5325 South Valentia Way *ph 303.477.5915* *info@aquaworksdbo.com*
Greenwood Village, CO 80111 *fx 303.300.3451* *www.aquaworksdbo.com*

MEMORANDUM

TO:	Scott Garncarz, CDPHE Financial Services Unit	**DATE**:	March 4, 2011
FROM:	Adam Sommers, P.E.	**CC:**	Theresa A. Miers, Mountain Water & Sanitation District
SUBJECT:	Mountain Water & Sanitation District Green Project Reserve Statement	**PN/File:**	

Introduction

The purpose of this memorandum is to summarize and justify the eligibility of certain components of the Mountain Water & Sanitation District potable water system upgrade project for the CDPHE's Green Project Reserve program. The CDPHE's Green Project Reserve program sets aside a minimum of 20% of SRF funding for the purpose of funding green infrastructure, water or energy efficiency improvements, or other environmentally innovative activities. The District is currently applying to the CDPHE for approval to make substantial improvements to its drinking water system, principally for the purpose of returning to compliance to the Radionuclide Rule.

This memorandum is intended to supplement documentation previously submitted by the District to the CDPHE. These items include:

- Construction Application & Project Summary: King's Valley Custom Resort, Filing Number 5, Lot 121 dated February 4, 2010
- Water Treatment System Improvements Engineering Drawings dated February 3, 2010
- Mountain Water & Sanitation District Technical, Managerial, and Financial Plan dated January 31, 2011
- Environmental Assessment: King's Valley Custom Resort, Filing Number 5, Lot 121 dated January 31, 2011
- Preliminary Engineering Report: King's Valley Custom Report, Filing Number 5, Lot 121 dated January 31, 2011
- Preliminary Engineering Report: Potable Water Distribution and Pumping System Upgrade Project submitted with this memorandum

The District has recently been informed that components of the proposed project may qualify for the Green Project Reserve Program. Therefore, this memo supplements the existing documentation with the additional material needed to support and justify eligibility for the program.

There are three components of the proposed project that meet criteria of Green Project Reserve Program:

Table 1 – Project Components

Part	Item
Component #1	Replacement and Upgrade of Potable Water Pumping Systems
Component #2	Installation of Ion Exchange Based Uranium/Gross Alpha Activity Removal System
Component #3	Upgrades to the Potable Water Distribution System

Each of the three components requires separate business cases, according to Section 5 of the Guidance Document. Business cases are presented as follows:

Component #1: Replacement and Upgrade of Potable Water Pumping Systems

Energy efficiency is defined by the Green Project Reserve Program as "the use of improved technologies and practices to reduce the energy consumption of water quality projects, use energy in a more efficient way, and/or produce/utilize renewable energy." The District's infrastructure was installed over the past forty years and is only repaired to maintain functionality. Much of the original infrastructure, specifically the pumping systems, is still in place and therefore antiquated, obsolete, and inefficient. There is the potential to substantially reduce the consumption of energy by upgrading these pumping systems.

The District pumps potable water at two separate locations:

A. On the Braun Site which is commonly known as the "Turbine Pumps." The turbine pumps convey approximately 30,000 gallons per day of potable water from a water storage tank on the Braun Site to a 220,000 gallon water storage tank on Lot 121, Filing Number 5. The water is pumped from an elevation of 9,196' to 9,474'. The existing pumps were installed circa 1980. The pumps run either on or off. The current pump curve will run at 62% efficiency with the new plant upgrades. A replacement pump has been selected that will operate at a maximum efficiency of 71.4%, resulting in an annual cost of $455. This achieves a 33% power savings.

B. On Lot 121, Filing Number 5 which is commonly known as the "Buried Valve Vault Pumps". The buried valve vault pumps maintain pressure in the District's distribution system.

The existing turbine pumps are approximately 30 years old. . The proposed uranium removal facility will place additional demand on these existing pumps as there will be an extra 30 psi to overcome for the ion exchange system. Therefore, the pumps will be functioning at a lower efficiency than as originally designed. This additional head to overcome will lower the efficiency of the existing turbine pumps to 62%+/-. Upgrading the system with pumps that better fit the demands of the new system will result in a more efficient installation, saving energy and operation costs. The new pumping system will operate at 71.4% efficiency, resulting in a 10% gain in efficiency.

