as presented in the 2002 Master Plan.

As shown in Table 2-1, the year 2000 census population for the City of Fountain was 15,197, and about 13,370 of these people were obtaining water from the Fountain water system. The majority of the approximately 1,800 residents not being served by the City receive water from the Widefield Water and Sanitation District, in particular those living in the area north of State Highway 16 and west of U.S. Highway 85. Additionally, a small number of residents in outlying areas of the City currently obtain water from private wells on individual properties.

As indicated in Table 2-1, the area served by the Widefield water system includes block group 3 of tract 45.01 and block group 1 of tract 45.08. It is also worth noting that the small population numbers within census tracts 44, 45.06, 45.07, and 46 can be attributed primarily to the fact that these areas of the city were relatively undeveloped in year 2000.



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City of Fountain, Colorado - Water Supply Plan

Fountain Water Service Planning Boundary

Figure 2-1

Table 2-1

Year 2000 Population

Census Tract	Block Group	City of Fountain	Water Service Area
44	9	6	6
45.01	3[(1)]	755	0
45.03	1	253	181
	2	823	823
	3	882	882
45.06	3	0	0
45.07	3	14	14
45.08	1[(1)]	921	0
	2	1,741	1,741
	3	1,964	1,952
	4	1,200	1,192
45.09	1	2,760	2,746
	2	927	927
	3	2,906	2,906
46	2	45	0
Total		**15,197**	**13,370**

[(1)]Served by other water utilities (Widefield and Security).

B. Future Population

At the time that the 2002 Water System Master Plan study was completed, population projections for the City of Fountain were available from the City's Comprehensive Development Plan and from a document prepared by the Pike's Peak Area Council of Governments (PPACG). Each of these documents contained three scenarios for population representing various assumptions regarding potential growth and development within the City. Based on an evaluation of recent increases in the number of residential service connections, it was decided that the High Level population forecast developed by the PPACG would be the most appropriate to use for projecting Fountain's future water requirements.

In October of 2004, Crowley Consulting published a report that contained updated population projections for the City of Fountain. The Crowley report contained a baseline set of projections that included the Mesa Ridge property, as well as a modified set of projections excluding Mesa Ridge. Even under the assumption that Fountain will not provide water service to the Mesa Ridge area, the population projections in the Crowley report were greater than those utilized in the 2002 Water System Master Plan.

After the 2004 Crowley report was published, the US government announced plans to station approximately 10,000 additional personnel at Fort Carson. It has been estimated that approximately 4,000 of these new personnel will live off base and that 25 to 50 percent of the off-base personnel will likely reside in the City of Fountain. Assuming that about 37 percent of the off-base personnel choose to live in Fountain and assuming an average of 3.7 people per military household, the resulting population increase for the City of Fountain is projected to be about 5,500 people (4,000 x 0.37 x 3.7).

Table 2-2 provides a summary of the population projections previously presented in the 2002 Water System Master Plan report and the adjustments made as a result of the Crowley report and expected Fort Carson impact. Table 2-2 also shows the service area population projections that will be used in this Master Plan to determine future water requirements within the City's service area. These projections are also shown graphically on Figure 2-2.

Table 2-2

Service Area Population Projections

Year	City of Fountain		Adjustments		Water Service Area	
	2002 Master Plan	Crowley Consulting[1]	Baseline Revision[2]	Fort Carson[3]	2002 Master Plan[4]	Updated Projection[5]
2000	15,197	15,197	0	0	13,370	13,370
2005	20,650	21,000	350	0	18,850	19,200
2010	26,096	26,800	704	5,500	24,300	30,500
2015	31,548	32,591	1,043	5,500	29,750	36,300
2020	37,000	38,382	1,382	5,500	35,200	42,000
2046	65,350	68,495	3,145	5,500	63,540	72,000

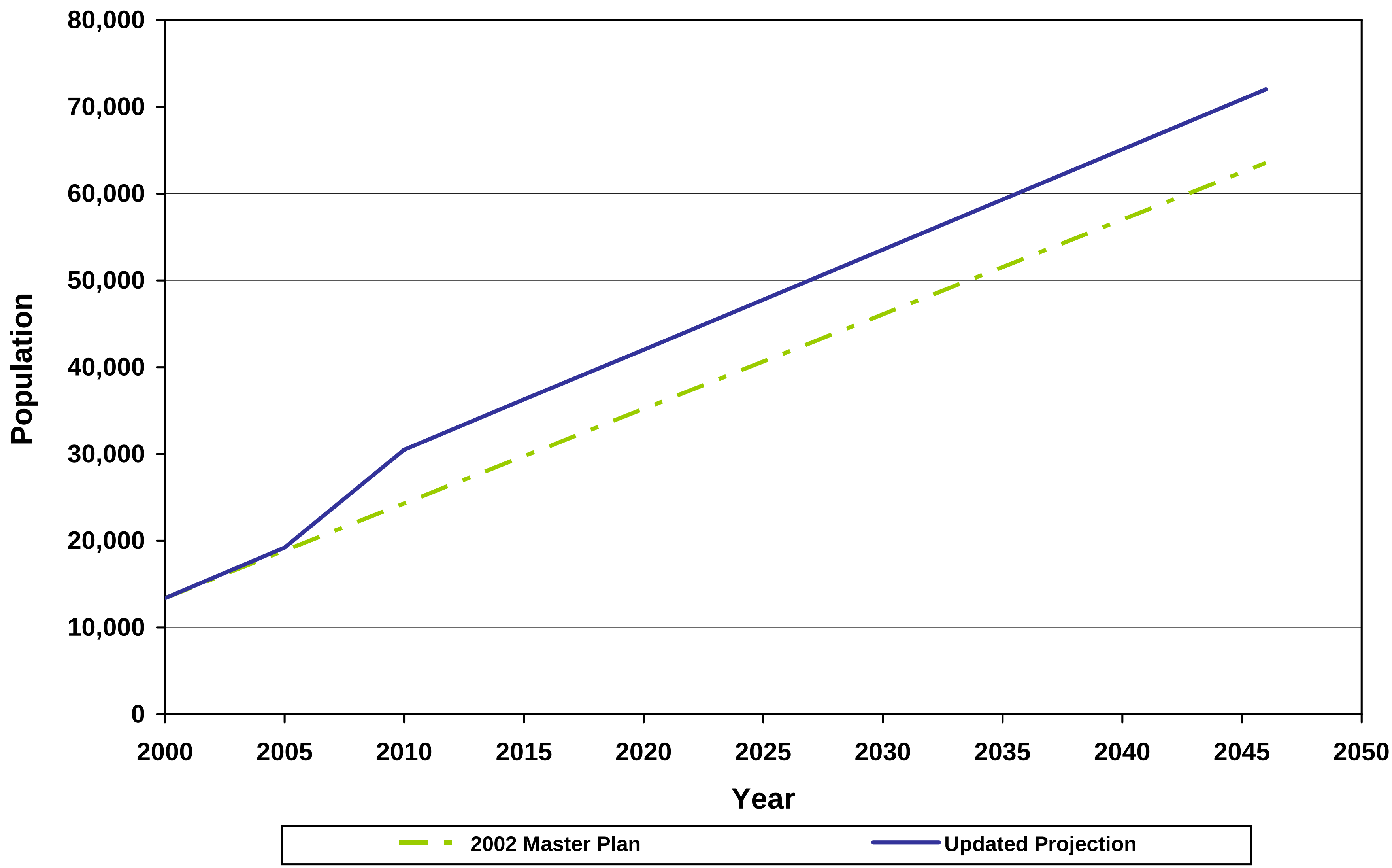
(6) Year 2015 value from Oct 2004 Crowley report; other values interpolated and extrapolated accordingly.

(7) Difference between updated projection by Crowley Consulting and the 2002 Water System Master Plan value.

(8) Anticipated number of Fort Carson personnel and family members who will reside in Fountain.

(9) City of Fountain population minus residents receiving water service from Widefield or Security.

(10) 2002 Water System Master Plan projection adjusted to reflect baseline revision and Fort Carson effect.



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City of Fountain, Colorado – Water Supply Plan

Population Projections

Figure 2-2

Chapter 3
Water Demands

Water demands can fluctuate over a wide range based on annual, daily and hourly variations. Water use is typically higher during dry years and hot months, when more water is used for irrigation. Additionally, water use typically follows a daily diurnal pattern, being low at night and peaking in the early morning and late afternoon. As a result, a water utility must be able to supply water at rates to meet these demands. Rates most important to the design and operation of a water system are average day (AD), maximum day (MD), and maximum hour (MH) demand.

Average day use is the total annual water use divided by the number of days in the year. Maximum day use is the maximum quantity of water used on any one day of the year. The maximum day demand is used to size water supply and treatment facilities to ensure that these facilities are capable of providing an adequate quantity of treated water every day of the year.

The greatest demands on a water system are generally experienced for short periods of time during the maximum demand day. These peak demands are referred to as maximum hour demands because they seldom extend over a period of more than a few hours. Although the duration of these extreme demands is relatively short, the rate of consumption during the maximum hour period often taxes the capabilities of the pumping facilities, distribution mains, and system storage. These demands are met by providing storage within the distribution system. The use of storage minimizes the required capacity of transmission mains and permits a more uniform and economical operation of supply and pumping facilities.

A. Historic Water Use

Fountain currently obtains water from the Fryingpan-Arkansas (Fry-Ark) Project and from wells located within the city limits. The City's annual allocation of Fry-Ark water is limited to 2,000 acre-feet (ac-ft). Accounting for a 5 percent evaporative loss charge, the City's usable allotment is 1,900 ac-ft, which is equivalent to approximately 1.7 million gallons per day (mgd). Because the Fry-Ark water supply is not sufficient to meet all of Fountain's water needs (particularly during the summer months), the City routinely supplements with water pumped from five City-owned wells.

Table 3-1 provides a summary of annual Fry-Ark water purchases and city well production for the past 10 years. Total annual water use within the Fountain system was determined by adding the volume of water pumped from the City wells to the annual Fry-Ark water purchases.

Table 3-1

Fry-Ark Water Purchases and City Well Production

Year	Fry-Ark[1]		City Wells		Total Use (MG)	Average Day (mgd)	Max Day (mgd)	MD/AD Ratio
	MG	percent	MG	percent				
1996	438.5	75	148.3	25	586.8	1.61	3.8	2.3
1997	468.4	72	179.6	28	648.0	1.78	4.2	2.4
1998	501.6	72	191.6	28	693.2	1.90	5.2	2.7
1999	536.6	82	115.9	18	652.5	1.79	3.6	2.0
2000	565.4	76	180.8	24	746.2	2.04	4.9	2.4
2001	558.7	74	197.4	26	756.1	2.07	5.1	2.5
2002	728.7	80	187.7	20	916.4	2.51	5.6	2.2
2003	662.3	77	195.8	23	858.1	2.37	5.4	2.3
2004	586.2	77	172.6	23	758.8	2.07	4.5	2.2

[1] Fountain has an annual allocation of approximately 620 million gallons (MG) per year of Fry-Ark water. In recent years, the City has exceeded this allocation by making short-term water exchanges.

The maximum day water demands shown in Table 3-1 were calculated from the daily meter readings for the Fry-Ark turnouts and the City's daily well production records. During the past 10 years, the maximum day water demand within the City's system has ranged from a low of 3.6 mgd to a high of 5.6 mgd, and the ratio of maximum day water use to average day water use (MD/AD) has ranged from 2.0 to 2.7, averaging about 2.4.

For planning purposes, it is common engineering practice to select a design demand ratio that is greater than the historic average ratio but less than the maximum ratio that has been experienced. If the historic average ratio were used for future planning, it would mean that, during approximately half of the future years, the City may not be able to meet system demands on one or more of the highest demand days.

Conversely, selecting a design demand ratio equal to the historic maximum ratio would mean that the full capacity of the City's system may only be utilized once during a ten-year or longer period. Designing and constructing facilities with sufficient capacity to meet this possible demand is not always economically justifiable. However, most utilities agree that being able to meet maximum day demands in nine out of ten years is a reasonable goal. By utilizing this criteria, utilities accept the fact that, during any given ten-year period, there may be a few days during which certain water facilities may have to be operated beyond their normal capacities or during which some form of water use restrictions may need to be imposed.

Therefore, a MD/AD design demand ratio of 2.6 was used to project Fountain's future maximum day water demands. This ratio is consistent with the design demand ratios being utilized by other front range water utilities including Denver, Colorado Springs, Pueblo, and Trinidad.

Since hourly water use data for the Fountain system was not readily available, actual maximum hour demand rates and MH/AD ratios could not be easily calculated for the Fountain system. Consequently, an assumed MH/AD ratio of 3.8 was utilized for projecting Fountain's future maximum hour demands. The assumed 3.8 MH/AD design demand ratio is based primarily on experience with the other front-range water utilities identified above.

Table 3-1 also shows that, during the past 10 years, the City has obtained between 72 and 82 percent of its annual water supply from the Fry-Ark project, with the remainder of the water obtained from the City's wells. An evaluation of the monthly water production and purchase records indicates that Fry-Ark water purchase volumes do not vary significantly throughout the year while well pumpage tends to be considerably higher during the summer months. In other words, to the extent possible, the Fry-Ark supply is being utilized as a base supply, and the wells are being used primarily as a supplemental source of supply to help meet the higher summer-time water demands.

B. Metered Sales

For any water utility, the volume of water entering the distribution system is typically greater than the volume of water that is ultimately sold to the customers. The difference between the volume of water entering the system and the volume of water sold is referred to as unaccounted-for water use. A portion of the unaccounted-for water use may be attributed to legitimate water uses that are not metered or billed, including water used for flushing mains and hydrants, water used for irrigating parks and city landscaping. The remainder of the unaccounted-for water may be attributed to other factors such as leakage from the distribution system, unauthorized water taps, under-registration by customer meters, and inaccuracies in supply and well meters.

An evaluation of water production versus metered sales performed during the 2002 Water System Master Plan study indicated that unaccounted-for water use in the Fountain system averaged 14 percent. To help reduce this level, the City has implemented a meter replacement program and is also planning to improve the tracking of non-billed City water uses such as park irrigation. Additionally, as the Fountain water system grows, the newer portions of the distribution system will probably have a lower percentage of leakage, thereby resulting in a further reduction in the overall percentage of unaccounted-for water use. As a result of all these factors, it is anticipated that the level of unaccounted-for water use within the Fountain system will gradually decline from 14 percent to 10 percent by year 2020. Achieving an unaccounted-for water use percentage of 10 percent or less is considered a reasonable goal within the water industry.

An evaluation of metered sales data performed as part of the 2002 Water System Master Plan study indicated that residential water usage accounts for 78 percent of the total annual water sales, and commercial usage accounts for the remaining 22 percent. Residential sales include single family homes, duplexes, apartments, and trailers. Commercial sales include office buildings, shopping malls, hotels, public buildings, schools, churches, hospitals, industries, and similar institutions.

As the City of Fountain grows and matures, it is anticipated that an increasing number of businesses and industries will locate within the city, thereby resulting in an increase in the percentage of water being sold to commercial customers. Consequently, for projecting future water demands, it is assumed that the percentage of commercial water use in the Fountain system will gradually increase from the current level of 22 percent to a future level of 35 percent by year 2020. By way of comparison, commercial water use represents about 32 percent of retail sales in Colorado Springs and 35 percent in Pueblo.

Based on the annual residential water usage and the estimated service area population, the average residential water demand in the Fountain system is approximately 100 gallons per capita per day (gpcd). Residential per capita water use can vary widely depending upon the age of the homes, size of the lots, economic status of the residents, and other intangible factors. Historically, per capita water use has been higher within newer subdivisions than it is in older, established areas. One of the reasons for this has been that newer homes are generally equipped with more water-using appliances than older homes. Additionally, newer homes are generally located on larger lots equipped with larger irrigation areas. Therefore, unless conservation measures are implemented by the City, the overall residential per capita water use could gradually increase from its current level of 100 gpcd to 115 gpcd by year 2020. Alternatively, conservation measures could be implemented by the City to keep residential per capita water use at or slightly less than the current rate.

C. Future Water Requirements

Future annual average day water demands were determined considering the preceding evaluations of population, residential per capita water use, metered sales apportionment, and unaccounted-for water use. Future maximum day and maximum hour water demands were determined by applying the previously discussed design ratios to the projected annual average day use.

Table 3-2 provides a summary of the design criteria values utilized in calculating the future water demands for the City of Fountain.

Table 3-2

Future Water Use Criteria

Design Year	**2010**	**2020**
Service Area Population	30,500	42,000
Average Residential Use, gpcd	110	115
Metered Sales Apportionment		
Percent Residential	68	65
Percent Commercial	32	35
Percent Unaccounted-for Water Use	11	10
Demand Ratios		
Maximum Day / Average Day	2.6	2.6
Maximum Hour / Average Day	3.8	3.8

Future water demands were projected using the values listed in Table 3-2, as shown in Table 3-3. As shown in Table 3-3, annual average day water use is projected to increase from its current level of 2.5 mgd to a level of 8.3 mgd by year 2020. The maximum day demand is projected to increase from its current level of 5.5 mgd to a level of 21.2 mgd by year 2020.

Table 3-3

Future Water Demands

Design Year	**2010**	**2020**
Average Day, mgd		
Residential	3.38	4.83
Commercial	1.61	2.60
Subtotal	4.99	7.43
Unaccounted-for	0.62	0.83
Total	5.61	8.26
Maximum Day, mgd	14.4	21.2
Maximum Hour, mgd	21.2	31.0

Although a 20-year planning period is generally adequate for sizing most water system facilities, it is often considered prudent to look more than 20 years into the future when planning major components such as water supply and treatment facilities, principal pumping stations and reservoirs, and large-diameter transmission mains. This longer-range view helps to ensure that the water supply will be adequate for the foreseeable future and also serves to minimize the possibility that major water system facilities will have to be duplicated or paralleled within a few years of their construction.

A review of the numerous development plans that have been submitted to the City of Fountain's planning department during the past year indicates that a considerable amount of the vacant land in the immediate vicinity of the City is already being targeted for development. If all of these plans come to fruition, and if the intermediate areas subsequently develop, population and resulting water demands within the Fountain service area could increase at the high projected rate well beyond the year 2020. Based on this long-range growth assumption, the City's average day and maximum day water demands were projected out to the year 2046, as shown in Table 3-4.

Table 3-4 presents water demand projections based on historic water usage. However, due to recent efforts by the City to encourage water conservation through public education and an inclining rate structure, current demands are lower than anticipated. The City also intends to implement additional measures in the near future to encourage water conservation. Based on this information, water demand projections were developed that consider the impact of current and future conservation. These projections are shown in Table 3-5 and assume a reduction in residential average day water demands of approximately 20 percent.

Table 3-4

Annual Water Demand Projections through 2046 (without Conservation)

Year	Annual Average Day		Maximum Day (mgd)
	(ac-ft/yr)	(mgd)	
2006	4,139	3.7	9.5
2007	4,675	4.2	10.7
2008	5,212	4.7	11.9
2009	5,748	5.1	13.2
2010	6,285	5.6	14.4
2011	6,594	5.9	15.1
2012	6,904	6.2	15.8
2013	7,214	6.4	16.5
2014	7,523	6.7	17.1
2015	7,833	7.0	17.8
2016	8,116	7.2	18.5
2017	8,399	7.5	19.2
2018	8,682	7.8	19.8
2019	8,965	8.0	20.5
2020	9,248	8.3	21.2
2021	9,540	8.5	21.8
2022	9,832	8.8	22.5
2023	10,125	9.0	23.2
2024	10,417	9.3	23.8
2025	10,710	9.6	24.5
2026	11,002	9.8	25.2
2027	11,294	10.1	25.9
2028	11,587	10.3	26.5
2029	11,879	10.6	27.2
2030	12,171	10.9	27.9
2031	12,464	11.1	28.5
2032	12,756	11.4	29.2
2033	13,048	11.6	29.9
2034	13,341	11.9	30.5
2035	13,633	12.2	31.2
2036	13,925	12.4	31.9
2037	14,218	12.7	32.6
2038	14,510	13.0	33.2
2039	14,803	13.2	33.9
2040	15,095	13.5	34.6
2041	15,327	13.7	35.1
2042	15,559	13.9	35.6
2043	15,792	14.1	36.2
2044	16,024	14.3	36.7
2045	16,256	14.5	37.2
2046	16,488	14.7	37.8

Table 3-5

Annual Water Demand Projections through 2046 (with Conservation)

Year	Annual Average (ac-ft/yr)	Annual Average (mgd)	Maximum Day (mgd)
2006	3,311	3.0	7.6
2007	3,740	3.3	8.6
2008	4,170	3.7	9.6
2009	4,599	4.1	10.5
2010	5,028	4.5	11.5
2011	5,276	4.7	12.1
2012	5,523	4.9	12.6
2013	5,771	5.2	13.2
2014	6,019	5.4	13.7
2015	6,266	5.6	14.3
2016	6,493	5.8	14.8
2017	6,719	6.0	15.3
2018	6,946	6.2	15.9
2019	7,172	6.4	16.4
2020	7,398	6.6	16.9
2021	7,632	6.8	17.5
2022	7,866	7.0	18.0
2023	8,100	7.2	18.5
2024	8,334	7.4	19.1
2025	8,568	7.6	19.6
2026	8,802	7.9	20.1
2027	9,035	8.1	20.7
2028	9,269	8.3	21.2
2029	9,503	8.5	21.8
2030	9,737	8.7	22.3
2031	9,971	8.9	22.8
2032	10,205	9.1	23.4
2033	10,439	9.3	23.9
2034	10,673	9.5	24.4
2035	10,907	9.7	25.0
2036	11,140	9.9	25.5
2037	11,374	10.2	26.0
2038	11,608	10.4	26.6
2039	11,842	10.6	27.1
2040	12,076	10.8	27.6
2041	12,262	10.9	28.1
2042	12,448	11.1	28.5
2043	12,633	11.3	28.9
2044	12,819	11.4	29.3
2045	13,005	11.6	29.8
2046	13,191	11.8	30.2

Chapter 4
Existing Facilities

The City of Fountain's water system includes wells, storage reservoirs, pumps, regulating valves, and a network of distribution mains. A map of the existing system (excluding FVA facilities) is shown on Figure 4-1. Water is obtained from a regional water supply system and from several city-owned wells. The Fountain distribution system is divided into two major pressure zones as well as one booster zone and one regulated zone that is supplied through pressure reducing valves. The following paragraphs discuss the City's water supply and distribution facilities in more detail.

A. Water Supply

Water for the City's potable water system comes from two main sources; surface water and well water. These sources are described in more detail below. In general, surface water is used as the City's primary supply, and the well water is used to supplement during periods of higher demand.

1. FVA Water

Surface water is obtained through participation in the Fountain Valley Authority (FVA) system. On an annual basis, this supply accounts for the majority (approximately 75 percent) of the City's water. Raw water from the Fryingpan-Arkansas Project is pumped from Pueblo Reservoir through the Fountain Valley Conduit to the Fountain Valley Water Treatment Plant (WTP). The water is then treated before being delivered via finished water pumping stations to the cities and towns of Fountain, Widefield, Security, Stratmoor Hills, and Colorado Springs, which comprise the FVA. These facilities were designed to supply a total annual volume of 20,100 acre-feet (ac-ft) of treated water to the participating municipalities at a constant rate throughout the year. The City's annual allocation of water is 2,000 ac-ft. Accounting for a 5 percent evaporative loss charge, the City's usable allotment is 1,900 ac-ft, which is equivalent to approximately 1.7 mgd.

A series of pumping stations and reservoirs along the length of the Fountain Valley Conduit are required to facilitate the flow of water through the

Fountain, Colorado
Existing Water
System Facilities

2006

Figure 4-1

transmission main. The water surface elevation in the Pueblo Reservoir is normally about 4,881 feet. Raw water from the Pueblo Reservoir is initially pumped by Pumping Plant No. 1 through about 12 miles of 42-inch main to Forebay Tank No. 2, which has an overflow elevation of 5,177 feet. Pumping Plant No. 2 pumps raw water from Forebay No. 2 through 16 miles of 39-inch pipe to the Clear Springs Regulating Tank, which has an overflow elevation of 5,622 feet. The Clear Springs Regulating Tank is located on the Fountain Valley Water Purification Plant site, and raw water flows by gravity from the regulating tank to the treatment facility.

Following treatment, the finished water flows from the plant into an adjacent clearwell. Pumping Plant No. 3 pumps water from the clearwell through 5 miles of 39-inch pipe to Forebay Tank No. 4, which is located just west of Fountain and has an overflow elevation of 5,767 feet. Pumping Plant No. 4 pumps water from Forebay No. 4 through 5 miles of 33-inch pipe to the Stratmoor Hills Terminal Tank, which is located on the south side of Colorado Springs and has an overflow elevation of 5,983 feet.

FVA finished water is delivered to the City at two locations. A turnout on the section of the Fountain Valley Conduit leading to Forebay Tank No. 4 allows water from the conduit into the City's Southwest Reservoir, a 3.0 million gallon (MG) ground storage reservoir located in the southwest part of the distribution system. The City's Southwest Reservoir has an overflow elevation of 5,740 feet, which is 27 feet lower than Forebay Tank No. 4. Because the overflow elevation of the Southwest Reservoir is below the normal operating gradient in this section of the Fountain Valley Conduit, water can flow from the conduit through a regulating valve into the City's reservoir. The water then flows by gravity from the City's Southwest Reservoir into the Low Zone distribution system.

As previously indicated, FVA Pumping Plant No. 4 takes suction from Forebay Tank No. 4 and discharges into a transmission main that conveys water northward to the Stratmoor Hills Terminal Tank. On the discharge side of Pumping Plant No. 4, a 24-inch diameter transmission main, referred to as the Fountain Valley Lateral, branches off from the Fountain Valley Conduit and heads northeast about 3 miles to the Widefield Regulating Tank, which is located at the Fountain/Widefield tank site along Goldfield Drive. Thus, some of the water that is pumped by Pumping Plant No. 4 flows through the Fountain Valley Lateral to the Widefield Regulating Tank, which has an overflow elevation of

5,942 feet. From there water flows by gravity to the Widefield Terminal Tank, the North Fountain Tank and the Joint Fountain/Widefield Storage Reservoir. From these reservoirs, water can either enter Fountain's High Zone distribution network or be pumped to the Joint Fountain/Widefield Elevated Tank, which serves the City's Booster Zone and the Widefield distribution system.

About one-third of the water that is delivered to the Widefield Regulating Tank is subsequently pumped through the 16-inch diameter Security Lateral to the Security Terminal Tanks. Thus, the Fountain Valley Lateral conveys water for Fountain, Widefield, and Security.

2. Well Water

Because the FVA water supply is not sufficient to meet all of Fountain's water needs, the City routinely supplements with water pumped from wells. The City owns and operates five wells located in the downtown area between Fountain Creek and the Union Pacific Railroad tracks. Wells No. 3, 4, and 5 discharge to the Low Zone distribution network. Wells No. 1 and 2 normally discharge to the High Zone distribution network, but during emergencies or unusual demand conditions they can be valved to temporarily discharge into the Low Zone.

A description of the well locations and capacities is given in Table 4-1. In general, these wells are relatively small with capacities ranging from 350 to 750 gallons per minute (gpm). This is equivalent to a total pumping capacity of 4.3 mgd and a firm pumping capacity (largest well offline) of 3.2 mgd. However, it should be noted that in recent years, the City has experienced reduced yield from these wells due to lower groundwater levels.

Table 4-1

Locations and Capacities of the City's Potable Wells

Well Number	Pressure Zone Served	General Location	Pumping Capacity (gpm)
1	High	Santa Fe Avenue and Hanover Street	750
2	High	Alabama Avenue and Race Street	650
3	Low	Main Street and Missouri Avenue	550
4	Low	Santa Fe Avenue and Linda Vista Drive	350
5	Low	Near Fountain-Fort Carson High School	660

The wells are generally only operated during periods of higher water demand, usually during the summertime, and account for approximately 25 percent of the total potable water delivered by the City annually. Water from these wells is disinfected before being pumped directly into the distribution system. As a result, FVA water and well water are not blended prior to reaching the City's customers. Therefore, customers located within the zone of influence of the wells primarily receive well water during the summer months while other customers continue to receive higher quality FVA water. Table 4-2 provides a comparison of the water qualities of the different water sources.

Table 4-2

Water Quality Comparison of the City's Water Supplies[1]

Water Quality Parameter	Concentration		Comments
	Wells Nos. 1 and 2	FVA Finished Water	
Alkalinity (as $CaCO_3$), mg/L	270 – 290	77 – 129	
Sulfate, mg/L	190 – 320	63 – 152	Federal Secondary Maximum Contaminant Level = 250 mg/L
pH, s.u.	7.6 – 8.2	7.2 – 7.6	
Calcium (as $CaCO_3$), mg/L	310 – 350	105 – 150	
Total Hardness (as $CaCO_3$), mg/L	450 – 500	138 – 228	Well water classified as very hard by USGS
Langlier Index	0.24 – 0.89	-0.28 – -0.90	Negative value may result in corrosion in the distribution system

[1]Based on water quality testing conducted between 1991 and 2001.

In general, water from the City's wells is of lower quality than FVA water, which has resulted in customer complaints, as discussed above. In order to address this issue, the well water must be treated or blended with higher quality water. Alternatives for improving water quality are evaluated in the following chapters.

B. Pressure Zones

In order to accommodate varying ground elevations within the service area without producing excessively low or high system pressures, the City's water distribution system is divided into two major pressure zones (referred to as the Low Zone and the High Zone) as well as one booster zone and one relatively small regulated zone supplied through pressure reducing valves. Table 4-3 provides a summary of the ground elevations and operating gradients within the various pressure zones that makeup the Fountain water system, and the subsequent paragraphs discuss the individual pressure zones in more detail.

Table 4-3

Pressure Zones

Pressure Zone	Minimum Ground Elevation (feet)	Maximum Ground Elevation (feet)	Operating Gradient (feet)
Low	5,500	5,600	5,740
Little Ranches	5,560	5,700	5,790
High	5,520	5,750	5,930
Booster	5,750	5,880	6,023

1. Low Zone

The Low Zone serves the low-lying ground in the southwest part of the City, generally southwest of the Union Pacific Railroad tracks. Ground elevations within the Low Zone range from about 5,500 feet along Fountain Creek to 5,600 feet along the Union Pacific railroad tracks. The Low Zone operates on a static hydraulic gradient of 5,740 feet as determined by the overflow elevation of the City's 3.0 million gallon Southwest Reservoir.

FVA water is supplied to the City's Low Zone from the Fountain Valley Conduit via a turnout located about 3 miles upstream of Forebay Tank No. 4 into Fountain's Southwest Reservoir and then flows by gravity into the distribution system. Additional water for the Low Zone is obtained from City Wells No. 3 and No. 4. Under unusual demand conditions or emergencies, water can also be supplied to the Low Zone from City Wells No. 1 and No. 2 or through pressure reducing valves located along the boundary between the Low and High zones.

2. High Zone

The High Zone serves most of the higher-lying ground in the northeast part of the City, generally northeast of the Union Pacific Railroad tracks. Ground elevations within the High Zone range from about 5,520 feet along Camp Creek to 5,750 feet in the vicinity of Janitell Junior High School. The High Zone operates on a static hydraulic gradient of 5,930 feet as determined by the overflow elevations of the Fountain Terminal Tank and the Joint Storage Reservoir.

FVA water is supplied to the High Zone through the Fountain Valley Lateral, which conveys water from the Fountain Valley Conduit to the Widefield Regulating Tank. Water flows by gravity from the regulating tank to the North Fountain Tank and Joint Storage Reservoir. From these reservoirs, water can flow by gravity into the High Zone distribution system or be pumped into the Booster Zone. Additional water for the High Zone is obtained from City Wells No. 1 and No. 2.

3. Little Ranches Zone

The Little Ranches Zone serves an area in the southeast part of the City where the ground elevations are too high to be served effectively from the Low Zone but lower than the ground being served from the High Zone. Ground elevations in the Little Ranches Zone range from about 5,560 feet to 5,700 feet. Water is supplied through a pressure reducing valve (PRV) that bleeds water from the High Zone into the regulated zone. Because there are no storage facilities within the Little Ranches Zone, the static hydraulic gradient within the zone is determined by the downstream pressure setting on the pressure reducing valve. The PRV is currently set to maintain an operating gradient of about 5,790 feet within the Little Ranches distribution system.

4. Booster Zone

The Booster Zone serves the high-lying ground in the north part of the City, generally north of Mesa Ridge Parkway. Ground elevations in this zone range from about 5,750 feet to 5,880 feet. The Booster Zone operates on a static hydraulic gradient of 6,023 feet as determined by the overflow elevation of the 750,000 gallon Joint Elevated Tank.

Water is pumped from the Joint Storage Reservoir into the Booster Zone using two pumps located in the base of the Joint Elevated Tank. Each of the pumps has a rated capacity of 1,300 gallons per minute (gpm) at a head of 100 feet, and each is equipped with a 50 horsepower (hp) motor that operates at a speed of 1,750 revolutions per minute (rpm).

C. Storage Facilities

Storage facilities in a distribution system serve a number of purposes, including flow equalization, fire reserve, and emergency supply. Without storage facilities, the supply, treatment, pumping, and transmission facilities would have to be sized to meet instantaneous peak demands within the service area, which would be both impractical and uneconomical. However, by constructing appropriately sized reservoirs at strategic locations throughout the service area, the other major system components can be more economically sized.

Table 4-4 provides a summary of pertinent information concerning the existing storage reservoirs within the City's distribution system. It should be noted that the Joint Storage Reservoir, the Joint Elevated Tank, and the associated booster pumps are all jointly owned and operated by the Cities of Fountain and Widefield.

Table 4-4

Water Storage Facilities

Facility	Volume (MG)	Overflow Elevation (feet)	Sidewater Depth (feet)
Southwest Reservoir	3.0	5,740	39
Fountain Terminal Tank	2.5	5,930	43
Joint Storage Reservoir(1)	4.0	5,930	37
Joint Elevated Tank(1)	0.75	6,023	30

(1)Jointly owned and operated by the Cities of Fountain and Widefield.

D. Distribution Mains

Except for a relatively small amount of 16-inch and 20-inch pipe, the water mains within Fountain's distribution system generally range in diameter from 4-inches to 12-inches. Most of the older pipes within the distribution system are cast iron or ductile iron, with a few asbestos cement pipes. Conversely, most of the newer pipes in the distribution system are polyvinyl chloride (PVC).

Since Fountain's Booster Zone and the northern part of its High Zone are located immediately adjacent to the City of Widefield's service area, the two utilities have established, by mutual agreement, a number of interconnections between the neighboring distribution systems. The valves on these interconnections are typically closed to keep the two systems separated during normal operations. However, in the event of an emergency in either distribution system, the valves on the interconnections could be opened to allow water to flow from one system to the other. Thus, these interconnections provide an additional level of reliability for both the Fountain and Widefield water utilities.

Chapter 5
Water Supply Alternatives

This chapter presents a review of findings from previous studies as well as three water supply alternatives that have been developed as part of this Master Plan.

A. SDS Participation Evaluation

Previous studies have focused on the use of water from the proposed SDS to meet long-term projected increases in water demand. The proposed SDS consists of a system of transmission mains, pumping stations, reservoirs, and treatment facilities designed to bring additional water from Pueblo Reservoir to serve the Pike's Peak area. These facilities are anticipated to be online by 2015.

It was originally assumed that the City's share of the SDS water would be conveyed from the SDS treatment facility to the Fountain service area through a future transmission main extended from the Colorado Springs distribution system. However, due to cost and scheduling issues, the City has recently begun exploring the possibility of an agreement with Colorado Springs to trade SDS water for an equivalent amount of FVA water. Under this potential arrangement, the City would not receive any SDS water from the proposed SDS WTP but would instead receive additional water through the existing Fountain Valley Conduit. Since the amount of water than can be delivered through the FVA system is essentially fixed, the increase water delivery to Fountain would be offset by a corresponding decrease in the delivery of FVA water to Colorado Springs. In exchange, Colorado Springs would retain what would have been Fountain's share of the SDS water being treated at the proposed SDS WTP.

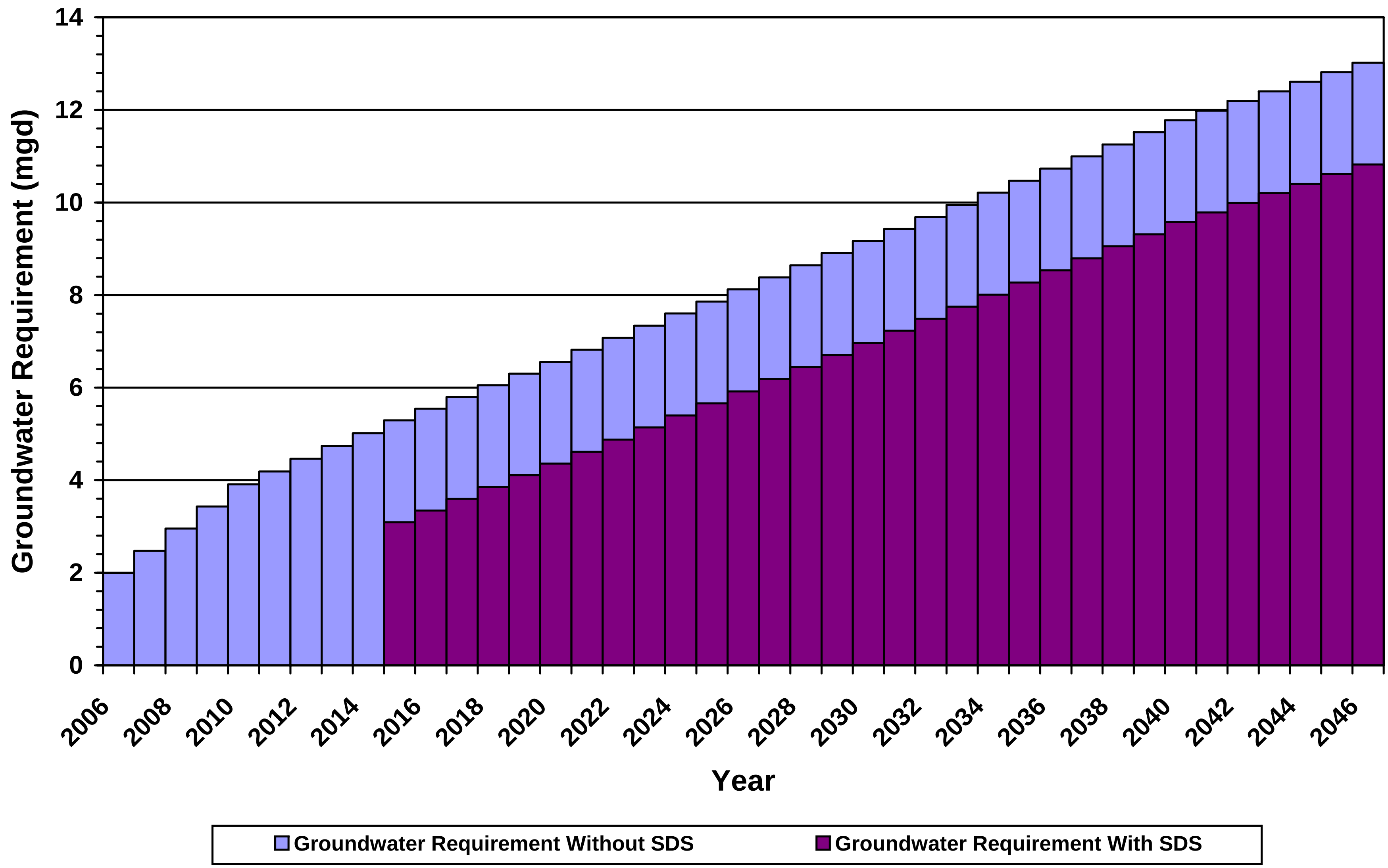
Under the above described arrangement, the increase in delivery of FVA water to Fountain would be equivalent in volume and rate to Fountain's SDS allotment. As currently envisioned, Fountain's level of participation in the SDS project will be 2,500 ac-ft per year, which is equivalent to an annual average delivery rate of 2.2 mgd. However, Fountain may be able to obtain up to 5.6 mgd of SDS water during periods of high demand.

Several studies to develop and evaluate water supply scenarios that utilize SDS water have been completed. These scenarios are briefly described below.

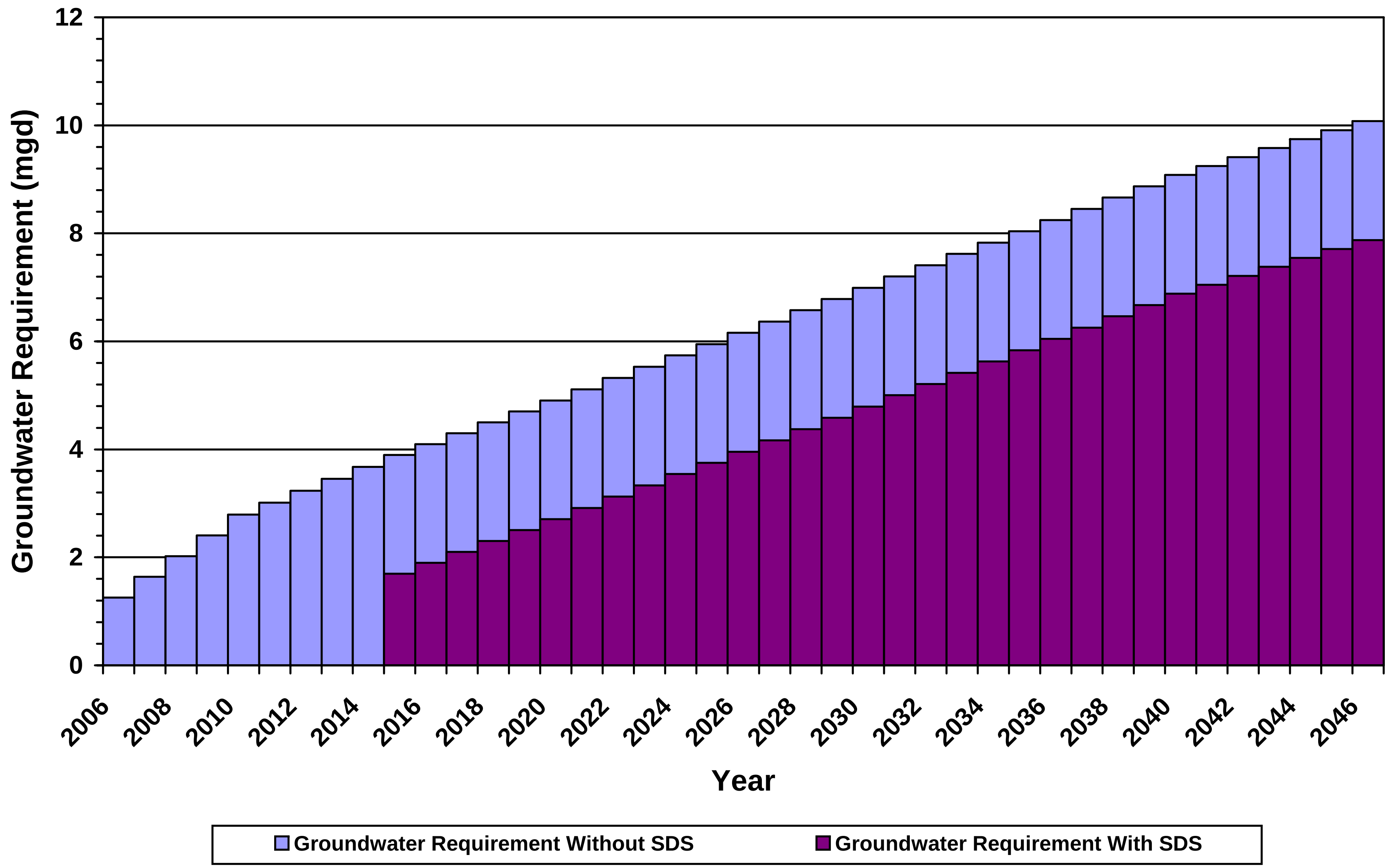
- **Scenario A:** All future water demands would be met with water from the SDS project. This scenario was dismissed due to the high cost of obtaining the required water rights.
- **Scenario B:** Future water demands would be met by utilizing 5,000 ac-ft/yr of SDS water and the remaining demand would be met with local supplies (wells). This scenario was also dismissed due to the high cost of obtaining the required water rights.
- **Scenario C:** Future water demands would be met by utilizing 2,500 ac-ft/yr of SDS water. The remaining demand would be met with local supplies (wells). Based on the City's existing and future water rights portfolio, this level of participation may be feasible.
- **Scenario D:** Future water demands would be met by utilizing local supplies (wells). Under this scenario, the City would not participate in SDS.