Table 2 – Energy Savings

	Existing Pumps	Proposed Pumps	Energy Savings
kW	8.2	7.54	
Cost Per Day	$5.00	$3.75	
Annual Costs	$1,824	$1,369	33%

Upgrading the pumps in both locations will result in energy savings as the pumps currently being manufactured are more efficient at using energy than the ones they will be replacing.

With the introduction of the VFD drive, slower starts and stops are implemented in the operation of the pumping facility which will help increase the longevity of the distribution and pumping system by reducing water hammer and pressure surges throughout the system.

The turbine pumps are used to fill the 220,000 gallon water storage tank on Lot 121. The distance between these two features is approximately 1,800'. The turbine pumps stop pumping when the tank reaches capacity. There currently is no remote control system between the water storage tank and the turbine pumps. District operations staff must manually turn on the pumps when the tank level is low and then manually turn the pumps off when tank capacity is achieved. Section 3.5-7 of the Guidance Document states that automated and remote control systems (SCADA) can qualify for the green project reserve if a business case is presented showing substantial energy savings. The proposed project includes adding a remote control system linking the water storage tank and the turbine pumps. The water surface elevation of the tank will continually be measured and the value transmitted to the turbine pumps. The turbine pumps will be set to maintain a constant water surface elevation level.

The SCADA system will also control the District's well pumps which currently must be manually turned on and off by operations staff. Controlling the pumps manually forces operators to drive throughout the district unnecessarily, translating to needless vehicular trips, waste of gasoline, and associated adverse impacts to the environment. Converting to an automated SCADA system would provide the following measurable benefits to energy efficiency:

Table 3 – Fuel Savings

Item	Number	Unit
Vehicle Trips Per Week	10	Trips
Trip Length	4	Miles
Miles Per Week	40	Miles
Vehicle Consumption	15	MPG
Weekly Fuel Consumption	2.66	Gallons
Fuel Cost	$3.25	Per Gallon
Cost Savings Per Year	$450.67	

There is no way to currently measure if the pumps are delivering the proper volume of water to the Lot 121 storage tank. A flow meter will be added with the proposed upgrades to the turbine site. The quantity of water and the operational duration of the pumps will be accounted for, which will help to improve the overall efficiency of the general operations of the District as well as monitor this particular area to quantify the water consumption and check for losses in the system.

Reducing the amount of power consumed by the turbine pumps achieved through system operational improvements and efficiency's lowers environmental impacts by decreasing the burden on power generation facilities. Configuring the pumps with VFDs on a SCADA system will meet the Green Project Reserve objective of integrating energy efficiency practices into daily management.

Component #2: Installation of Ion Exchange System

Environmentally innovative projects are defined by the Green Project Reserve Program as "those that demonstrate new and/or innovative approaches to delivering services or managing water resources in a more sustainable way." Current violations to the CDPHE's Radionuclide Rule not only pose health concerns to residents within the District, but to the environment as well. Currently, naturally-occurring radionuclides (primarily uranium), are extracted from the earth by the drinking-water wells. Absent removal, the radionuclides enter the wastewater collection

system for delivery to the District's wastewater treatment plant. This results in higher radionuclide levels than desirable in both the wastewater effluent and wastewater residuals. Installing an ion exchange system to capture radionuclides before they reach the wastewater treatment system will correct this issue. Further, the radionuclide ion exchange process being proposed does not require the use of any chemicals in the water treatment, thereby eliminating the addition of sodium chloride through backwash operations as a means of regenerating the ion exchange media. These two factors will provide a measurable improvement to the means of managing water resources in a more sustainable way.

The Green Project Reserve Program states projects that significantly reduce the volume of residuals, minimize the generation of residuals, or lower the amount of chemicals in the residuals may qualify for the program. Calculations were made to determine the amount of uranium that will be removed from the potable water system. The media vessels will need to be exchanged every 341 days as they accumulate 15 pounds of uranium. The calculations show that 6,671,985 grams of uranium will be retained by the system of the course of 365 days. This is nearly 6.7 kg that will not have the potential to be retained in the wastewater residuals.