Since the City's participation in and timing of SDS is uncertain, it is prudent to consider both Scenarios C and D have. If the City decides not to participate in SDS, it will need to develop additional local supplies. Figures 5-1 and 5-2 show the groundwater requirements to meet projected average day demands for the years 2006 through 2046. The amount of groundwater required is the City's projected average day demand less FVA water. Figure 5-2 shows the projected average day groundwater requirements if the City was to implement conservation measures. Figures 5-1 and 5-2 show the City's groundwater requirements for two scenarios: SDS participation and no SDS participation.

An evaluation was completed to determine the financial impact of the City's participation in SDS versus developing additional local supplies. For this evaluation, it was assumed that if the City does not participate in SDS, it will need to develop 2.2 mgd of water with similar treated water quality utilizing local groundwater. A yield of 0.75 mgd per well was assumed based on data from existing wells. Therefore, the City will need to develop 5 additional wells, which



BLACK & VEATCH building a world of difference™ ENERGY WATER INFORMATION GOVERNMENT	City of Fountain, Colorado – Water Supply Plan	Figure 5-1
	Projected Annual Average Day Groundwater Requirements	



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City of Fountain, Colorado – Water Supply Plan

Projected Annual Average Day Groundwater Requirements with Conservation

Figure 5-2

includes two stand-by wells. This water will require treatment due to high total dissolved solids (TDS) concentrations. Costs for 2 mgd of additional reverse osmosis (RO) treatment and brine disposal were also included in the evaluation, which assumes low quality wells and therefore, a low RO bypass ratio. Three alternatives were developed for brine disposal. These alternatives include:

- Drying beds. Under this alternative, brine would be sent to lined drying beds for evaporation.

- Zero liquid discharge (ZLD) with the benefit of being located near a power plant. Under this alternative, brine would be sent to concentrators to evaporate the water. The heat required for this process would be provided by the waste heat produced by the power plant. The concentrated salt would then be sent to a landfill for disposal.

- ZLD not located near to a power plant. Under this alternative, brine would be sent to concentrators to evaporate the water. The heat required for this process would be provided by electricity. The concentrated salt would then be sent to a landfill for disposal.

Table 5-1 shows the cost comparison for the City's participation in SDS versus no participation for the years 2015 (when SDS is expected to come online) through 2046.

Table 5-1

Evaluation of City's Participation in SDS versus Developing Local Supplies

Cost Component	Cost for 2.2 mgd of Treated Water			
	SDS Participation	Wells/RO Treatment w/ Drying Beds	Wells/RO Treatment w/ ZLD Near Power Plant	Wells/RO Treatment w/ ZLD Not Near Power Plant
Capital cost opinion	$26,000,000	$20,000,000	$20,000,000	$20,000,000
O&M cost opinion	$29,000,000	$28,000,000	$38,000,000	$69,000,000
Total cost opinion	$56,000,000	$48,000,000	$58,000,000	$88,000,000

The cost opinion for the City's participation in SDS is of the same order of magnitude as that for developing wells and RO treatment utilizing either drying beds or ZLD near a power plant for brine treatment. Therefore, it is recommended that the City continue to pursue participation in SDS and budget accordingly. If the SDS project does not move forward, the City can use those funds to develop additional local supplies.

B. Local Water Supply Alternatives

Three water supply alternatives and one sub-alternative were developed with the goal of meeting interim and ultimate water demands. As discussed previously, prior studies determined that participating in SDS at levels greater than 2,500 ac-ft/yr was not feasible. In addition, implementation of a regional non-potable water system for Fountain was not recommended for the following reasons:

- A cursory investigation concluded that there is insufficient areas with large irrigation demand in a single region of the City of justify a regional non-potable water system.
- When plans for development are submitted to the City, localized non-potable water supplies should be evaluated on a case by case basis to determine if a well can be acquired that would have adequate water quality to be utilized for purposes such as landscape irrigation at parks and schools. However, it should be noted that the majority of the wells on the southern end of the City have TDS concentrations above 1,000 mg/L and would require blending with a higher quality water supply to be suitable for turf irrigation.

Therefore, the alternatives developed as part of this Master Plan focus on utilizing additional wells to meet future water demands in addition to existing FVA and well supplies, and water from SDS.

The State of Colorado does not allow the drilling of new wells within 600 feet of existing wells to avoid negative impacts to existing well owners. Due to the large number of existing wells within the Fountain Creek Basin, finding an acceptable site to drill new wells is challenging. In addition, the Fountain Creek alluvium is braided with a mixture of sands and clays that make locating wells with adequate yield difficult. Therefore, it is recommended that the City acquire existing wells with demonstrated yields and re-drill them as necessary to meet municipal requirements. The northern part of the City has relatively high water quality wells that can be chlorinated and pumped directly into the distribution system without additional treatment. It is recommended that the City acquire and develop some of these northern wells, as identified below.

Since the number of wells required to meet future demands exceeds the expected supply associated with the available northern wells, it is recommended that the City acquire and/or develop additional wells in the southern part of the City. However, as discussed in Chapter 4, the quality of the well water in the southern portion of the City is poor with respect to TDS (average 700 to 1,500 mg/L), and therefore, these alternatives include treatment of the groundwater. Although additional treatment capabilities could potentially be provided at each individual well site, the most practical long-term solution is to construct one treatment facility with sufficient capacity to treat the water from all of the City wells.

The water quality of several existing wells located in and near the City of Fountain is included in the Appendix, prioritized based on the potential to be utilized by the City. Figure 5-3 is a map showing the location of these wells and Figure 5-4 shows the average TDS concentration of each well.

The following assumptions were utilized in developing alternatives:

- New wells were anticipated to yield 0.75 mgd each.
- A minimum of one standby well was provided at all times.

These alternatives are described in detail below.

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City of Fountain, Colorado - Water Supply Plan

Existing Well Sites In and Near the City of Fountain

Figure 5-3

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City of Fountain, Colorado - Water Supply Plan

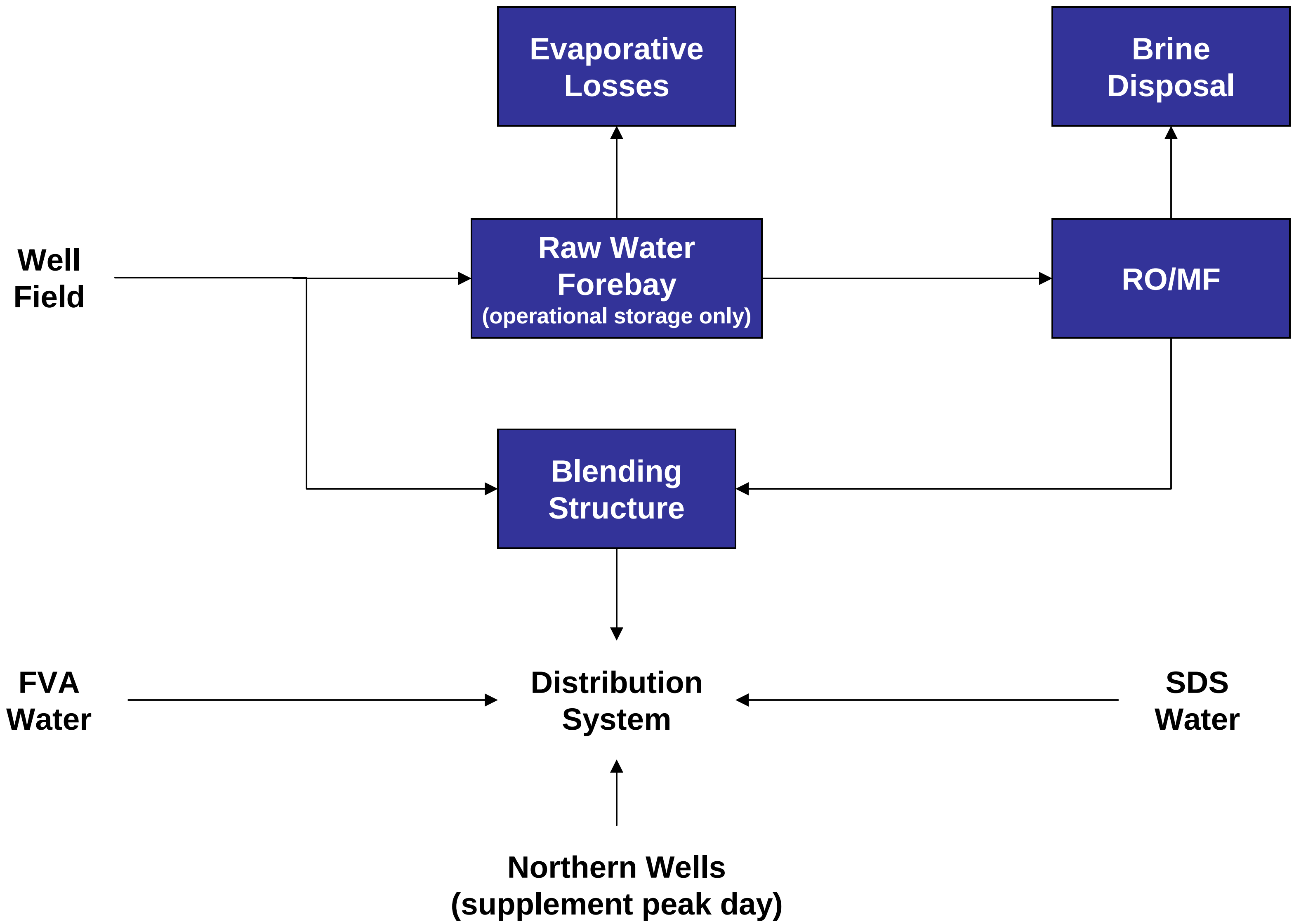
Average Groundwater TDS Concentrations Near Fountain

Figure 5-4

1. Alternative 1

Under Alternative 1, the City would utilize wells and reverse osmosis/microfiltration (RO/MF) treatment to meet maximum day demands. Figure 5-5 shows a schematic representation of Alternative 1. The following is a list of the assumptions associated with Alternative 1:

- The City would continue to utilize its full allotment of FVA water, as well as water from its existing wells.
- The City would develop additional wells as needed to meet maximum day demands. These wells would be developed in areas north and south of the City's existing wells.
- Water from the northern wells would only be used during periods of peak water demands. The water from the northern wells is of higher quality than the southern wells and are not anticipated to require treatment.
- Three northern wells, known as the Venetucci Wells, have been identified as potential well sites. Under a proposed agreement, the City could develop and utilize these three wells until 2014, at which time the City would turn over two of the three wells to the Towns of Widefield and Security.
- A temporary RO/MF WTP would be utilized for treatment of southern wells beginning in 2008 and would be operated while a permanent RO/MF WTP was being constructed. It is recommended that the permanent treatment facility be located just south of the Southwest Reservoir, in the general vicinity of the gravel pits. Once the permanent RO/MF WTP was constructed, the temporary facility would be decommissioned. The permanent RO/MF WTP would be expanded as needed to meet maximum day demands.
- A portion of the water from the existing and southern wells would be treated with RO/MF and blended with untreated well water and FVA and SDS water before entering the distribution system. The treatment goal of the RO/MF facility would be to have a blended water TDS concentration of less than 500 mg/L, which is the Federal Secondary Maximum Contaminant Level.



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City of Fountain, Colorado – Water Supply Plan

Alternative 1 Schematic – Pump Wells to Meet Maximum Day Demands

Figure 5-5

- Brine handling facilities would be constructed. These facilities could be drying beds, ZLD, or deep well injection. For purposes of this study, it was assumed that ZLD located near a power plant would be utilized for brine disposal.

- An augmentation reservoir would be constructed to offset impacts on Fountain Creek due to pumping additional wells, as well as help meet SDS augmentation requirements.

- A raw water reservoir would be constructed as a forebay for the permanent WTP and provide operational storage.

- If available, the City would utilize SDS water beginning in 2015. As discussed in Chapter 1, the City may be able to vary the supply of SDS water based on seasonal demands. However, for purposes of this study, it was assumed that the City would only receive SDS water at a constant rate year-round. SDS participation was assumed since, as discussed previously, the costs for participating in SDS are of the same order of magnitude as those for developing and utilizing local supplies.

Table 5-2 provides a summary of the components associated with Alternative 1 and the anticipated year of implementation for each component. The estimated costs associated with the infrastructure listed in Table 5-2 are presented in Chapter 6.

Table 5-2

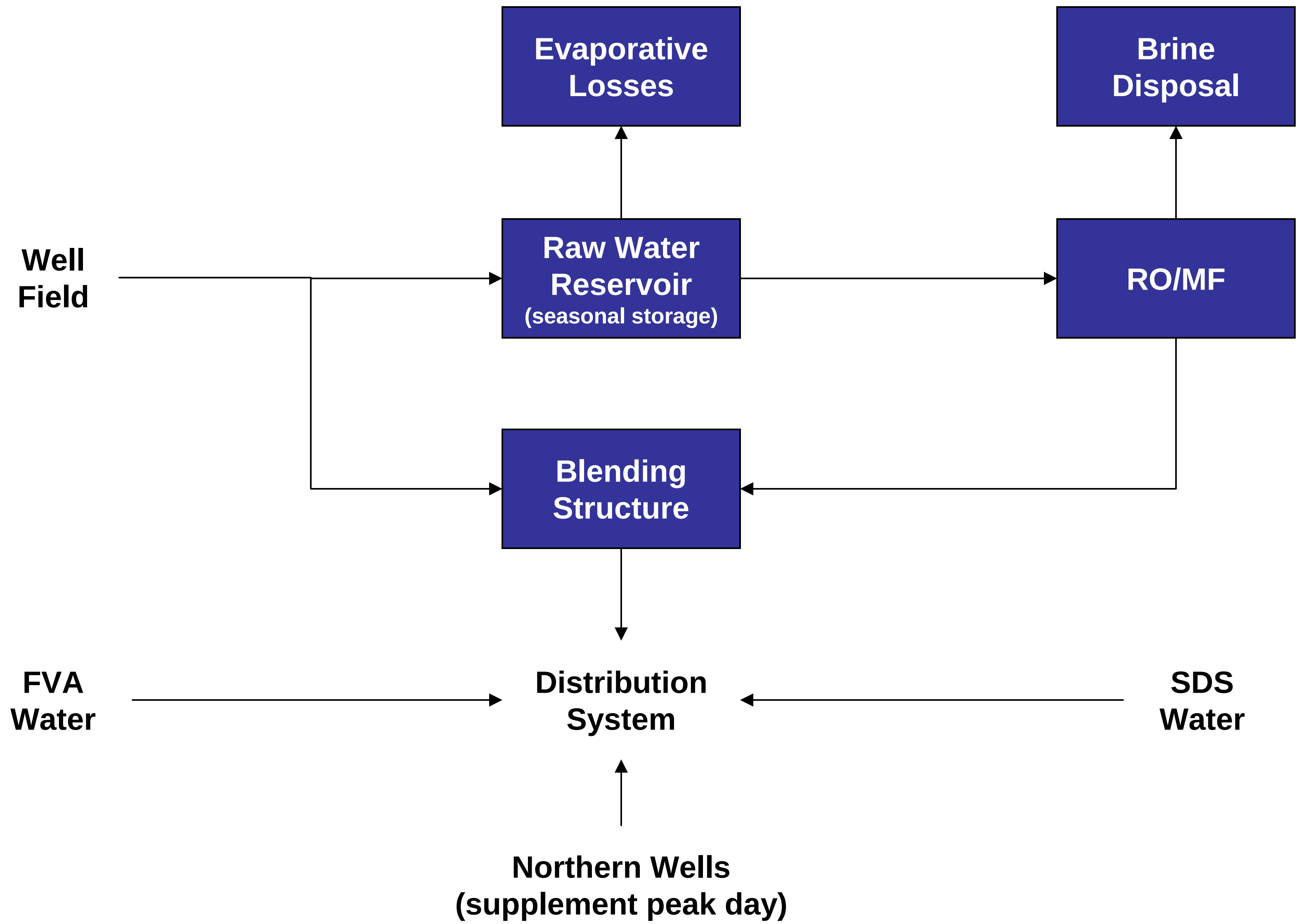
Alternative 1 Components

Year	Project Description
2007	Develop 4 northern wells and 1 southern well
2008	Develop 2 northern wells and 4 southern wells 1.5 mgd temporary RO/MF treatment facility online
2009	Develop 1 northern well and 1 southern well
2010	Develop 2 southern wells
2011	Develop 1 southern well 10 mgd permanent RO/MF treatment facility online Decommission temporary RO/MF treatment facility
2012	Develop 1 southern well
2013	Develop 3 southern wells Augmentation reservoir online
2014	Develop 1 southern well Turn over two Ventucci wells to Widefield and Security
2015	SDS online WTP forebay online
2019	Develop 3 southern wells
2021	Expand RO/MF treatment facility to 15 mgd
2022 – 2031	Develop 10 southern wells
2032	Expand RO/MF treatment facility to 20 mgd
2033 – 2046	Develop 13 southern wells

2. Alternative 2

Under Alternative 2, the City would pump wells at a constant rate equal to the annual average day demand and utilize storage and RO/MF treatment to meet maximum day demands. Figure 5-6 shows a schematic representation of Alternative 2. The following is a list of assumptions associated with Alternative 2:

- The City would continue to utilize its full allotment of FVA water, as well as water from its existing wells.
- The City would develop additional wells as needed to meet maximum day demands until raw water storage was constructed.



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City of Fountain, Colorado – Water Supply Plan

Alternative 2 Schematic – Pump Wells to Meet Average Day Demands and Provide Single Pass Treatment

Figure 5-6

These wells would be developed in areas north and south of the City's existing wells. After raw water storage is constructed, wells will only be required to meet average day demands.

- A raw water reservoir would be constructed in two phases. This reservoir would be expanded as needed to ensure water is available for treatment whenever the demand exceeds the supply provided by the wells.

- Once raw water storage is constructed, treated water from the southern wells will be the best quality and therefore, be used as the primary supply. Water from the northern wells would only be used during periods of peak water demands and would not be treated prior to entering the distribution system.

- Three northern wells, known as the Venetucci Wells, have been identified as potential well sites. Under a proposed agreement, the City could develop and utilize these three wells until 2014, at which time the City would turn over two of the three wells to the Towns of Widefield and Security.

- A temporary RO/MF WTP would be utilized for treatment of southern wells beginning in 2008 and would be operated while a permanent RO/MF WTP was being constructed. It is recommended that the permanent treatment facility be located just south of the Southwest Reservoir, in the general vicinity of the gravel pits. Once the permanent RO/MF WTP was constructed, the temporary facility would be decommissioned. The permanent RO/MF WTP would be expanded as needed to meet maximum day demands.

- A portion of the water from the existing and southern wells would be treated with RO/MF and blended with untreated well water and FVA and SDS water before entering the distribution system. The treatment goal of the RO/MF facility would be to have a blended water TDS concentration of less than 500 mg/L, which is the Federal Secondary Maximum Contaminant Level.

- Brine handling facilities would be constructed. These facilities could be drying beds, ZLD, or deep well injection. For purposes of this study, it was assumed that ZLD located near a power plant would be utilized for brine disposal.

- An augmentation reservoir would be constructed to offset impacts on Fountain Creek due to pumping additional wells, as well as help meet SDS augmentation requirements.

- If available, the City would utilize SDS water beginning in 2015. As discussed in Chapter 1, the City may be able to vary the supply of SDS water based on seasonal demands. However, for purposes of this study, it was assumed that the City would only receive SDS water at a constant rate year-round. SDS participation was assumed since, as discussed previously, the costs for participating in SDS are of the same order of magnitude as those for developing and utilizing local supplies.

Table 5-3 provides a summary of the components associated with Alternative 2. The estimated costs associated with the infrastructure listed in Table 5-3 are presented in Chapter 6.

Table 5-3

Alternative 2 Components

Year	Project Description
2007	Develop 4 northern wells and 1 southern well
2008	Develop 2 northern wells and 4 southern wells 1.5 mgd temporary RO/MF treatment facility online
2009	Develop 1 northern well and 1 southern well
2010	Develop 2 southern wells
2011	Develop 1 southern well 10 mgd permanent RO/MF treatment facility online Decommission temporary RO/MF treatment facility
2012	Develop 1 southern well
2013	Develop 3 southern wells Augmentation reservoir online
2014	Develop 1 southern well Turn over two Ventucci wells to Widefield and Security
2015	SDS online Raw water storage reservoir online
2021	Expand RO/MF treatment facility to 15 mgd
2032	Expand RO/MF treatment facility to 20 mgd

3. Alternatives 3 and 3a

Under Alternative 3, the City would pump wells and utilize RO/MF, all at a constant rate equal to the annual average day demand and utilize storage and additional microfiltration (MF) treatment to meet maximum day demands. Figure 5-7 shows a schematic representation of Alternative 3. The following is a list of the assumptions associated with Alternative 3:

- The City would continue to utilize its full allotment of FVA water, as well as water from its existing wells.

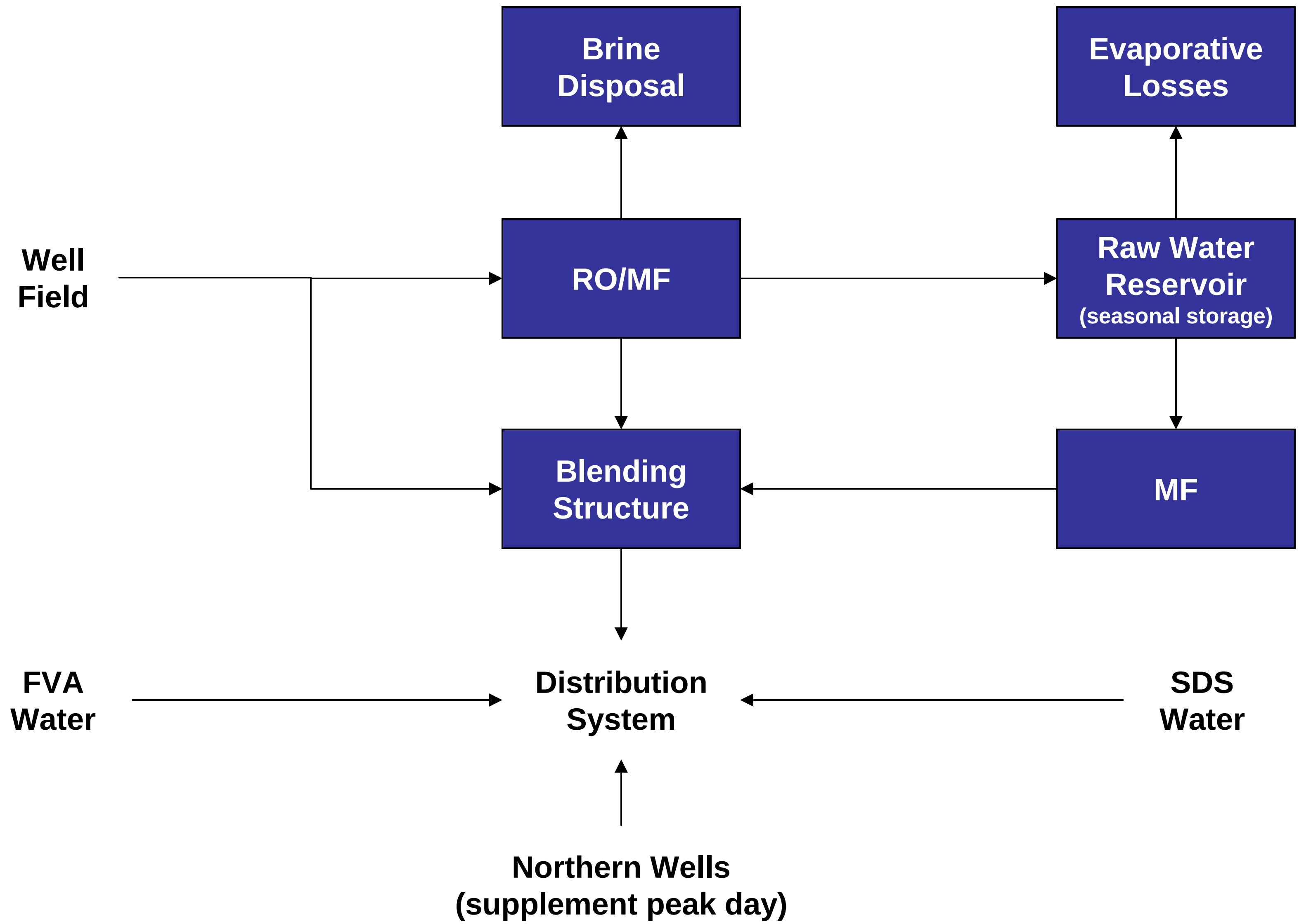
- The City would develop additional wells as needed to meet maximum day demands until raw water storage was constructed. These wells would be developed in areas north and south of the City's existing wells. After raw water storage is constructed, wells will only be required to meet average day demands.

- A raw water reservoir would be constructed in two phases. This reservoir would be expanded as needed to ensure water is available for treatment whenever the demand exceeds the supply provided by the wells.

- Once raw water storage is constructed, treated water from the southern wells will be the best quality and therefore, be used as the primary supply. Water from the northern wells would only be used during periods of peak water demands and would not be treated prior to entering the distribution system.

- Three northern wells, known as the Venetucci Wells, have been identified as potential well sites. Under a proposed agreement, the City could develop and utilize these three wells until 2014, at which time the City would turn over two of the three wells to the Towns of Widefield and Security.

- A temporary RO/MF WTP would be utilized for treatment of southern wells beginning in 2008 and would be operated while a permanent RO/MF WTP was being constructed. It is recommended that the permanent treatment facility be located just south of the Southwest Reservoir, in the general vicinity of the gravel pits. Once the permanent RO/MF WTP was constructed, the temporary facility would be decommissioned. The permanent



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Alternatives 3 and 3a Schematic – Pump Wells to Meet Average Day Demands and Provide Double Pass Treatment

Figure 5-7

RO/MF WTP would be expanded as needed to meet maximum day demands until a MF facility was constructed, as discussed below.

- A portion of the water from the existing and southern wells would be treated with RO/MF and blended with untreated well water and FVA and SDS water before entering the distribution system. The treatment goal of the RO/MF facility would be to have a blended water TDS concentration of less than 500 mg/L, which is the Federal Secondary Maximum Contaminant Level.

- A MF treatment facility would ultimately be constructed adjacent to the RO/MF WTP. Once online, the MF facility would provide peaking treatment capacity and would allow the permanent RO/MF facility to be operated at a constant rate equal to the annual average day demand. During periods of the year when water demands dropped below the annual average day demand, the extra treated RO/MF water would be stored in the raw water reservoir. During periods of the year when water demands exceeded the annual average demand, the MF facility would be utilized to retreat the water from the raw water reservoir before sending it into the distribution system.

- Brine handling facilities would be constructed. These facilities could be drying beds, ZLD, or deep well injection. For purposes of this study, it was assumed that ZLD located near a power plant would be utilized for brine disposal.

- An augmentation reservoir would be constructed to offset impacts on Fountain Creek due to pumping additional wells, as well as help meet SDS augmentation requirements.

- If available, the City would utilize SDS water beginning in 2015. As discussed in Chapter 1, the City may be able to vary the supply of SDS water based on seasonal demands. However, for purposes of this study, it was assumed that the City would only receive SDS water at a constant rate year-round. SDS participation was assumed since, as discussed previously, the costs for participating in SDS are of the same order of magnitude as those for developing and utilizing local supplies.

Table 5-4 provides a summary of the components associated with Alternative 3. The estimated costs associated with the infrastructure listed in Table 5-4 are presented in Chapter 6.

Table 5-4

Alternative 3 Components

Year	Project Description
2007	Develop 4 northern wells and 1 southern well
2008	Develop 2 northern wells and 4 southern wells 1.5 mgd temporary RO/MF treatment facility online
2009	Develop 1 northern well and 1 southern well
2010	Develop 2 southern wells
2011	Develop 1 southern well 4.0 mgd permanent RO/MF treatment facility online
2012	Develop 1 southern well
2013	Develop 3 southern wells Augmentation reservoir online
2014	Develop 1 southern well Turn over two Ventucci wells to Widefield and Security
2015	SDS online Raw water storage reservoir online
2018	15 mgd MF treatment facility online Decommission temporary RO/MF treatment facility
2029	Expand RO/MF treatment facility to 6.5 mgd
2031	Expand MF treatment facility to 20 mgd

A sub-alternative of Alternative 3 was also developed. This alternative has the same components as Alternative 3, but considers the impact of conservation on average day and maximum day demand projections. If the City opts to implement conservation measures, it can downsize the capacity of some water supply and treatment infrastructure. A reduction of 20 percent in average day and maximum day demands was assumed in developing this alternative. Table 5-5 provides a summary of the components associated with Alternative 3a.

Table 5-5

Alternative 3a Components

Year	Project Description
2007	Develop 4 northern wells and 1 southern well
2008	Develop 2 northern wells and 4 southern wells 1.5 mgd temporary RO/MF treatment facility online
2009	Develop 1 northern well and 1 southern well
2010	Develop 2 southern wells
2011	Develop 1 southern well 4.0 mgd permanent RO/MF treatment facility online
2012	Develop 1 southern well
2013	Augmentation reservoir online
2014	Turn over two Ventucci wells to Widefield and Security
2015	SDS online Raw water storage reservoir online
2018	Expand RO/MF treatment facility to 5.0 mgd 10 mgd MF treatment facility online Decommission temporary RO/MF treatment facility
2029	Expand MF treatment facility to 15 mgd

Chapter 6
Evaluation of Water Supply Alternatives

This chapter presents an evaluation of the three water supply alternatives described in Chapter 5.

A. Unit Costs

Unit costs were utilized to develop both capital and operation and maintenance (O&M) cost opinions for each alternative. Table 6-1 lists the unit costs that were utilized in developing capital costs.

Table 6-1

Capital Unit Costs[1]

Component	Cost	Unit
Wells	$400,000	Each
Pipelines	Variable[2]	Inch-diameter per foot
Pump Stations	$4,500	Per horsepower
Fountain Creek Diversion	$3,000,000	Lump sum
RO/MF Water Treatment Plant (WTP)	$3.30	Per gallon per day
RO/MF Temporary WTP	$1.83	Per gallon per day
Brine Handling (Drying Beds)	$23.75[3]	Per gallon per day
Brine Handling (Zero Liquid Discharge)	$23.00	Per gallon per day
MF WTP	$1.50	Per gallon
Gravel Pit Site Acquisition	$1,000	Per acre
Gravel Pit Conversion	$4,500	Per ac-ft

(1)Capital costs include allowances for contingency, engineering, administration and legal.
(2)Pipeline costs were based on construction costs for recent similar projects and vary between $6.00 and $12.00 per linear foot for each inch in diameter.
(3)Assumed 400 acres of drying beds required per mgd of brine at a cost of $58,300 per acre.

Annual O&M costs were developed based on 1) a flat rate per million MG of treated water, and 2) a combination of a labor and maintenance rate (based on a specified percentage of the capital cost) plus electricity for non-treatment related facilities. Table 6-2 lists the unit costs that were utilized in developing O&M costs.

Table 6-2

Annual O&M Unit Costs

Component	Labor and Maintenance (Percent of Capital Cost)	Electricity	Flat-Rate O&M
Wells	1.60	$135/MG	-
Pipelines	0.20	-	-
Pump Stations	1.60	$34/MG	-
Reservoir Maintenance	0.15	-	-
SDS Facilities	-	-	$1,150/MG
MF WTP	-	-	$400/MG
RO/MF WTP	-	-	$1,100/MG
Brine Handling (Drying Beds)	-	-	$1,125/MG
Brine Handling (ZLD Located Near Power Plant)	-	-	$1,500/MG
Brine Handling (ZLD Not Located Near Power Plant)	-	-	$2,700/MG

B. Capital Cost Evaluation

As discussed in Chapter 5, three water supply alternatives and one sub-alternative were developed with the goal of meeting water demand projections through the year 2046. The alternatives developed as part of this Master Plan focus on primarily utilizing additional local wells to meet future water demands. These alternatives are summarized below.

- Alternative 1 – The City would utilize wells and RO/MF treatment to supplement imported water supplies to meet maximum day demands.

- Alternative 2 – The City would pump wells at a constant rate equal to the annual average day demand and utilize RO treatment and storage to meet maximum day demands. With this alternative, substantial raw water storage near the WTP is utilized to reduce the number of required groundwater wells.

- Alternative 3 – The City would pump wells and utilize RO/MF at a constant rate equal to the annual average day demand and utilize storage and additional MF treatment to meet maximum day demands. This alternative may seem counter-intuitive, since water treated by RO/MF is stored in an open reservoir, thereby requiring it to be treated again using MF to meet Safe Drinking Water Act regulations. However, this alternative reduces the size of the RO/MF facilities, which could result in significant capital cost savings.

- Alternative 3a – This sub-alternative has the same components as Alternative 3, but considers the impact of conservation on average day and maximum day demand projections.

A capital cost comparison was developed to compare the above alternatives. Capital costs associated with each of the alternatives were divided into the following categories:

- Wells and Pump Stations
- Wellfield Pipelines
- Storage Reservoirs
- Water Rights
- Water Treatment
- SDS Participation

The following sections summarize the capital cost opinions for the main components of each of the above defined water supply alternatives.

1. Alternative 1

Infrastructure improvements associated with Alternative 1 are shown on Figure 6-1.

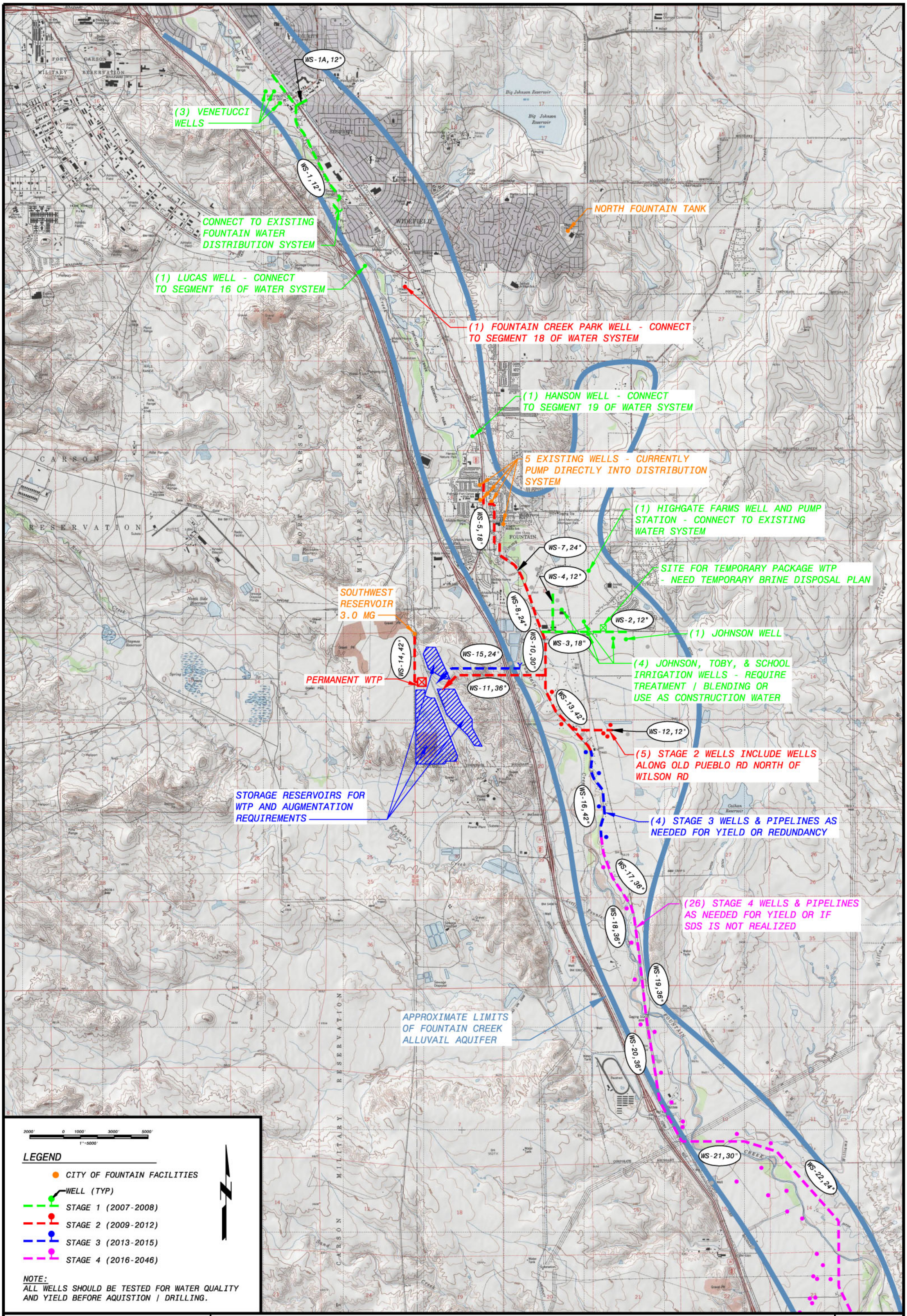
Table 6-3 lists the well and raw water pump station costs associated with Alternative 1. A total of 47 new wells are required under Alternative 1 to meet projected maximum day demands through the year 2046.

Table 6-3

Well and Pump Station Costs Associated with Alternative 1

Year	Component Description	Cost
2007	Highgate Farms Well and Pump Station	$314,000
	3 Venetucci Wells	$1,370,000
	1 South Well (Johnson or Other)	$400,000
2008	1 North Well (Lucas or Other)	$400,000
	1 North Well (Hanson or Other)	$400,000
	1 South Well (Johnson or Other)	$400,000
	3 South Wells (Toby and/or Others)	$1,200,000
2009	1 North Well (Fountain Creek Park or Other)	$400,000
	1 South Well	$400,000
2010	2 South Wells	$800,000
2011	1 South Well	$400,000
	Fountain Creek Diversion Pump Station	$3,000,000
2012	1 South Well	$400,000
2013	3 South Wells	$1,200,000
2014	1 South Well	$400,000
2024 - 2046	26 South Wells	$10,400,000
	Capital Cost Opinion for Wells and Pump Stations	**$21,884,000**

Table 6-4 lists the welfield pipeline costs associated with Alternative 1. These pipelines are required to connect the additional wells to the proposed RO/MF treatment facility and are labeled with the prefix WS (Water Supply) to prevent confusion between these improvements and the distribution system improvements. It is important to note that water from the northern wells is not



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Infrastructure Improvements Associated with Alternative 1

Figure 6-1

expected to require treatment and therefore will be pumped directly into the distribution system.

Table 6-4

Wellfield Pipeline Costs Associated with Alternative 1

Year	No.	Segment Location	Pipe Diameter (inches)	Pipe Length (feet)	Cost
2007	WS-1	Along Fountain Creek from Venetucci Wells	12	8,500	$720,000
	WS-1A	Venetucci Wells to Widefield System	12	1,500	$170,000
	WS-2	Wilson Road East Segment	12	2,500	$220,000
2008	WS-3	Wilson Road West Segment	18	2,500	$260,000
	WS-4	Lateral North of Wilson Road	12	2,200	$190,000
2009	WS-5	Highway 85 to Old Pueblo Road	18	2,300	$250,000
	WS-7	Old Pueblo Road	24	2,000	$300,000
	WS-8	Old Pueblo Road to Wilson Road	24	3,600	$530,000
2010	WS-10	Old Pueblo Road South of Wilson	30	2,700	$490,000
	WS-11	Pipeline to RO/MF WTP	48	6,200	$4,470,000
2011	WS-12	Old Pueblo Road (East Lateral)	12	2,500	$150,000
	WS-13	Old Pueblo Road (North of East Lateral)	42	4,000	$990,000
	WS-14	WTP to Southwest Reservoir	42	3,500	$670,000
	WS-15	Fountain Creek Diversion Pipeline	24	4,300	$1,250,000
2014	WS-16	Old Pueblo Road (South of East Lateral)	42	5,200	$1,140,000
2019	WS-17	Old Pueblo Road (South of WS-14)	36	3,100	$510,000
2022	WS-18	Old Pueblo Road (South of WS-15)	36	3,100	$660,000
2023	WS-19	Old Pueblo Road (South of WS-16)	36	3,100	$810,000
2024	WS-20	Old Pueblo Road (South of WS-16)	36	3,100	$950,000
2025	WS-21	Old Pueblo Road (South of WS-18)	30	10,000	$2,950,000
2026	WS-22	Old Pueblo Road (South of WS-18)	24	12,500	$3,490,000
Capital Cost Opinion for Wellfield Pipelines					**$21,170,000**

Lafarge, Incorporated is currently performing gravel mining operations west of the City. A report completed by the Applegate Group in February 2006 recommended that the City utilize these pits for raw water storage once the gravel mining operations are concluded. Table 6-5 lists the components and costs associated with the augmentation and pretreatment storage reservoirs. As discussed previously, an augmentation reservoir will offset impacts on Fountain Creek due to pumping additional wells and help meet SDS augmentation requirements. Under Alternative 1, only a minimal amount of pretreatment storage is necessary to allow operational flexibility, since the wells will be utilized to meet maximum day demands.

Table 6-5

Storage Reservoir Costs Associated with Alternative 1

Year	Task or Facility	Capacity (ac-ft)	Cost
2007	Purchase Lafarge Site		$620,000
2012	Design Augmentation Reservoir		$357,000
2013	Construct Augmentation Reservoir (Lafarge Area 1)	1,200	$3,573,000
2014	Design Pretreatment Reservoir		$200,000
2015	Construct Pretreatment Reservoir (Lafarge Area 2)	500	$2,000,000
Capital Cost Opinion for Storage Reservoirs			**$6,750,000**

An analysis was completed by W.W. Wheeler and Associates to determine the amount of augmentation water the City is required to deliver into Fountain Creek or Pueblo Reservoir to offset impacts of pumping wells in the Fountain Creek Alluvium. A copy of the findings is included in the Appendix in a letter dated June 13, 2006 and email correspondence dated July 11, 2006. The W.W. Wheeler report estimated the cost for acquiring water rights at $10,000 per acre foot. Table 6-6 lists the amount of water rights and associated costs to obtain this augmentation water.

It is important to note that water rights accounting of Fountain Creek is calculated monthly. Since Alternative 1 requires groundwater pumping to meet maximum day demands, additional augmentation is required for this alternative.

Table 6-6

Augmentation Water Rights Costs Associated with Alternative 1

Year	Volume (ac-ft)	Cost
2006	460	$4,600,000
2007	250	$2,500,000
2008	250	$2,500,000
2009	250	$2,500,000
2010	250	$2,500,000
2011	150	$1,500,000
2012	160	$1,600,000
2013	425	$4,250,000
2014	425	$4,250,000
2015	200	$2,000,000
2016 - 2046	3,480	$34,800,000
Capital Cost Opinion for Augmentation Water Rights		**$63,000,000**

Table 6-7 lists the estimated costs by year associated with the City's participation in SDS. These costs were assumed to be the same for all the alternatives.

Table 6-7

SDS Costs Associated with Alternative 1

Year	Cost
2008	$536,000
2009	$1,442,000
2010	$655,000
2011	$4,738,000
2012	$10,119,000
2013	$8,170,000
2014	$787,000
Capital Cost Opinion for SDS Participation	**$26,447,000**

Table 6-8 lists the components and costs associated with treating the water from the proposed southern wells for Alternative 1.