Table 4 – Uranium Calculations

Line:	Item:	Amount:	Unit:
	Formulas		
A	Resin Loading Capacity	10,000	mg (U)/ kg (resin)
B	Volume of Resin per Vessel	3.2	ft^3
C	Total # of Vessels per System	10	Vessels
D	Bulk Density of Resin	43	lb/ft^3
E	Weight of Resin Per Vessel	137.6	lb
F	Average Raw Water Concentration	160	ug/l
G	Peak Flow Rate	50	gpm
H	Average Flow Rate	21	gpm
I	Well Utilization	42%	
J	Maximum Uranium Storage	15	lb
K	Uranium Mass Rate	6,803,886	mg (uranium)
L	Weight Per Vessel	62.3	kg
M	Total Vessels Required for 15lb	10.9	Vessels
N	Uranium Loading	0.040	lb/day
	Calculate Maximum Uranium Weight for 10 Vessels		
O	Uranium Mass Weight	6,233,280	g
P	Weight of Uranium	13.74	lb

	Run Time Based on 10 Vessels		
Q	Run Time Per Exchange	341	Days
R	Throughput	10,298,283	Gallons

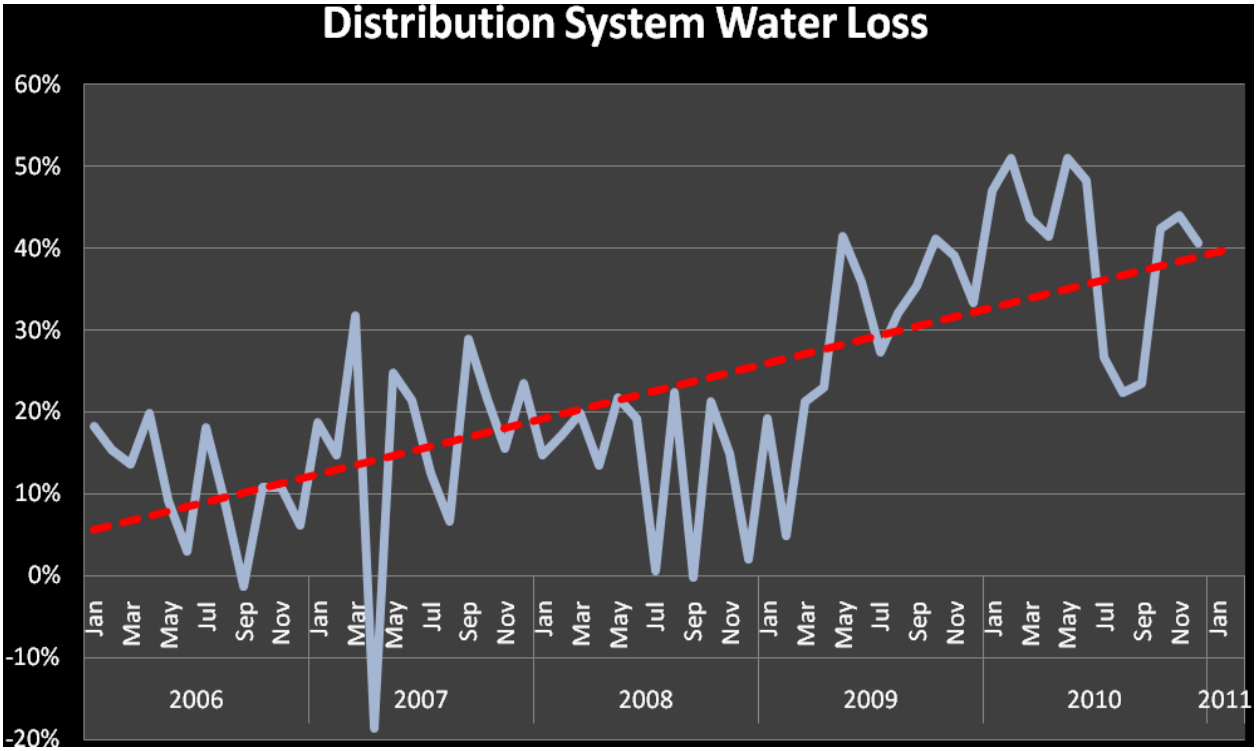
In the event radionuclides are retained in the wastewater residuals, there is the potential that residuals could be classified as hazardous, therefore requiring disposal at a hazardous waste facility. The additional cost to dispose of these residuals is estimated at $5,800 per month. Therefore, retaining the radionuclides in the drinking water treatment facility and disposing of them properly in a hazardous waste facility prior to being introduced into the wastewater collection system has measureable environmental and financial benefits.