Table 6-8

Water Treatment Costs Associated with Alternative 1

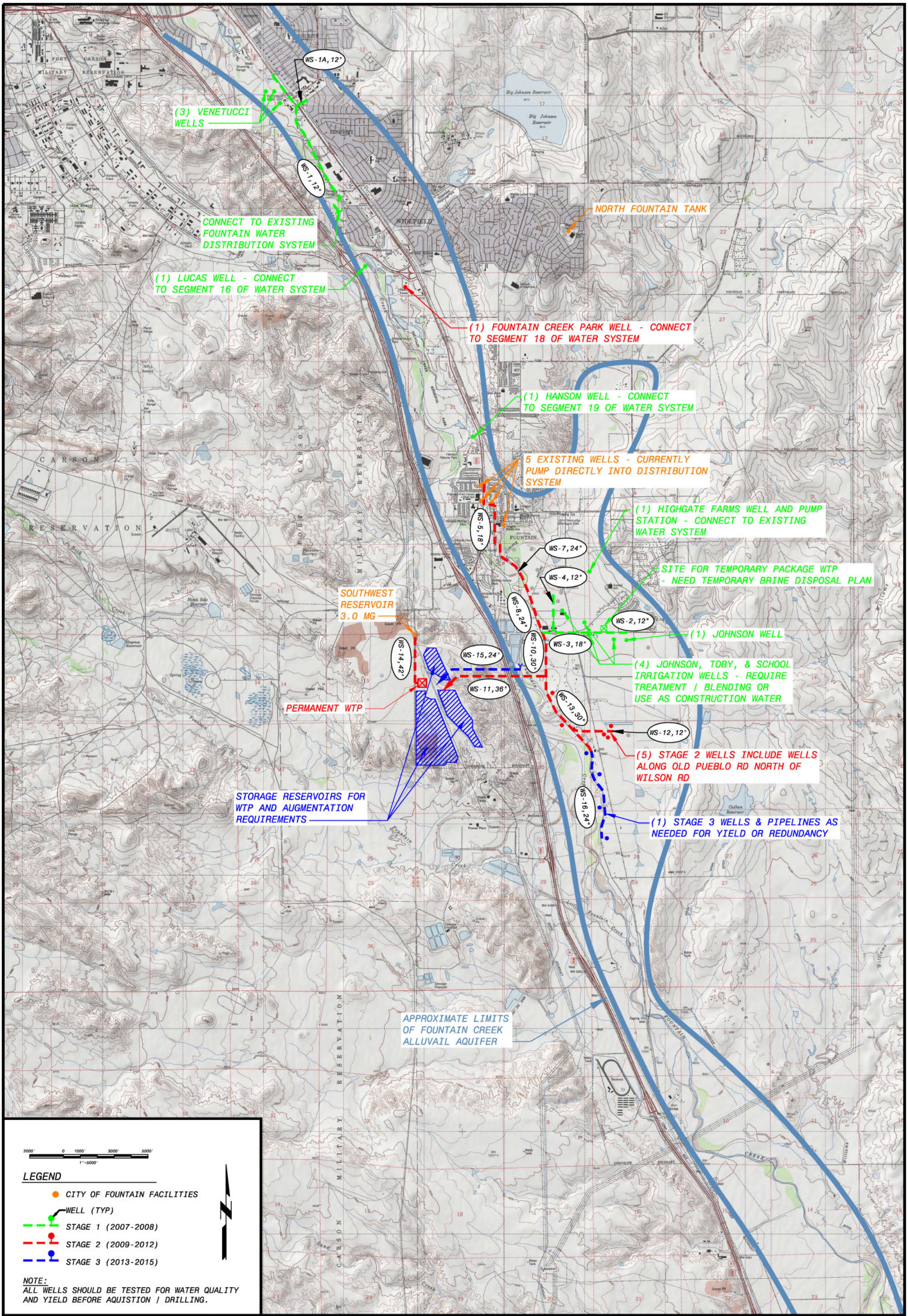
Year	Component	Cost
2006	Alluvium Study	$125,000
	Treatability/Brine Handling Study	$125,000
	Environmental/Permitting Assessment	$35,000
2007	Design and Permit 1.5 mgd Temporary RO/MF WTP	$75,000
	Procure 1.5 mgd Temporary RO/MF WTP	$2,059,000
	Utilize Temporary Brine Handling Facilities	$1,000,000
	Purchase Permanent RO/MF WTP Site	$300,000
	Design 10 mgd Permanent RO/MF WTP (30 Percent)	$2,250,000
2008	Install Temporary RO/MF WTP (Online Summer 2008)	$686,000
	Acquire Permits for Permanent RO/MF WTP	$75,000
	Negotiate Design/Build/Operate Agreement for Permanent RO/MF WTP	$50,000
2009	Construct 10 mgd RO/MF WTP (Online Summer 2011)	$33,000,000
	Construct Brine Handling Facilities	$23,438,000
2021	Expand RO/MF WTP (Additional 5 mgd)	$16,500,000
	Expand Brine Handling Facilities	$21,094,000
2032	Expand RO/MF WTP (Additional 5 mgd)	$16,500,000
	Capital Cost Opinion for Water Treatment	**$117,312,000**

The total estimated capital cost opinion for Alternative 1 is approximately $257 million.

2. Alternative 2

Infrastructure improvements associated with Alternative 2 are shown on Figure 6-2.

Table 6-9 lists the well and raw water pump station costs associated with Alternative 2. A total of 21 new wells are required under Alternative 2 to meet projected maximum day demands through the year 2046.



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Infrastructure Improvements Associated with Alternatives 2 and 3

Figure 6-2

Table 6-9

Well and Pump Station Costs Associated with Alternative 2

Year	Component Description	Cost
2007	Highgate Farms Well and Pump Station	$314,000
	3 Venetucci Wells	$1,370,000
	1 South Well (Johnson or Other)	$400,000
2008	1 North Well (Lucas or Other)	$400,000
	1 North Well (Hanson or Other)	$400,000
	1 South Well (Johnson or Other)	$400,000
	3 South Wells (Toby and/or Others)	$1,200,000
2009	1 North Well (Fountain Creek Park or Other)	$400,000
	1 South Well	$400,000
2010	2 South Wells	$800,000
2011	1 South Well	$400,000
	Fountain Creek Diversion Pump Station	$3,000,000
2012	1 South Well	$400,000
2013	3 South Wells	$1,200,000
2014	1 South Well	$400,000
	Capital Cost Opinion for Wells and Pump Stations	**$11,484,000**

Table 6-10 lists the pipeline segment descriptions and costs associated with Alternative 2. These pipelines are required to connect the additional wells to the proposed RO/MF treatment facility. It is important to note that water from the northern wells is not expected to require treatment and therefore will be pumped directly into the distribution system.

Table 6-10

Wellfield Pipeline Costs Associated with Alternative 2

Year	No.	Segment Location	Pipe Diameter (inches)	Pipe Length (feet)	Cost
2007	WS-1	Along Fountain Creek from Venetucci Wells	12	8,500	$720,000
	WS-1A	Venetucci Wells to Widefield System	12	1,500	$170,000
	WS-2	Wilson Road East Segment	12	2,500	$220,000
2008	WS-3	Wilson Road West Segment	18	2,500	$260,000
	WS-4	Lateral North of Wilson Road	12	2,200	$190,000
2009	WS-5	Highway 85 to Old Pueblo Road	18	2,300	$250,000
	WS-7	Old Pueblo Road	24	2,000	$300,000
	WS-8	Old Pueblo Road to Wilson Road	24	3,600	$530,000
2010	WS-10	Old Pueblo Road South of Wilson	30	2,700	$490,000
	WS-11	Pipeline to RO/MF WTP	36	6,200	$3,830,000
2011	WS-12	Old Pueblo Road (East Lateral)	12	2,500	$150,000
	WS-13	Old Pueblo Road (North of East Lateral)	30	4,000	$710,000
	WS-14	WTP to Southwest Reservoir	42	3,500	$670,000
	WS-15	Fountain Creek Diversion Pipeline	24	4,300	$1,250,000
2014	WS-16	Old Pueblo Road (South of East Lateral)	24	5,200	$660,000
		Capital Cost Opinion for Wellfield Pipelines			**$10,400,000**

As discussed previously, Lafarge, Incorporated, is currently performing gravel mining operations west of the City and the February 2006 Applegate Group report recommended that the City utilize these pits for raw water storage once the gravel mining operations are concluded. Table 6-11 lists the costs associated with the augmentation and pretreatment storage reservoirs. Under Alternative 2, three mined areas with a total storage volume of 4,500 ac-ft will be utilized to meet maximum day demands. This will enable the City to limit the number of additional wells that will be required in the future and also minimize the pipe diameter sizes within the raw water collection system.

Table 6-11 Storage Reservoir Costs Associated with Alternative 2			
Year	**Task or Facility**	**Capacity (ac-ft)**	**Cost**
2007	Purchase Lafarge Site		$620,000
2012	Design Augmentation Reservoir		$357,000
2013	Construct Augmentation Reservoir (Lafarge Area 1)	1,200	$3,573,000
2014	Design Pretreatment Reservoir		$404,000
2015	Construct Pretreatment Reservoir (Lafarge Area 2)	1,300	$4,044,000
2020	Develop Lafarge Area 3	1,200	$8,727,000
2033	Expand Lafarge Area 3	800	$3,387,000
Capital Cost Opinion for Storage Reservoirs			**$21,112,000**

Table 6-12 lists the amount of water rights and associated costs to obtain the required augmentation water associated with Alternative 2.

Table 6-12 Augmentation Water Rights Costs Associated with Alternative 2		
Year	**Volume (ac-ft)**	**Cost**
2006	460	$4,600,000
2007	250	$2,500,000
2008	250	$2,500,000
2009	250	$2,500,000
2010	250	$2,500,000
2011	150	$1,500,000
2012	160	$1,600,000
2013	175	$1,750,000
2014	175	$1,750,000
2015	200	$2,000,000
2016 - 2046	3,040	$30,400,000
Capital Cost Opinion for Augmentation Water Rights		**$53,600,000**

The costs associated with purchasing augmentation water rights are slightly less for Alternative 2 because the maximum pumping rate from the alluvium is reduced from maximum day demands to average day demands.

The costs for participating in SDS were assumed to be the same for each alternative. These costs are shown in Table 6-7. In addition, the costs associated with treating the water from the proposed southern wells are the same for Alternative 2 as Alternative 1. These costs are shown in Table 6-8.

The total estimated capital cost opinion for Alternative 2 is approximately $240 million.

3. Alternative 3

The costs for the wells and raw water pump stations, wellfield pipeline segments, storage reservoirs, and water rights associated with Alternative 3 are the same as those associated with Alternative 2. These improvements are shown on Figure 6-2 and costs for these improvements are shown in Tables 6-9, 6-10, 6-11, and 6-12, respectively. As discussed previously, the costs associated with participating in SDS were assumed to be the same for each alternative. These costs are shown in Tables 6-7.

Table 6-13 lists the costs associated with treating the water from the proposed southern wells for Alternative 3.

Table 6-13

Water Treatment Costs Associated with Alternative 3

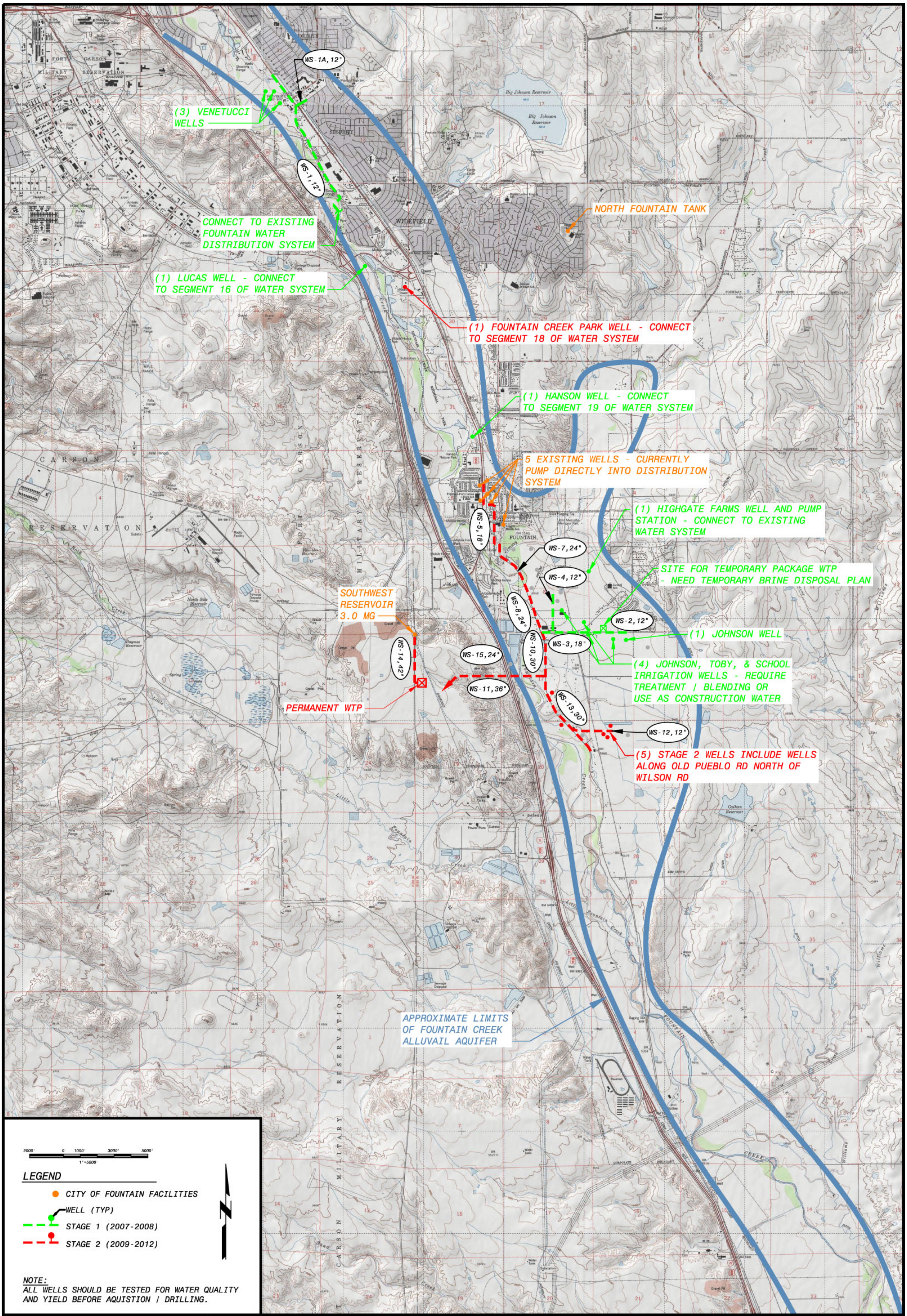
Year	Component	Cost
2006	Alluvium Study	$125,000
	Treatability/Brine Handling Study	$125,000
	Environmental/Permitting Assessment	$35,000
2007	Design and Permit 1.5 mgd Temporary RO/MF WTP	$75,000
	Procure 1.5 mgd Temporary RO/MF WTP	$2,059,000
	Utilize Temporary Brine Handling Facilities	$1,000,000
	Purchase Permanent RO/MF WTP Site	$300,000
	Design 4 mgd Permanent RO/MF WTP (30 Percent)	$2,250,000
2008	Install Temporary RO/MF WTP (Online Summer 2008)	$686,000
	Acquire Permits for Permanent RO/MF WTP	$75,000
	Negotiate Design/Build/Operate Agreement for Permanent RO/MF WTP	$50,000
2009	Construct 4 mgd RO/MF WTP (Online Summer 2011)	$13,200,000
	Construct Brine Handling Facilities	$25,781,000
2018	Design and Construct 15 mgd MF WTP	$22,500,000
2029	Expand RO/MF WTP (Additional 2.5 mgd)	$8,250,000
2031	Expand MF WTP (Additional 5 mgd)	$7,500,000
	Capital Cost Opinion for Water Treatment	**$84,011,000**

The total estimated capital cost opinion for Alternative 3 is approximately $207 million.

4. Alternative 3a

Infrastructure improvements associated with Alternative 3a are shown on Figure 6-3.

Table 6-14 lists the well and raw water pump station costs associated with Alternative 3a. A total of 17 new wells are required under Alternative 3a to meet projected maximum day demands through the year 2046.



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Infrastructure Improvements Associated with Alternatives 3a

Figure 6-3

Table 6-14

Well and Pump Station Costs Associated with Alternative 3a

Year	Component Description	Cost
2007	Highgate Farms Well and Pump Station	$314,000
	3 Venetucci Wells	$1,370,000
	1 South Well (Johnson or Other)	$400,000
2008	1 North Well (Lucas or Other)	$400,000
	1 North Well (Hanson or Other)	$400,000
	1 South Well (Johnson or Other)	$400,000
	3 South Wells (Toby and/or Others)	$1,200,000
2009	1 North Well (Fountain Creek Park or Other)	$400,000
	1 South Well	$400,000
2010	2 South Wells	$800,000
2011	1 South Well	$400,000
	Fountain Creek Diversion Pump Station	$3,000,000
2012	1 South Well	$400,000
	Capital Cost Opinion for Wells and Pump Stations	**$9,884,000**

The costs for the wellfield pipeline segments, and storage reservoirs associated with Alternative 3a are assumed to be the same as those associated with Alternatives 2 and 3. These costs are shown in Tables 6-10 and 6-11, respectively.

As discussed previously, the City is required to deliver augmentation water into Fountain Creek to offset any impact of pumping additional wells. Table 6-15 lists the amount of water rights and associated costs to obtain this augmentation water under Alternative 3a.

Table 6-15

Augmentation Water Rights Costs Associated with Alternative 3a

Year	Volume (ac-ft)	Cost
2006	460	$4,600,000
2007	250	$2,500,000
2008	250	$2,500,000
2009	250	$2,500,000
2010	250	$2,500,000
2011	150	$1,500,000
2012	160	$1,600,000
2013	175	$1,750,000
2014	175	$1,750,000
2015	200	$2,000,000
2016 -2046	1,970	$19,700,000
Capital Cost Opinion for Augmentation Water Rights		**$42,900,000**

As discussed previously, the costs associated with SDS participation were assumed to be the same for each alternative. These costs are shown in Table 6-7.

Table 6-16 lists the costs associated with treating the water from the proposed southern wells for Alternative 3a.

Table 6-16

Water Treatment Costs Associated with Alternative 3a

Year	Component	Cost
2006	Alluvium Study	$125,000
	Treatability/Brine Handling Study	$125,000
	Environmental/Permitting Assessment	$35,000
2007	Design and Permit 1.5 mgd Temporary RO/MF WTP	$75,000
	Procure 1.5 mgd Temporary RO/MF WTP	$2,059,000
	Utilize Temporary Brine Handling Facilities	$1,000,000
	Purchase Permanent RO/MF WTP Site	$300,000
	Design 4 mgd Permanent RO/MF WTP (30 Percent)	$2,250,000
2008	Install Temporary RO/MF WTP (Online Summer 2008)	$686,000
	Acquire Permits for Permanent RO/MF WTP	$75,000
	Negotiate Design/Build/Operate Agreement for Permanent RO/MF WTP	$50,000
2009	Construct 4 mgd RO/MF WTP (Online Summer 2011)	$13,200,000
	Construct Brine Handling Facilities	$21,094,000
2018	Design and Construct 10 mgd MF WTP	$15,000,000
2029	Expand RO/MF WTP (Additional 1.0 mgd)	$1,650,000
2031	Expand MF WTP (Additional 5 mgd)	$7,500,000
	Capital Cost Opinion for Water Treatment	**$65,224,000**

The total estimated capital cost opinion for Alternative 3a is approximately $176 million.

Table 6-17 provides a side-by-side comparison of the capital cost opinions for each water supply alternative.

Table 6-17

Capital Cost Comparison of the Proposed Water Supply Alternatives

Component	Capital Cost Opinion			
	Alternative 1	Alternative 2	Alternative 3	Alternative 3a
Wells and Pump Stations	$21,884,000	$11,484,000	$11,484,000	$9,884,000
Wellfield Pipelines	$21,170,000	$10,400,000	$10,400,000	$10,400,000
Storage Reservoirs	$6,750,000	$21,112,000	$21,112,000	$21,112,000
Augmentation Water Rights	$63,000,000	$53,600,000	$53,600,000	$42,900,000
Water Treatment and Brine Handling	$117,312,000	$117,312,000	$84,011,000	$65,224,000
SDS Participation	$26,447,000	$26,447,000	$26,447,000	$26,447,000
Total Capital Cost Opinion	**$256,563,000**	**$240,355,000**	**$207,054,000**	**$175,967,000**

C. O&M Cost Evaluation

O&M cost opinions were developed for each water supply alternative for the planning period 2006 through 2046. It is important to note that these costs are above and beyond the O&M costs that the City is currently experiencing. These costs have been developed based on the following categories:

- SDS
- Well Electricity
- Raw Water Pump Station Electricity and Maintenance
- Water Treatment and Brine Handling
- Pipeline Maintenance
- Storage Reservoir Maintenance

Table 6-18 summarizes the total O&M costs for years 2006 through 2046 associated with each of the alternatives. Annual O&M costs vary by year and generally increase with the addition of new facilities.

Table 6-18

O&M Cost Comparison of the Proposed Water Supply Alternatives

Category	**Total Cost (Years 2006 – 2046)**			
	Alternative 1	**Alternative 2**	**Alternative 3**	**Alternative 3a**
SDS	$29,466,000	$29,466,000	$29,466,000	$29,466,000
Well Electricity	$19,481,000	$18,416,000	$18,907,000	$14,170,000
Pump Station Electricity and Maintenance	$25,627,000	$23,124,000	$13,596,000	$10,795,000
Water Treatment and Brine Handling	$244,659,000	$246,039,000	$142,028,000	$103,808,000
Pipeline Maintenance	$1,287,000	$767,000	$767,000	$767,000
Storage Reservoir Maintenance	$338,000	$871,000	$871,000	$871,000
Total	**$320,858,000**	**$318,683,000**	**$205,635,000**	**$159,877,000**

Chapter 7
Distribution System Analyses

A. Hydraulic Model

An important aspect of water system studies is the development of a hydraulic model to analyze and evaluate the performance of the water distribution network under various demand and operating conditions. For this study, a hydraulic model of the City's distribution system was developed using H_2OMAP software, pertinent data regarding existing water system facilities, and information concerning the magnitude and distribution of water demands within the City's service area.

The physical aspects of the distribution system represented in a hydraulic model include storage reservoir elevations and capacities; pump operating characteristics; the diameter, length, and interior roughness of each water main; and the characteristics of various regulating valves. Distribution system maps provided by the City were used to identify the diameter and length of each main in the distribution network and the locations of the various wells, pumps, regulating valves, and storage reservoirs. The operating characteristics of the booster pumps were determined from head-capacity curves, while the capacities and operating characteristics of the five existing wells were determined by evaluating historical pumping records. Additional information concerning reservoir elevations and capacities was obtained from construction drawings. The control settings for the various regulating valves were obtained through discussions with water utility personnel.

In addition to the physical components of the distribution system, the hydraulic model contains information on the water demands within the service area. Current and projected average day water demands were allocated to the network junctions by user class. Residential water use was allocated on a per capita basis, using the current and future population distributions discussed in Chapter 2. Commercial water use was allocated by considering the locations of large users, present commercial land use, and the potential for future development. Unaccounted-for water use was allocated throughout the distribution system, based on the relative density of development.

To calculate flows and pressures, the hydraulic analysis program utilizes engineering equations and mathematical algorithms in an iterative solution process. For each specified scenario, the program calculates the head loss through each water main, the total dynamic head and pumping rate for each pump that is operating, the fill or draft rate at each reservoir, and the flow rate through each regulating valve.

Although there are a number of theoretical and empirical equations available for calculating head losses through pipes, the most commonly used formula within the water distribution industry is the Hazen-Williams equation. This empirical equation expresses head loss as a function of pipe diameter, pipe length, pipe interior roughness, and water flow rate. In the Hazen-Williams equation, interior roughness is represented with a roughness coefficient that is generally referred to as the "C-value". Roughness coefficients are dependent on a number of factors, including pipe material and method of fabrication, type of lining, pipe age, and amount of tuberculation. For the Fountain distribution system hydraulic model, appropriate pipe C-values were assigned based on pipe age and pipe material.

B. Application of Model

Once the hydraulic model had been developed, it was used to analyze the performance of the distribution system under various demand and operational scenarios. A series of analyses were conducted to identify potential deficiencies in the Fountain distribution system, evaluate various combinations of improvements and modifications, and establish a recommended long-range capital improvement program to reinforce and expand the system as necessary to meet projected water demands.

The hydraulic model was set up to perform EPS (extended period simulation) analyses to simulate the performance of the distribution system over a 24-hour period. In these analyses, diurnal demand patterns are utilized in the model to vary the water demands hour-by-hour in order to simulate typical daily water use fluctuations within the distribution system. It was no possible to determine actual diurnal water use patterns within the Fountain system because the operating records were not detailed enough to allow calculations of hourly flow rates at the FVA pipeline turnouts, hourly pumpage at the wells, hourly pumpage at the Goldfield pumping station, and hourly fill/draft rates at the reservoirs. However, by using available data from other utilities with similar characteristics, it was possible to develop representative diurnal patterns suitable for use in the Fountain EPS model.

A series of hydraulic analyses were performed to evaluate system performance for maximum day demand conditions for each design year. An important aspect of these simulations was evaluating the diurnal water level fluctuations within the various distribution system reservoirs. For the maximum day simulations, it was important to ensure that the water levels within the reservoirs did not drop below acceptable emergency reserve levels at any time during the day and that the reservoirs could be adequately replenished during the off-peak periods.

The maximum day analyses were also used to determine the ability of the distribution system facilities to maintain acceptable residual pressures throughout the distribution network during the periods of highest demand. The most critical condition usually occurs near the end of the peak demand period, when reservoir water levels are depressed, but system demands are still relatively high. This condition generally produces the lowest residual pressures within the system. The distribution network is considered to be adequate if residual pressures of at least 30 pounds per square inch (psi) are maintained at all locations within the distribution grid under peak demand conditions.

As part of this study, average day EPS analyses were also set up for each design year in order to evaluate the operation of the distribution system under more typical demand conditions. Other criteria for developing the recommended improvement program included increasing system reliability and enhancing operational flexibility.

C. Pressure Zones

As discussed in Chapter 4, Fountain's water distribution system is divided into four pressure zones: Low, Little Ranches, High, and Booster. The Low Zone serves the low-lying ground in the southwest part of the City, the Little Ranches Zone serves a small area in the southeast part of the system, the High Zone serves most of the higher-lying ground to the northeast, and the Booster Zone serves the highest ground in the northern-most part of the City. A series of closed valves and PRVs form the boundaries between the various zones.

The Low, High and Booster Zones contain storage reservoirs that establish the static operating gradients for those zones. Because there is no reservoir in the Little Ranches Zone, the operating gradient in that zone is established by the downstream setting of the PRV that controls the flow of water from the High Zone into the Little Ranches Zone. Currently, the operating gradient in the Little Ranches Zone is approximately 5,790 feet, or about 50 feet higher than the gradient in the Low Zone.

In order to develop a long-range plan for serving future water customers, it was necessary to layout the probable future boundaries between the four pressure zones. It was assumed that the existing zones will be expanded as necessary to serve adjacent growth areas that have similar ground elevations. Because the Low, High, and Booster Zones contain existing storage reservoirs that establish the static gradients within these pressure zones, no changes are recommended for the operating gradients in these zones, with one exception, as discussed below.

Based on a review of the topography in this part of the service area, it is recommended that the future operating gradient within the Little Ranches Zone be increased to about 5,820 feet so that it is closer to the midpoint between the Low Zone and High Zone gradients. This will result in a relatively modest increase of 13 psi for existing customers within the Little Ranches Zone, which would be beneficial for those customers on the highest ground within the zone who currently have static pressures of less than 40 psi. The proposed 5,820-foot gradient would also make it feasible to construct a ground storage reservoir for the Little Ranches Zone on the high ground near the intersection of Kane Road and the proposed Powers Boulevard extension.

Under this scenario, a small portion of the High Zone system (along Ohio Avenue and R.E.A. Road) will be transferred to the Little Ranches Zone. This means that the small number of existing customers along these roads will experience a decrease in their pressures as a result of the proposed boundary modifications. However, because the ground elevations along these roads are relatively low and system pressures in this area are currently quite high, the customers will still have adequate pressures.

Table 7-1 summarizes current and future operating gradients for the City's pressure zones, as well as the approximate range of ground elevations and static pressures within each zone.

Table 7-1

Pressure Zone Characteristics

Pressure Zone	Current Operating Gradient (feet)	Proposed Operating Gradient (feet)	Approximate Range of Ground Elevations (feet)	Approximate Range of Static Pressures (psi)
Low	5,740	5,740	5,410 to 5,600	61 to 143
Little Ranches	5,790	5,820	5,530 to 5,700	52 to 126(1)
High	5,930	5,930	5,540 to 5,780	65 to 169
Booster	6,023	6,023	5,720 to 5,880	62 to 131

(1)Based on proposed operating gradient.

Future water demands were determined for each pressure zone based on the proposed pressure zone boundaries, as shown in Table 7-2. A relatively large percentage of the projected demand increase is expected to occur within the High Zone, with smaller amounts of growth occurring in the Low and Little Ranches Zones, and essentially no growth within the Booster Zone.

Table 7-2

Water Demands by Pressure Zone

Design Year	Pressure Zone	Average Day (mgd)	Maximum Day (mgd)	Maximum Hour (mgd)
2010	Booster	0.26	0.7	1.1
	High	2.85	7.3	10.6
	Little Ranches	0.78	2.2	3.5
	Low	1.72	4.2	6.0
2020	Booster	0.26	0.7	1.1
	High	4.26	10.8	15.5
	Little Ranches	1.47	4.1	6.4
	Low	2.27	5.6	8.0

D. Water Supply Facilities

As previously discussed, Fountain currently obtains water from the Fry-Ark Project and from several wells located within the city limits. In recent years, FVA water has been used as the City's primary base supply, while the City wells have been utilized as a supplemental supply on the higher-demand days. Treated FVA water is delivered to the City at two locations. One turnout on the Fountain Valley Conduit allows water to be bled from the FVA pipeline into the City's Southwest Reservoir. Water then flows by gravity into the Low Zone distribution system. A subsequent turnout on the Fountain Valley Conduit allows water to be diverted through a transmission lateral for delivery to the Fountain Terminal Tank and the Joint Fountain/Widefield Storage Reservoir. From these reservoirs, the water can flow by gravity into the City's High Zone or be pumped into the Booster Zone.

For the purposes of the distribution system hydraulic analyses, the following assumptions were utilized:

- Fountain will continue to utilize its allocation of FVA water, which is equivalent to an annual average delivery rate of 1.7 mgd.
- The five existing city wells have a combined capacity of about 4.3 mgd.
- An additional 3.0 mgd of water will be obtained by the summer of 2007 through a water exchange agreement with Widefield and Security. This water will most likely be introduced into the northwest part of Fountain's distribution system in the vicinity of Interstate 25 and Carson Drive.
- An additional 3.0 mgd of water will be available by the summer of 2008 from city-owned wells in the vicinity of Interstate 25 and State Highway 16. Water from these wells would be pumped and disinfected with chlorine. No additional treatment will be provided before entering the distribution system.
- An additional 2.5 mgd of well water will be available in the vicinity of Wilson Road and Jimmy Camp Road in year 2009. Water from these wells would be pumped and disinfected with chlorine. No additional treatment will be provided before entering the distribution system.

- An additional 2.2 mgd of water will be available by 2011, either through participation in SDS or through additional wells.

E. Pumping Stations

Based the assumptions listed above, all future SDS and/or treated well water will be introduced into the existing Southwest Reservoir and then flow by gravity from the reservoir into the Low Zone. Since only a portion of this water will actually be used in the Low Zone, it will be necessary to construct pumping stations to lift some of the water from the Low Zone to the higher-lying zones.

About year 2011, or concurrent with any new water supply being introduced into the Southwest Reservoir, a pumping station should be constructed along Wilson Road to transfer water from the Low Zone into the Little Ranches Zone. It is recommended that this proposed pumping station be designed with an initial capacity of 6 mgd, with the capability to be easily expanded to at least 16 mgd in the future. Although the exact timing of the pumping station expansion should ultimately be coordinated with future expansion(s) of the proposed WTP, it is anticipated that the expansion will occur about year 2017. Additionally, at the same time that the Wilson Road pumping station is expanded, a second pumping station should be constructed to pump water from the Little Ranches Zone into the High Zone. This second station should have a capacity of about 11 mgd and should be located in the vicinity of the future Kane Ranch reservoir (to be discussed later).

F. Storage Facilities

Equalization and emergency storage requirements for the City's water distribution system were evaluated as part of this study. These evaluations are discussed in the subsequent sections.

1. Equalization Storage

The amount of equalization storage needed is a function of an area's demand characteristics and the capacities of the major system components. Supply, treatment, pumping, and transmission facilities are generally sized to meet maximum day demands and equalizing storage is sized to meet demands in excess of this rate. Thus, storage facilities provide water when demands exceed the maximum day rate, and refill when demands are less than the maximum day rate.

Based on assumed diurnal demand patterns, the volume of equalization storage needed on a maximum demand day was calculated. Based on these calculations, a volume of 3 MG is sufficient to meet equalization storage requirements under projected maximum day demand conditions for the next 20 years. However, as will be discussed in the following paragraphs, this does not mean that a total storage volume of 3 million gallons would be sufficient to meet Fountain's future requirements.

2. Emergency Storage

In addition to having sufficient equalization storage, it is also necessary to maintain an appropriate amount of reserve storage in case of a fire or an emergency such as a main break, equipment failure, power outage, contamination of raw water supply, or natural disaster. The amount of emergency storage in a particular water system is generally decided by the utility based on an assessment of risk and the desired degree of reliability. A common engineering design practice is to assume that the total volume of storage within a distribution system should be equal to at least twice the required volume of equalization storage. Thus, for the Fountain system, it would be appropriate to have a total storage volume of 6 million gallons or more.

Typically, a water utility provides sufficient storage to meet the fire flow requirements established by the Insurance Services Office (ISO), which is an organization that grades municipal fire defense capabilities for insurance rating purposes. Part of an ISO evaluation consists of determining needed and available fire flows at various locations throughout a utility's service area. Needed fire flows are calculated based on the size, type of construction, exposure, and occupancy of each building or complex. For fighting a residential fire, a flow rate of 1,000 gpm is generally sufficient, provided that the residential structure is no higher than two stories and is separated from adjacent structures by more than 10 feet. Although necessary fire flow rates can be as high as 12,000 gpm for some commercial or industrial facilities, 3,500 gpm is the maximum fire flow required to be supplied by municipal water systems for ISO insurance rating purposes. Fire flow requirements in excess of 3,500 gpm, if not available through the municipal water system, may affect the rating of an individual building or complex, but will not affect the overall city rating.

The calculated fire flow rate must be sustained for a minimum duration (generally 2 to 3 hours) at a minimum residual pressure of 20 psi. A 3,500 gpm fire flow for a period of 3 hours is equivalent to a volume of 630,000 gallons. Based on the preceding discussion, 6 MG of emergency storage within Fountain's system is more than adequate to provide this volume of fire reserve.

3. Storage Conclusions

As indicated in Chapter 4, Fountain's water distribution system currently contains nearly 8 million gallons of storage (assuming that half of the volume of water in the Joint Storage Reservoir and Joint Elevated Tank belong to the City of Fountain). Thus, based on the preceding discussions, the overall total volume of storage currently within the Fountain system is adequate for meeting projected flow equalization requirements for the next 20 years, as well as satisfying emergency and fire flow requirements.

However, it is important to evaluate how the storage volume is distributed among the various pressure zones within the distribution system. Currently, the Low Zone contains 3.0 MG of storage (the Southwest Reservoir), the High Zone contains 4.5 MG (the Fountain Terminal Tank and half of the Joint Storage Reservoir), the Booster Zone contains 375,000 gallons (half of the Joint Elevated Tank), and the Little Ranches Zone has no storage.

Based on the projected demands by pressure zone, the existing storage within the Low, High, and Booster Zones will be adequate to meet future requirements for the next 20 years or more. However, since the Little Ranches Zone currently has no storage facility, consideration was given to the future construction of a reservoir that could effectively serve this intermediate service level. Based on the projected demands within the Little Ranches Zone, 1.5 MG of storage would be sufficient.

In addition to providing storage, any reservoir constructed to serve the Little Ranches Zone could also serve as a backup storage facility for the adjacent zones. In an emergency, water could be pumped from the Little Ranches Zone into the High Zone or bled from the Little Ranches Zone into the Low Zone. For this reason, it would be advantageous to size the proposed Little Ranches storage reservoir so that it would be capable of meeting emergency needs in the Low, Little Ranches, or High Zones. Therefore, it is recommended the proposed Little Ranches storage reservoir have a volume of 3.0 MG.

G. Transmission Mains

As previously discussed, it is anticipated that SDS and treated well water will be delivered to the Southwest Reservoir. In order to effectively convey water from this location to the City's existing and future distribution grid, it will be necessary to construct a number of key transmission mains within the Fountain water system.

Within the Low Zone, it is recommended that a 36-inch transmission main be constructed from the Southwest Reservoir, across the Low Zone, to the proposed booster pumping station along Wilson Road. Within the Little Ranches Zone, a 30-inch transmission main should be constructed from the discharge side of the Wilson Road pumping station to the site of the proposed Kane Ranch reservoir and pumping station. Within the High Zone, a 24-inch main should be constructed from the discharge side of the Kane Ranch pumping station, north to C&S Road, where it will connect to several future distribution mains within the High Zone.

H. Fire Flow Considerations

A comprehensive fire protection evaluation was not included as part of this study. However, fire flow requirements were considered while performing the hydraulic analyses. In the old downtown area (bounded by Main Street, Iowa Avenue, Hamilton Street, and Missouri Avenue), the available fire flow rates currently range from about 1,600 gpm to 2,100 gpm, which is relatively good considering that all of the east-west distribution mains in this area are 4-inch pipes. Despite the small-diameter mains, fire flow rates of this magnitude are possible in this area primarily because the distribution network is well grided, i.e. there are numerous distribution loops and no dead-end mains.

Additionally, there is also a pressure reducing valve on the east side of the downtown area that allows water to flow from the High Zone into the Low Zone during periods of high demand or during an emergency such as a fire.

I. Control Valves

A number of existing and proposed PRVs will be utilized for transferring water from the higher to lower zones during periods of peak demand or during emergencies. Table 7-3 provides a summary of existing and proposed PRVs within the Fountain distribution system. The maximum flow rates listed in the table are based on the results of hydraulic analyses performed to simulate future demand conditions.

It should be noted that, when the boundary between the High Zone and Little Ranches Zone is modified as previously described, the existing PRV located near the intersection of Link Road and Circle C Road will no longer be needed. Consequently, this PRV will need to be removed or bypassed when the boundary modification is implemented.

Table 7-3

Pressure Reducing Valves

From and To Zones	Valve Status	Maximum Flow (mgd)	Location
High to Little Ranches	Proposed	1.5	Link Road south of Valli Farms Road
	Proposed	1.5	Ohio Avenue at Jimmy Camp Road
	Proposed	1.5	Intersection of Kane Road and Shumway Road
High to Low	Existing	0.4	Ohio Avenue and Hamlin Street
	Existing	1.5	Jimmy Camp Road, south of Ohio Avenue
	Proposed	0.5	U.S. Highway 85, south of Mesa Road
	Proposed	1.5	I-25 Frontage Road
Little Ranches To Low	Existing	1.5	Link Road, south of Falling Star Road

J. Recommended Improvements

As a result of the hydraulic analyses that were conducted as part of this study, deficiencies within the distribution system were identified, and a recommended long-range capital improvement program was developed, as described below and shown on Figure 7-1.

1. Pressure Zones

The existing pressure zones within the Fountain distribution system should be expanded as necessary to accommodate the projected growth areas, as shown on Figure 7-1. As discussed previously, it is recommended that the operating gradient within the Little Ranches Zone be increased to about 5,820


Joint Storage Reservoir
4.0 Mil Gal
Overflow Elev = 5,930 ft
Joint Elevated Tank
0.75 Mil Gal
Overflow Elev = 6,023 ft
Booster Pumping Station
Fountain Terminal Tank
2.5 Mil Gal
Overflow Elev = 5,930 ft
Inset A
Jointly owned with
City of Widefield
Well #4
Well #5
Well #1
Well #2
Well #3
High Gate Pump
High Gate Well
Proposed Reservoir
3.0 Mil Gal
Overflow Elev = 5,820 ft
Inset B
Proposed
Pumping Station
Proposed
Pumping Station
Southwest Reservoir
3.0 Mil Gal
Overflow Elev = 5,740 ft
Future Water
Treatment Plant
1,300 650 0 1,300 2,600
Feet
Legend
Existing Facilities
Water Mains and Diameter (inches)
Low Zone
Little Ranches Zone
High Zone
Booster Zone
Other Facilites
Storage Reservoir
Pumping Station
Well
Pressure Reducing Valve
Proposed Facilities
Phase I Mains and Diameter (inches)
Low Zone
Little Ranches Zone
High Zone
Phase II Mains and Diameter (inches)
Low Zone
Little Ranches Zone
High Zone
Other Facilites
Water Treatment Plant
Storage Reservoir
Pumping Station
Well
Pressure Reducing Valve
Normally Closed Gate Valve
Flow Meter
Fountain, Colorado
Water System Master Plan
Recommended Distribution
System Improvements
BLACK & VEATCH
Corporation
2006
Figure 7-1

feet so that it will be more nearly at the midpoint between the High and Low Zone gradients.

2. Storage Facilities

The existing storage facilities are adequate to meet the future requirements within the Low, High, and Booster pressure zones through the year 2020. It is recommended that a new 3.0 MG reservoir with an overflow elevation of 5,820 feet be constructed to serve the Little Ranches Zone. This reservoir should be located on the high ground near the intersection of Kane Road and the proposed Powers Boulevard extension. It is recommended that the reservoir be constructed by 2010 to provide peaking and emergency storage for customers in the Little Ranches Zone.

3. Pumping Stations

It is recommended that two new pumping stations be constructed; one along Wilson Road and one at the site of the proposed Kane Ranch Reservoir. These stations will be essential for transferring water from the proposed WTP into the higher service areas.

The proposed Wilson Road pumping station should be constructed by year 2011 at the boundary between the Low Zone and the Little Ranches Zone. The station will take suction from the proposed 36-inch transmission main in the Low Zone and discharge to the future 30-inch transmission main in the Little Ranches Zone. Although the station should be designed to have an ultimate firm pumping capacity of about 16 mgd, it can initially be constructed with a capacity of about 6 mgd.

The proposed Kane Ranch pumping station should be constructed by year 2017, and should be with a firm pumping capacity of about 11 mgd. The station will take suction from the proposed 30-inch transmission main in the Little Ranches Zone and discharge to the proposed 24-inch transmission main in the High Zone.

4. Distribution Mains

Figure 7-1 shows the existing distribution network along with the recommended diameter, alignment, and timing of the proposed distribution mains.

a. Phase 1 and Phase 2 Improvement Mains

In order to facilitate the budgeting and planning process, the recommended distribution system facilities have been grouped into two phases. Phase 1 facilities are recommended for construction by 2015 and Phase 2 facilities are recommended for construction after 2015. The alignments shown on Figure 7-1 are the approximate locations used for the hydraulic analyses. Specific street locations should be determined during the preliminary design and improvements in undeveloped areas may change based on changing growth patterns.

The Phase 1 Improvements include major transmission mains in the Low Zone and a number of additional mains to reinforce the existing distribution network and to extend service into future growth areas. The Phase 1 transmission mains are needed to enhance the ability to convey water from the Southwest Reservoir to existing and future customers in future growth areas. As shown on Figure 7-1, the principle proposed Phase 1 transmission main is the 36-inch main in the Low Zone between the Southwest Reservoir and the site of the future booster pumping station along Wilson Road.

The Phase 2 Improvements include a number of mains to reinforce the existing distribution network and extend service to projected growth areas. It is recommended that a 30-inch main be constructed in the Little Ranches Zone along Wilson Road and the Powers Boulevard corridor between the Wilson Road booster pumping station and the Kane reservoir. In the High Zone, it is recommended that a 24-inch transmission main along the Powers Boulevard corridor be constructed between the Kane Ranch pumping station and C&S Road. These improvements will complete the sequence of mains needed to convey water from the proposed WTP into the Little Ranches and High Zones.

Tables 7-4 and 7-5 summarize the probable costs of the recommended Phase 1 and Phase 2 water main improvements. These costs are planning level estimates that reflect generalized assumptions regarding conditions along the proposed alignments and are intended for budgeting purposes. Once the exact route for a particular main has been determined, the cost estimate should be re-evaluated and, if necessary, adjusted appropriately to reflect actual conditions along the selected route.

All costs are based on current construction prices and include allowances for contingencies and for legal, engineering, and administrative expenses, but do not include allowances for land, right-of-way, or rock excavation. Construction costs are based on conventional open-cut installation within the right-of-way of existing streets and include allowances for removing a section of pavement equal to the width of the trench and subsequently replacing the pavement.