Projects that significantly reduce or eliminate the use of chemicals in the water treatment system may qualify for the Green Project Reserve. The District had considered an ion exchange system that required regenerating the filters and sending the waste (both radionuclides and regeneration chemicals) to the wastewater plant. The alternative system would have required 65.4 pounds of sodium chloride per regeneration cycle. Regeneration would be required every 34 days. The proposed ion-exchange system, therefore, eliminates 700 pounds per year of sodium chloride that would otherwise be needed for the water treatment system. Eliminating 700 pounds of sodium chloride per year from being discharged by the wastewater treatment facility measurably improves the sustainability efforts of the District.

Component #3: Upgrades to Potable Water Distribution System

Water efficiency is defined as the "use of improved technologies and practices to deliver equal or better services with less water. Water efficiency encompasses conservation and reuse efforts, as well as water loss reduction and prevention, to protect water resources for the future." The District is concerned about the amount of water loss that is taking place in the distribution system. There is a substantial discrepancy between the amount of water produced each month compared to the amount billed to customers each month. The amount of water loss has increased from approximately 10% in 2006 to 40% in 2010. The amount of water lost in the distribution system in 2010 was 8,919,790 gallons. This number will only increase unless improvements are made to the distribution system. There is the potential to substantially increase water efficiency by replacing and rehabilitating the distribution system consistent with provisions of Section 2.5-2 of the Guidance Document.

Figure 1 – Distribution System Water Loss Graph



The benefits achieved by reducing potable water loss are numerous and measurable. These items include, but are not limited to:

- Reduction in the volume of water extracted from the District's groundwater wells. This will serve to protect the long term viability of the fractured granite aquifer upon which the District and others rely for their water supply
- Improving vegetation's access to groundwater by maintaining a more stable water table
- Lower energy consumption
- Decease in run time of well pumps
- Fewer chemicals consumed during disinfection of raw water
- Decrease in pump runtime required to pressurize distribution system
- Increased longevity of treatment and distribution equipment
- Decrease in the amount of uranium and alpha emitters extracted
- Less frequent exchanging of the ion exchange media vessels

Upgrading the distribution system will result in better service to the residents of the District. System pressure will be more reliable once the leaks are fixed. Also, the Operations staff is continually being reactive and addressing failures within the systems as they occur, requiring service shut-downs. Proactively addressing deficient areas of the distribution system before they fail will reduce the frequency of shut-downs of the system. Proper water infrastructure management will determine where water losses could be occurring and remedy them before failure is critical.

The benefits of reducing water losses are measureable and the cost savings are quantifiable. The District has a comprehensive 10-year budget forecast. Within the budget there is a section dedicated to water operations costs. The water operations section consists of costs dedicated to water treatment; this includes chemicals, electricity, repairs, ion-exchange media, and supplies, among other items. Expenditures on these items are proportional to the amount of water produced. The costs will be less when the amount of water produced decreases and greater when the amount of water produced increases. The water operations budget for Year 1 is $131,350 and increases thereafter to adjust for inflation and new treatment capabilities.

Table 5 – Water Savings Calculations

Year	Water Operations Budget	Water Losses Before Repairs	Water Losses After Repairs	Water Savings From Repairs	Water Savings	Improvement Costs	Net Savings
1	$ 131,350	40%	10%	30%	$ 39,405	$ 44,531	$ (5,126)
2	$ 144,207	42%	10%	32%	$ 46,146	$ 44,531	$ 1,615
3	$ 165,344	44%	10%	34%	$ 56,382	$ 44,531	$ 11,851
4	$ 169,808	46%	10%	36%	$ 61,649	$ 44,531	$ 17,118
5	$ 174,420	49%	10%	39%	$ 67,361	$ 44,531	$ 22,830
6	$ 179,184	51%	10%	41%	$ 73,55	$ 44,531	$ 29,026
7	$ 184,108	54%	10%	44%	$ 80,278	$ 44,531	$ 35,747
8	$ 189,198	56%	10%	46%	$ 87,568	$ 44,531	$ 43,037
9	$ 194,459	59%	10%	49%	$ 95,476	$ 44,531	$ 50,945
10	$ 202,999	62%	10%	52%	$ 105,667	$ 44,531	$ 61,136
Total					$ 713,491	$ 445,310	$ 268,181

The water operations budget will decrease as water efficiency improves. Less power will be required to operate the pumps, fewer chemicals will be required for disinfection, and the ion-exchange media will last longer. Currently, the District is experiencing a 40% water loss. It is

expected this number will increase if the system is not repaired. A growth rate of 5% was used for future water losses. The District believes that completely eliminating water loss by repairing the system is unrealistic and estimates a 10% water loss will always occur. Therefore, the District believes the water savings will begin at 30% for Year 1 and grow to 52% by Year 10.