Table 7-4

Probable Costs of Phase 1 Water Mains

Main No.	Pressure Zone	Location	Diameter (inches)	Length (feet)	Probable Cost ($)
1	Low	No existing street	8	800	80,000
2	Low	No existing street	12	2,600	210,000
3	Little Ranches	Ermel Road	12	400	50,000
4	Little Ranches	Ermel Road	8	2,600	220,000
5	Little Ranches	Shumway Road	12	1,300	130,000
6	High	Valli Farms Road	8	1,000	90,000
7	Little Ranches	Link Road	12	4,000	430,000
8	Little Ranches	Squirrel Creek Road	12	1,100	120,000
9	High	Squirrel Creek Road	12	1,600	160,000
10	High	Shumway Road	12	2,600	260,000
11	High	Kane Road	12	2,600	260,000
12	High	I-25 Frontage Road	16	3,800	430,000
13	High	No existing street	12	3,100	300,000
14	High	U.S. Highway 85	12	900	100,000
15	High	Mesa Road	12	3,800	480,000
16	Low	U.S. Highway 85	8	7,500	630,000
17	Low	No existing street	12	1,000	170,000
18	Low	Wilson Road	36	1,500	350,000
19	Low	Jimmy Camp Road	12	700	80,000
20	Little Ranches	Shumway Road	12	1,300	130,000
21	Little Ranches	Link Road	12	1,600	160,000
22	Little Ranches	Link Road	12	1,300	130,000
23	Little Ranches	Link Road	12	2,600	260,000
24	Little Ranches	Kane Road Road	12	2,600	260,000
25	Little Ranches	Kane Road and R.E.A. Road	8	2,100	180,000
26	Little Ranches	No existing street	8	6,600	340,000
27	High	C & S Road	20	2,600	340,000
28	High	Link Road	12	1,300	130,000
29	High	C & S Road	20	1,100	150,000
30	High	Marksheffel Road	16	6,800	820,000
31	High	No existing street	12	900	60,000
32	High	No existing street	16	5,000	400,000
33	Low	Charter Oak Ranch Road	36	5,200	1,030,000
34	Low	No existing street	36	2,800	500,000
35	Low	No existing street	36	1,300	600,000
36	Low	No existing street	36	2,700	860,000
37	Low	Old Pueblo Road	36	1,700	450,000
38	Low	Wilson Road	36	2,000	500,000
39	Low	Wilson Road	36	4,700	1,180,000
40	Little Ranches	No existing street	16	4,200	340,000
Phase 1 Total					**$13,370,000**

Table 7-5

Probable Costs of Phase 2 Water Mains

Main No.	Pressure Zone	Location	Diameter (inches)	Length (feet)	Probable Cost ($)
41	High	No existing street	16	1,400	120,000
42	High	Future Powers Blvd extension	16	5,400	430,000
43	Little Ranches	No existing street	30	2,700	510,000
44	Little Ranches	Future Powers Blvd corridor	30	5,300	790,000
45	Little Ranches	Future Powers Blvd corridor	30	3,000	430,000
46	Little Ranches	No existing street	16	2,600	220,000
47	High	Future Powers Blvd corridor	24	3,000	370,000
48	High	Squirrel Creek Road	12	2,600	260,000
49	High	Future Powers Blvd corridor	24	7,000	820,000
50	Low	Old Pueblo Road	12	3,600	360,000
51	Low	No existing street	8	4,900	240,000
52	Low	No existing street	8	2,000	230,000
53	Low	No existing street	12	2,700	180,000
54	Little Ranches	Future Powers Blvd corridor	12	2,700	180,000
55	Low	Future Powers Blvd corridor	12	1,600	140,000
56	Low	No existing street	16	5,100	410,000
57	High	Pleasant Valley Road	12	5,800	600,000
58	High	No existing street	12	12,700	860,000
59	Low	Future Powers Blvd corridor	16	3,400	270,000
60	Low	No existing street	16	2,900	240,000
61	Low	No existing street	16	2,800	270,000
62	Low	Old Pueblo Road	16	6,400	740,000
63	Low	No existing street	12	5,900	380,000
64	Low	Old Pueblo Road	12	6,200	620,000
65	Low	Future Powers Blvd corridor	12	7,400	490,000
66	Low	Birdsall Road	12	3,400	370,000
67	High	Future Powers Blvd corridor	12	2,600	170,000
68	High	No existing street	12	2,600	170,000
69	Little Ranches	No existing street	12	2,600	170,000
70	Low	No existing street	12	4,900	330,000
Phase 2 Total					**$11,370,000**

The main numbers listed in Tables 7-4 and 7-5 correspond to the numbers shown on Figure 7-1 and are representative of a tentative priority schedule.

However, the actual timetable of distribution main improvements may differ slightly from the proposed schedule. Factors that may accelerate or delay a given improvement include availability of easements, scheduling of street improvements, and construction of other utilities.

b. Local Distribution Mains

Because it is not possible to accurately predict the layout of the numerous local distribution mains within future developments and subdivisions, local main improvements were not identified as part of this study. However, in order to assist the City in sizing and laying out the local distribution mains within future developments, the following guidelines are provided:

- Install 12-inch mains as a minimum size on a mile grid.
- Use a minimum pipe size of 8-inches for any main extending more than 500 feet without cross-ties.
- Use minimum pipe sizes of 8 inches in commercial areas and 6-inches in residential areas.
- Wherever possible, eliminate dead-end mains to provide a more reliable looped network.

c. Fire Flow Considerations

As discussed previously, a comprehensive fire protection evaluation was not included as part of this study. However, fire flow requirements were considered while performing the hydraulic analyses and the recommended distribution system facilities were sized to provide a reasonable degree of fire protection. Fire flow rates greater than 1,000 gpm will be generally obtainable throughout the distribution network, with significantly higher fire flow rates being available along the primary development corridors, where the larger-diameter distribution mains are located.

Since downtown is a commercial area, it may be desirable to have higher available fire flow rates. The most practical way to achieve higher fire flow rates in the downtown area would be to replace the 4-inch main on Ohio Avenue (between Main Street and Hamilton Street) with an 8-inch main. As a result of this main replacement, the range of available fire flow rates in the downtown area would increase to between 2,200 gpm and 4,000 gpm. This main replacement project could be performed at the City's discretion, ideally in conjunction with other street or utility upgrade projects so as to minimize the inconvenience for local businesses and possibly reduce overall costs.

Chapter 8
Recommended Capital Improvements Plan

This chapter presents the recommended water supply alternative and an associated capital improvements plan (CIP). The water system improvements recommended in this report are staged to coincide with anticipated development and to aid the City in planning and financing its CIP.

The sequence and timing of the improvements proposed below are based on the anticipated development patterns within the City's service area. Since actual development may vary somewhat from the projected pattern, it is recommended that the City revisit this Master Plan at regular intervals to ensure that all components of the proposed CIP are still appropriate.

A. Recommended Water Supply Alternative

Based on the financial evaluation completed in Chapter 6, it is recommended that the City implement Alternative 3a. The recommended infrastructure improvements associated with Alternative 3a are listed in Table 8-1 and shown on Figure 6-3.

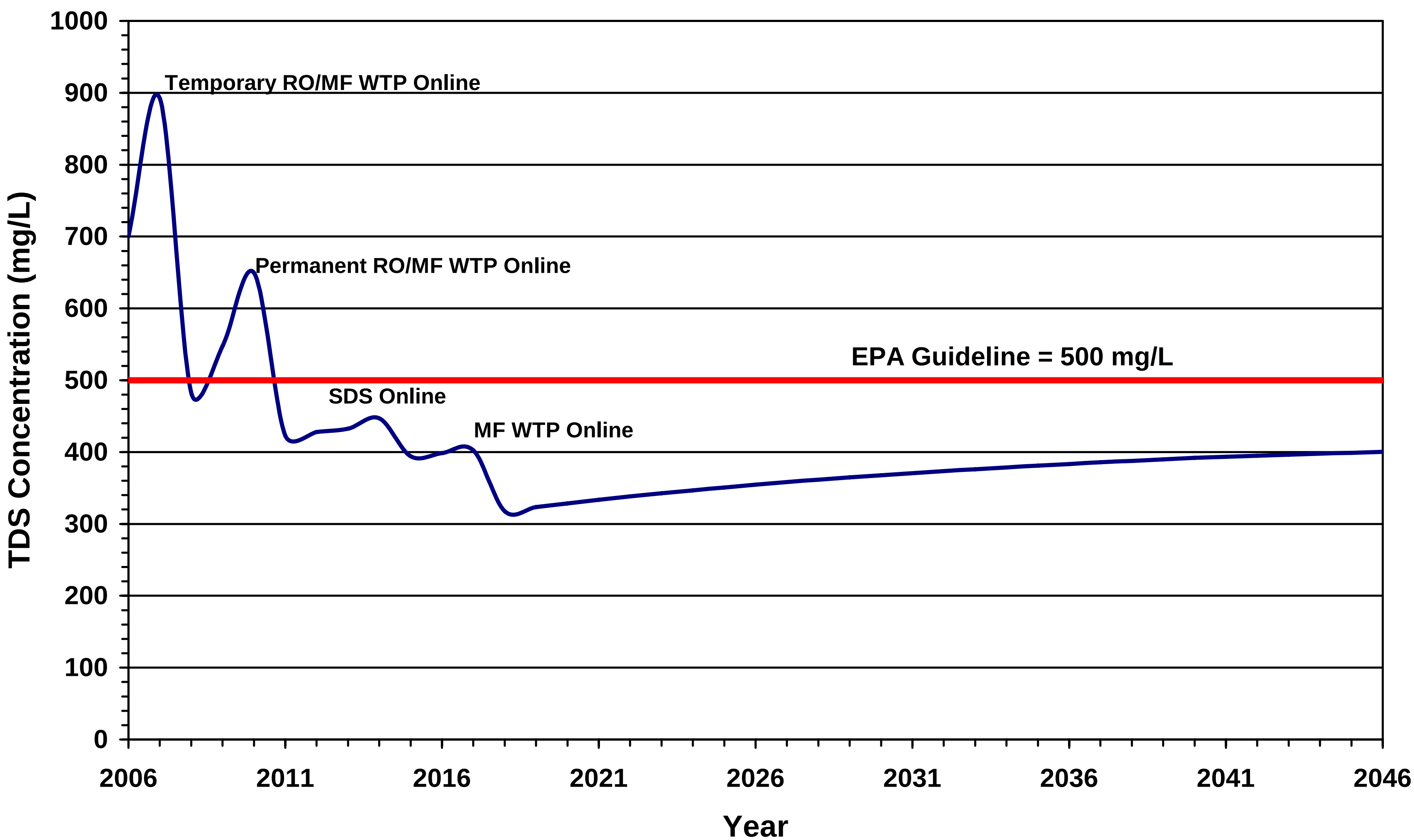
Table 8-1

Alternative 3a Components

Year	Project Description
2007	Develop 4 northern wells and 1 southern well
2008	Develop 2 northern wells and 4 southern wells 1.5 mgd temporary RO/MF treatment facility online
2009	Develop 1 northern well and 1 southern well
2010	Develop 2 southern wells
2011	Develop 1 southern well 4.0 mgd permanent RO/MF treatment facility online
2012	Develop 1 southern well
2013	Augmentation reservoir online
2014	Turn over two Ventucci wells to Widefield and Security
2015	SDS online Raw water storage reservoir online
2018	Expand RO/MF treatment facility to 5.0 mgd 10 mgd MF treatment facility online Decommission temporary RO/MF treatment facility
2029	Expand MF treatment facility to 15 mgd

Alternative 3a has the lowest capital cost opinion as well as the lowest projected O&M costs. Under this alternative, the City would implement conservation measures to reduce future water demands. The City would pump wells and utilize RO/MF at a constant rate equal to the annual average day demand and utilize storage and additional MF treatment to meet maximum day demands.

Figure 8-1 shows the predicted distribution system water quality with respect to TDS concentrations throughout the planning period if Alternative 3a is implemented. As shown on Figure 8-1, once the permanent RO/MF WTP is online, finished water TDS concentrations are expected to stay below EPA's Secondary Standard of 500 mg/L.



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City of Fountain, Colorado – Water Supply Plan

Predicted TDS Concentrations in the Distribution System for Alternative 3a

Figure 8-1

B. Recommended Distribution System Improvements

Table 8-2 provides a summary of probable costs for the proposed Phase 1 and Phase 2 recommended distribution system improvements, including water mains, storage reservoirs, and flow control valves.

Table 8-2

Summary of Probable Costs for Distribution System Improvements

Phase	Recommended Improvements	Probable Cost ($)
Phase 1 (by 2015)	Water Transmission and Distribution Mains	13,370,000
	Fire Protection Upgrade (Replace 4 inch main on Ohio Ave with 8 inch main)	200,000
	Wilson Road Pumping Station	1,200,000
	3.0 mil gal ground storage reservoir	2,000,000
	PRVs and Flow control valves	350,000
	Phase 1 Total	**$ 17,120,000**
Phase 2 (after 2015)	Water Transmission and Distribution Mains	11,370,000
	Wilson Road Pumping Station Expansion	500,000
	Kane Ranch Pumping Station	1,000,000
	PRVs and Flow control valves	230,000
	Phase 2 Total	**$ 13,100,000**

C. Capital Improvements Plan

The capital and O&M costs associated with the recommended water supply and distribution system improvements were used to develop a staged CIP, as shown in Table 8-3.

Table 8-3

Staged CIP for the City's Recommended Water System Improvements[1]

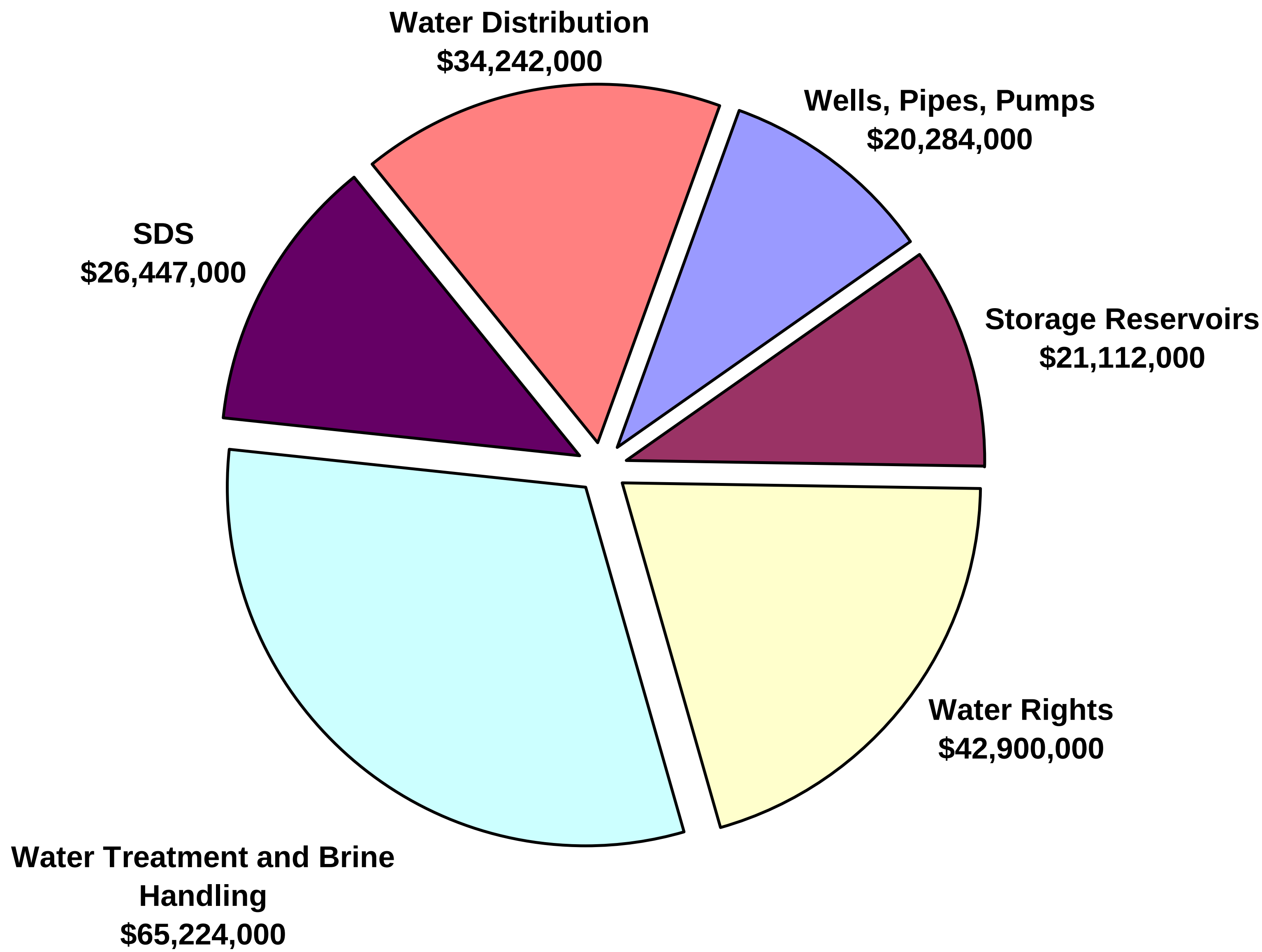
Year	Capital Cost	O&M Cost[2]
2006	$4,885,000	$0
2007	$11,998,000	$93,000
2008	$13,577,000	$1,227,000
2009	$37,926,000	$1,319,000
2010	$16,995,000	$1,371,000
2011	$15,848,000	$2,644,000
2012	$13,386,000	$2,907,000
2013	$14,773,000	$3,172,000
2014	$3,601,000	$4,314,000
2015	$6,044,000	$4,862,000
2006 - 2015 Subtotal	**$139,033,000**	**$21,909,000**
2016 - 2020	$39,950,000	$19,458,000
2021 - 2030	$22,153,000	$38,072,000
2031 - 2046	$9,073,000	$85,615,000
2016 - 2046 Subtotal	**$71,176,000**	**$143,145,000**
Total	**$210,209,000**	**$165,054,000**

[1]With conservation projections assume a 20 percent reduction in average and maximum day demand projections.

[2]O&M costs are in addition to the City's current O&M costs.

1. Capital Costs

Figure 8-2 presents graphically the capital cost for the recommended alternative broken out by project component for planning period (2006 through 2046). As shown on Figure 8-2, the largest expenditure is for water treatment and brine handling. As discussed in Chapter 5, three brine handling options were explored as part of this study. A forth option, deep well injection, was identified but not investigated as part of this study. However, it is important to note that substantial savings could potentially be realized if deep well injection is determined to be feasible and a subsequent feasibility study should be performed.



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City of Fountain, Colorado – Water Supply Plan

Capital Cost By Component Assuming Conservation (2006 – 2046)

Figure 8-2

The second largest capital expenditure in the near-term planning horizon is related to participation in SDS. As discussed in Chapter 5, the cost to provide SDS water is comparable to the cost to provide water from additional local supplies. However, local supplies can be developed incrementally as demands are realized and therefore, capital expenditures may be able to be delayed if the City does not participate in SDS.

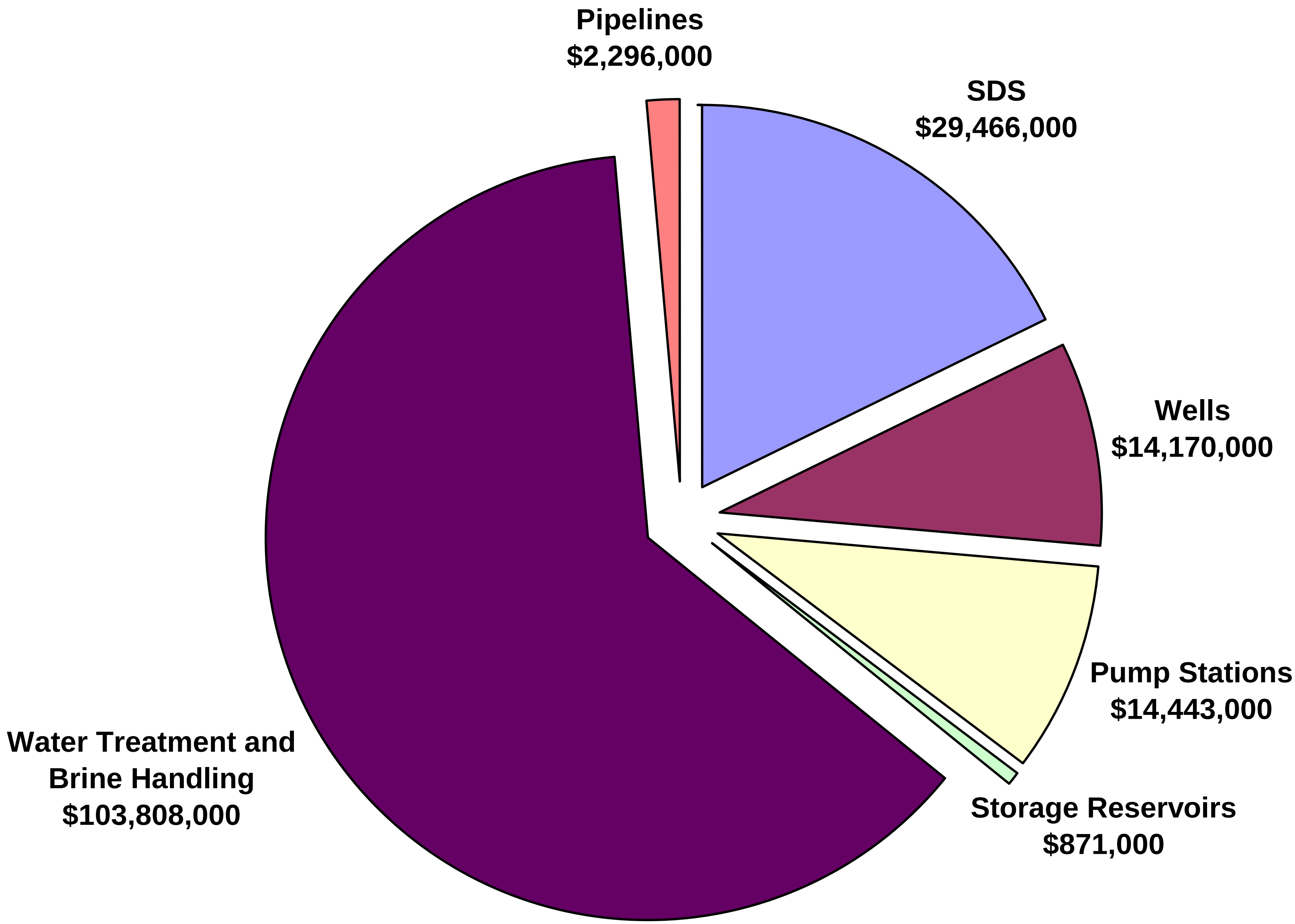
Storage costs account for approximately $21 million dollars of the total capital costs. A savings of approximately $3 million dollars may be realized if water releases from Pueblo Reservoir can be used to meet augmentation requirements. W.W. Wheeler is currently investigating this option.

2. O&M Costs

Figure 8-3 shows the O&M cost for the recommended alternative broken out by project component for the entire planning period and Figure 8-4 shows the annual average O&M cost broken out by component through the entire planning period.

Similar to the capital costs, and as shown on these figures, the largest O&M expenditure is for water treatment and brine handling. It is important to note that the O&M costs associated with brine handling are based on an optimistic assumption that the ZLD facility will be located near a power plant that has sufficient suitable waste heat for the evaporation process. This option was assumed due to the perceived difficulty in obtaining large amounts of land required to utilize drying beds for brine handling. However, it is recommended that the City explore the drying bed option further and, if there is sufficient land available on which to construct drying beds, the City could potentially save approximately $750,000 per year in O&M costs. An additional $2.5 million dollars per year would be required to operate a ZLD facility if waste heat from a power plant is not available.

The second largest O&M expenditure is related to participation in SDS. This estimate is based on costs to deliver water from SDS system at the time this study was prepared. However, both capital and O&M costs are subject to change as the SDS project moves forward, and Fountain should reevaluate the decision to participate as costs are revised.



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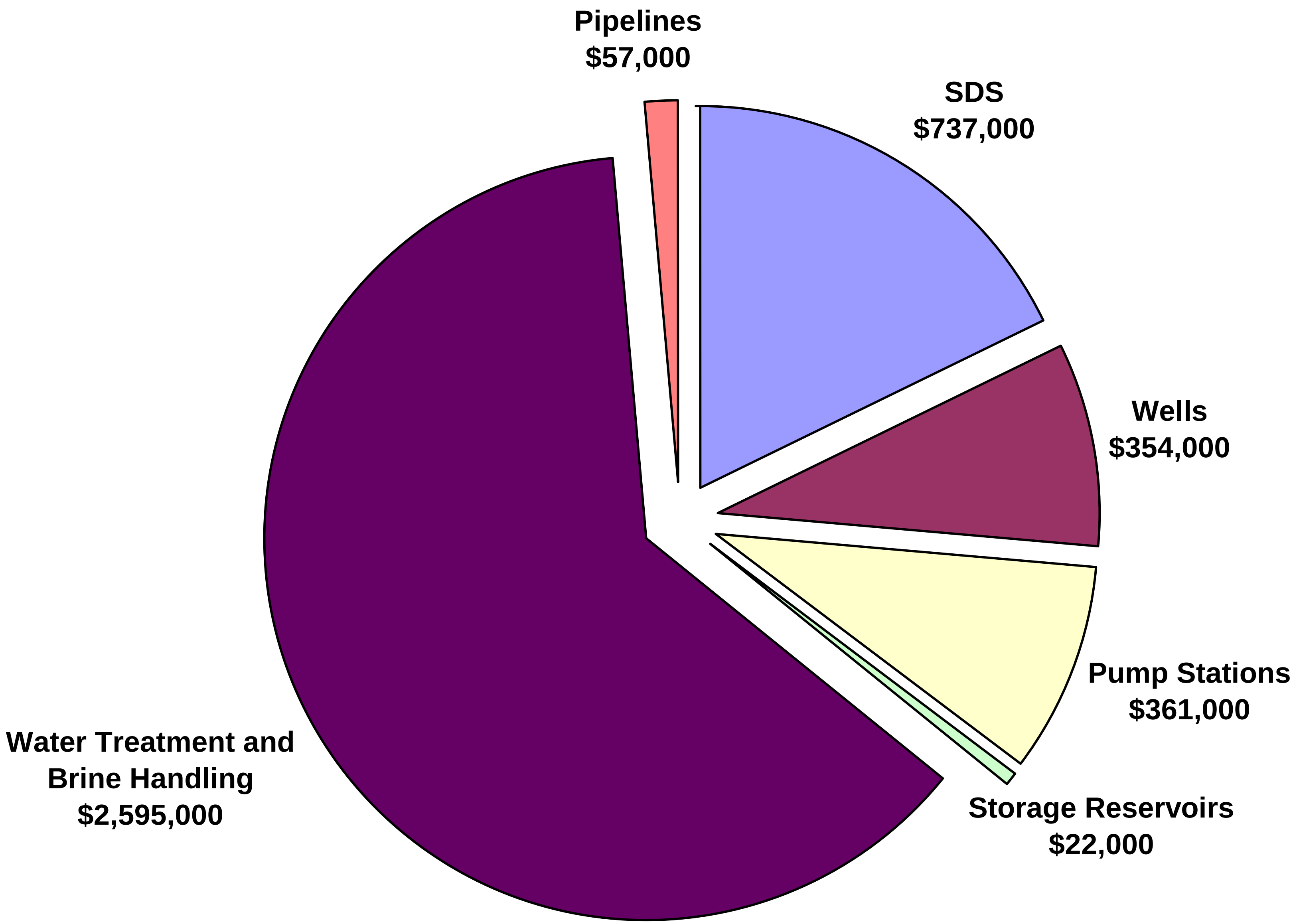
City of Fountain, Colorado – Water Supply Plan

O&M Cost By Component Assuming Conservation (2006 – 2046)

Figure 8-3



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City of Fountain, Colorado – Water Supply Plan

Average Annual O&M Cost By Component
Assuming Conservation (2006 – 2046)

Figure
8-4

D. Reduced Levels of Service

The recommended plan described above provides the City with a reliable water system capable of meeting anticipated water demands through the planning period. However, these recommendations require over 60 percent of the total capital improvements to be funded and constructed between 2007 and 2015 and the financial impacts may not be acceptable to the City. If the City cannot implement these recommendations due to financial limitations, reduced level of service alternatives could be considered.

The reduced level of service alternatives presented herein are based on the following criteria:

- Sufficient water supplies are provided to meet the same estimated maximum day water demands as for Alterative 3a.
- Water treatment facilities provided under the reduced level of service will enable the City to produce a blended water quality in the distribution system of less than 750 mg/L for TDS, instead of the Federal Secondary Guideline value of 500 mg/L.
- The blended water quality of 750 mg/L or less for TDS will be met for all demands equal to or less than 80 percent of the projected maximum day demand condition. During the highest demand periods, additional wells would be operated but the water treatment facilities would be by-passed resulting in slightly poorer water quality. Alternatively, water curtailment measures could be implemented to reduce the peak demands associated with dry summer days and meet the water quality target of 750 mg/L.
- After year 2020, facilities will be in place to meet the recommended target service levels (Alternative 3a).

1. Alternative 3b – Reduced Service with SDS Participation

Alternative 3b includes a revised implementation plan for water treatment and brine handling facilities. Table 8-4 lists the costs associated with treated water for Alternative 3b.

Table 8-4

Water Treatment Costs Associated with Alternative 3b

Year	Component	Cost
2006	Alluvium Study	$125,000
	Treatability/Brine Handling Study	$125,000
	Environmental/Permitting Assessment	$35,000
2007	Design and Permit 0.5 mgd Temporary RO/MF WTP	$75,000
	Procure 0.5 mgd Temporary RO/MF WTP	$686,000
	Utilize Temporary Brine Handling Facilities	$1,000,000
	Purchase Permanent RO/MF WTP Site	$300,000
	Design 3.0 mgd Permanent RO/MF WTP and Brine Handling Facilities	$1,500,000
2008	Install Temporary RO/MF WTP (Online Summer 2008)	$230,000
	Acquire Permits for Permanent RO/MF WTP	$75,000
2009	Construct Brine Handling Facilities (First Year)	$3,076,000
2010	Construct Brine Handling Facilities (Second Year)	$3,076,000
2018	Construct 7.5 mgd MF WTP	$11,250,000
2020	Construct Permanent 3.0 mgd RO/MF WTP	$4,500,000
	Expand Brine Facilities	$14,355,000
2029	Expand MF WTP (Additional 7.5 mgd)	$11,250,000
2030	Expand RO/MF WTP (Additional 2.0 mgd)	$6,600,000
	Capital Cost Opinion for Water Treatment	**$58,257,000**

Alternative 3b requires approximately $10.3 million between years 2006 and Years 2015 as compared to $41.1 million for Alternative 3a. Of this $30.8 million difference, $13.8 million is delayed to later years and $7 million is eliminated entirely from the budget.

2. Alternative 3c – Reduced Service without SDS Participation

Alternative 3c includes a revised implementation plan for water treatment and brine handling facilities. Table 8-5 lists the costs associated with treated water for Alternative 3c.

Table 8-5

Water Treatment Costs Associated with Alternative 3c

Year	Component	Cost
2006	Alluvium Study	$125,000
	Treatability/Brine Handling Study	$125,000
	Environmental/Permitting Assessment	$35,000
2007	Design and Permit 0.5 mgd Temporary RO/MF WTP	$75,000
	Procure 0.5 mgd Temporary RO/MF WTP	$686,000
	Utilize Temporary Brine Handling Facilities	$1,000,000
	Purchase Permanent RO/MF WTP Site	$300,000
	Design 0.5 mgd Permanent RO/MF WTP and Brine Handling Facilities	$1,500,000
2008	Install Temporary RO/MF WTP (Online Summer 2008)	$230,000
	Acquire Permits for Permanent RO/MF WTP	$75,000
2009	Construct Brine Handling Facilities (First Year)	$3,076,000
2010	Construct Brine Handling Facilities (Second Year)	$3,076,000
2013	Construct Permanent 0.5 mgd RO/MF WTP	$1,650,000
2015	Design and Construct 5 mgd MF WTP	$7,500,000
2018	Expand RO/MF WTP (Additional 1.0 mgd) and Abandon Temporary WTP	$3,300,000
2020	Expand Brine Handling Facilities	$20,508,000
2021	Expand MF WTP (Additional 5.0 mgd)	$7,500,000
	Expand RO/MF WTP (Additional 3.0 mgd)	$9,900,000
2029	Expand MF WTP (Additional 5.0 mgd)	$7,500,000
2030	Expand RO/MF WTP (Additional 2.5 mgd)	$9,900,000
	Capital Cost Opinion for Water Treatment	**$76,410,000**

Alternative 3c requires approximately $19.5 million in treatment between years 2006 and Years 2015. To provide the same level of service, Alternative 3a requires $41.1 million in treatment facilities and an additional $26 million in SDS. Of the $47.6 million difference, a total of $35.1 million is delayed to later years and $12.5 million is eliminated entirely from the budget.

3. Comparison of Alternatives 3a, 3b, and 3c

Tables 8-6 and 8-7 provide a comparison of capital and O&M costs associated with the reduced service level alternatives compared to the recommended alternative, respectively.

Table 8-6

Comparison of Capital Costs For Recommended and Reduced Service Level Alternatives

Year	Alternative 3a	Alternative 3b	Alternative 3c
2006	$4,885,000	$4,885,000	$4,885,000
2007	$11,998,000	$9,875,000	$9,875,000
2008	$13,577,000	$13,070,000	$12,534,000
2009	$37,926,000	$13,308,000	$11,866,000
2010	$16,995,000	$14,791,000	$14,136,000
2011	$15,848,000	$14,528,000	$9,790,000
2012	$13,386,000	$13,386,000	$3,267,000
2013	$13,023,000	$14,773,000	$8,253,000
2014	$1,851,000	$3,601,000	$2,814,000
2015	$4,044,000	$6,044,000	$13,544,000
2006 - 2015 Subtotal	**$133,533,000**	**$108,261,000**	**$90,964,000**
2016 - 2020	$39,950,000	$53,405,000	$49,738,000
2021 - 2030	$22,153,000	$32,503,000	$47,803,000
2031 - 2046	$9,073,000	$9,073,000	$9,073,000
2016 - 2046 Subtotal	**$71,176,000**	**$94,981,000**	**$106,614,000**
Total	**$210,209,000**	**$203,242,000**	**$197,578,000**

Comments:
1. Alternative 3a provides a robust system that meets recommended EPA guidelines.
2. Alternative 3b provides reduced levels of service while Fountain continues to participate in SDS.
3. Alternative 3c provides reduced levels of service and no SDS participation.

Table 8-7

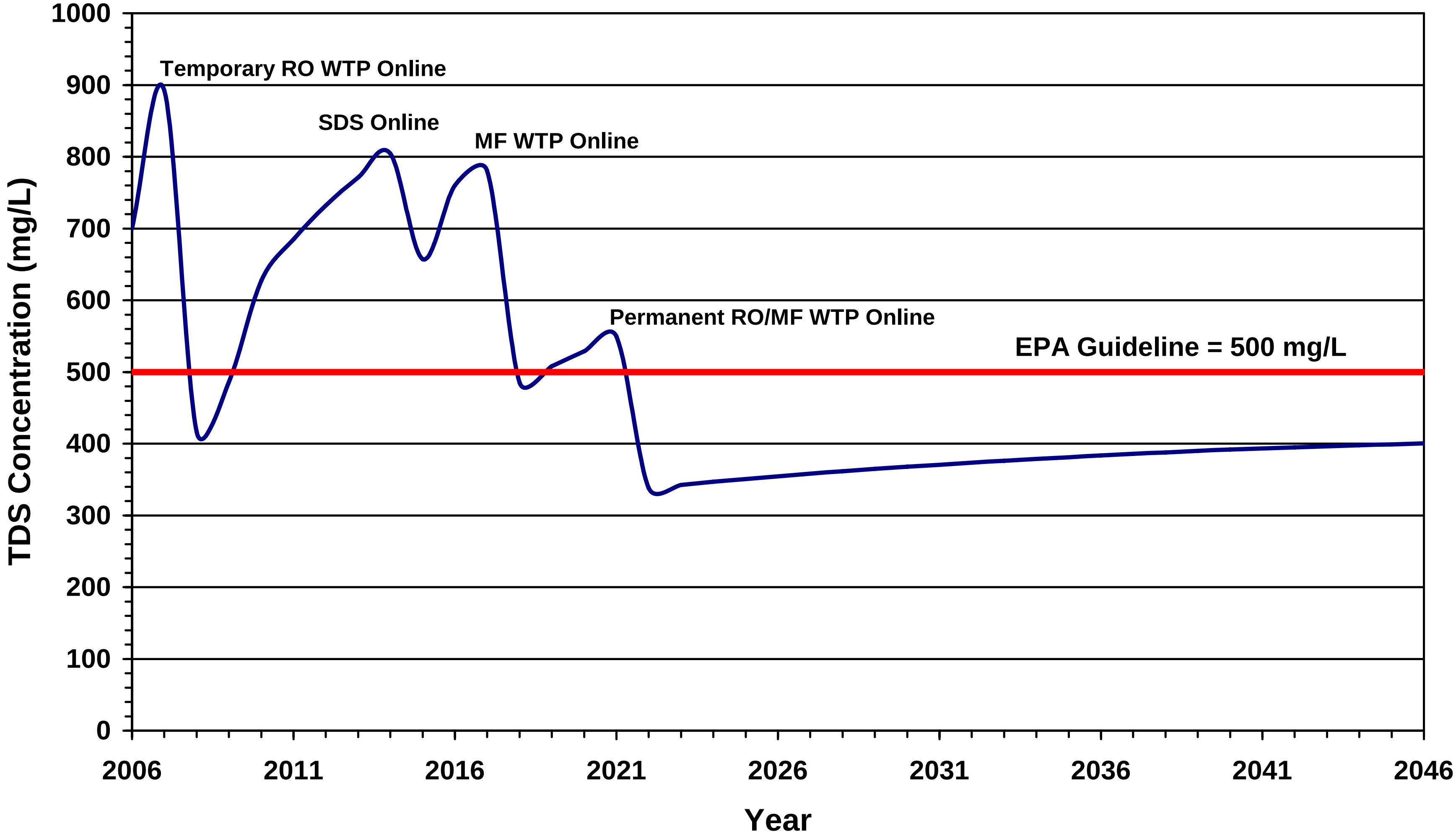
Comparison of O&M Costs For Recommended and Reduced Service Level Alternatives[(1)]

Year	Alternative 3a	Alternative 3b	Alternative 3c
2006	$0	$0	$0
2007	$93,000	$93,000	$93,000
2008	$1,227,000	$712,000	$712,000
2009	$1,319,000	$799,000	$799,000
2010	$1,371,000	$846,000	$846,000
2011	$2,644,000	$985,000	$985,000
2012	$2,907,000	$1,013,000	$1,013,000
2013	$3,172,000	$1,042,000	$1,042,000
2014	$4,314,000	$946,000	$1,403,000
2015	$4,862,000	$2,139,000	$2,011,000
2006 - 2015 Subtotal	**$21,909,000**	**$8,575,000**	**$8,904,000**
2016 - 2020	$19,458,000	$12,010,000	$12,034,000
2021 - 2030	$38,072,000	$37,199,000	$40,106,000
2031 - 2046	$85,615,000	$85,615,000	$88,869,000
2016 - 2046 Subtotal	**$143,145,000**	**$134,824,000**	**$141,009,000**
Total	**$165,054,000**	**$143,399,000**	**$149,913,000**

(1) O&M costs are in addition to the City's current O&M costs.

Table 8-7 shows that the O&M costs for Alternatives 3b and 3c are lower that 3a in early years. However, after year 2020, Alternative 3c has the highest O&M cost because it does not realize the benefits of the low cost/high quality SDS water.

Figures 8-5 and 8-6 show the predicted distribution system water quality with respect to TDS concentrations throughout the planning period for Alternatives 3b and 3c. As shown on these figures, finished water TDS concentrations are not expected to drop below EPA's Secondary Standard of 500 mg/L until after 2020 for the reduced level of service alternatives.



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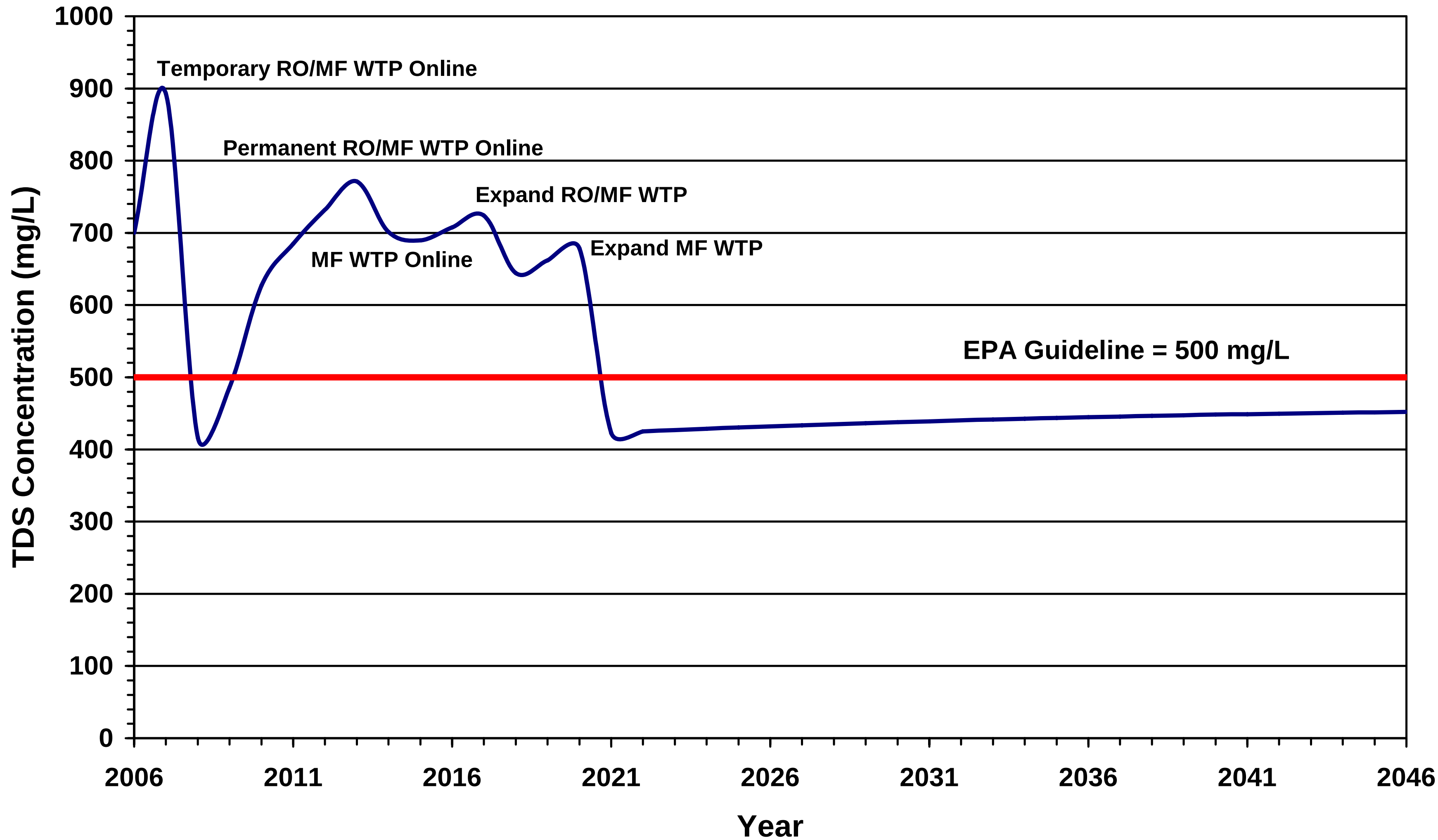
Predicted TDS Concentrations in the Distribution System for Alternative 3b

Figure 8-5



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Predicted TDS Concentrations in the Distribution System for Alternative 3c

Figure 8-6

E. Next Steps

Assuming conservation measures are implemented, Fountain may utilize groundwater to meet as much as 90 percent of maximum day demands and 65 percent of annual demands by 2020 if the City does not participate in SDS. If the City elects to participate in SDS, its reliance on groundwater could still be as much as 77 percent during maximum day demand periods and 41 percent during average day demand periods. Therefore, it is imperative that an alluvium study be performed to confirm sufficient water is available to meet groundwater demands.

As discussed previously, RO treatment of the groundwater is required in order to meet the EPA Secondary Standard for finished water TDS concentrations. RO treatment produces a brine stream that must be disposed of. The Colorado Department of Public Health and Environment requires the development of a Brine Management Plan to evaluate options for brine disposal prior to permitting. In addition, the brine handling costs discussed in this Master Plan are rough order-of-magnitude costs and should be defined further. Therefore, it is recommended that the City perform a treatability/brine handling study.

Budget amounts of $125,000 for each of these studies have been included as part of the recommended CIP.