The financial savings attributable to water conservation can be quantified because the amount of financial savings is directly proportional to the amount of water saved. The District believes that it will save $713,491 in the first ten years of implementation through the water savings. The improvement project will cost approximately $400,000 ($445,310 with interest). The net savings would, therefore, be $268,111 for the first ten years. The greatest financial savings, however, would take place once the loan project costs have been repaid after Year 10.

Conclusion

The benefits to be made through the Green Project Reserve Program are significant, both environmentally and financially. The environmental benefits include:

- Decreased energy consumption
- Improved water efficiency
- Reduced chemical usage
- Improved wastewater residual quality
- Less chemicals used for water treatment
- Fewer radionuclides being introduced to the environment
- Protection of the fractured granites ground water aquifer

The financial benefits achieved by improving sustainability are significant. Those savings are summarized below:

Table 6 – Cost Savings Summary

Item	Amount
Category #1	$905/year
Category #2	$5,800/month
Category #3	$268,131 first 10 years; greater thereafter.

Given the substantial environmental and economic benefits, the District believes that $566,775 of the project costs is eligible for the Green Project Reserve Program. The costs are detailed as follows:

Table 7 – Green Project Reserve Eligible Costs

Green Project Reserve	Component #1	Component #2	Component #3	Total
WRT Ion Exchange Skid	$65,775			$65,775
Turbine Pump Equipment Upgrades		$30,000		$30,000
Turbine Pump Auxiliary Upgrades (electrical, piping, etc.)		$15,000		$15,000
Booster Pump Upgrades		$31,000		$31,000
Booster Pump Auxiliary Upgrades (electrical, piping, etc.)		$5,000		$5,000
SCADA System Addition		$20,000		$20,000
Distribution System Improvements			$400,000	$400,000
Grand Total	**$65,775**	**$101,000**	**$400,000**	**$566,775**

5325 South Valentia Way ***ph.*** *303.477.5915* *info@aquaworksdbo.com*
Greenwood Village, CO 80111 ***fax*** *303.300.3451* *www.aquaworksdbo.com*

AquaWorks DBO INC
DESIGN BUILD OPERATE

Mr. Scott Garncarz May 10, 2011
Water Quality Control Division
Colorado Department of Public Health and Environment
4300 Cherry Creek Drive South
Denver, CO 80246-1530

RE: Mountain Water & Sanitation District
Response to Green Project Reserve Comments

Dear Mr. Garncarz:

I am writing in response to an email sent to AquaWorks DBO on May 6, 2011. In it, you requested further clarifications from the Mountain Water & Sanitation District on the Green Project Reserve Statement memorandum from AquaWorks DBO dated March 4, 2011.

The following are responses to your items. I have summarized your comments in bold and then responded to each of them.

Pumping System Information: Estimate percentage of power savings gained by replacing buried valve vault pumps:

Variable frequency drives (VFD) will be installed on both pumps in the buried valve vault. Running the pumps off of a VFD provides considerable savings over throttling the pumps. Energy savings can be estimated by comparing this project to established guidance. It is possible to increase energy savings by up to 30% (http://www.maintenanceresources.com/referencelibrary/acdrives/vfd.htm) based upon several factors. Not all factors will be realized with this project. The project will therefore only take credit for half (15%) of the maximum possible decrease in power savings of 30%.

Distribution Line Replacement: Estimate the linear feet of the entire distribution system and the percentage that will be replaced. Estimate number of valves, hydrants, and flow meters that will be replaced. Identify the type of pipe that will be used.

The district estimates that there are 58,000 linear feet of distribution main consisting primarily of 6” ductile iron pipe. An engineer’s opinion of probable costs states that approximately 1,210 feet will be replaced with this project - equivalent to approximately 2% of the total system. It is worth

noting that the worst 2% of the distribution system, which causes a disproportionate amount of water loss, will be replaced. The existing 6” ductile iron pipe will be replaced with 6” C900 PVC. A map from 1973 showing both existing and proposed water distribution system infrastructure is attached to this letter to show the general layout of the distribution system.

The district estimates that five pressure reducing valves, two fire hydrants, four isolation valves, and two flow meters will be replaced with this project.

I hope the responses adequately address your concerns. Please feel free to contact me at (303) 477-5915 if you have any questions.

Sincerely,

AQUAWORKS DBO, INC.

Adam Sommers, P.E., AICP

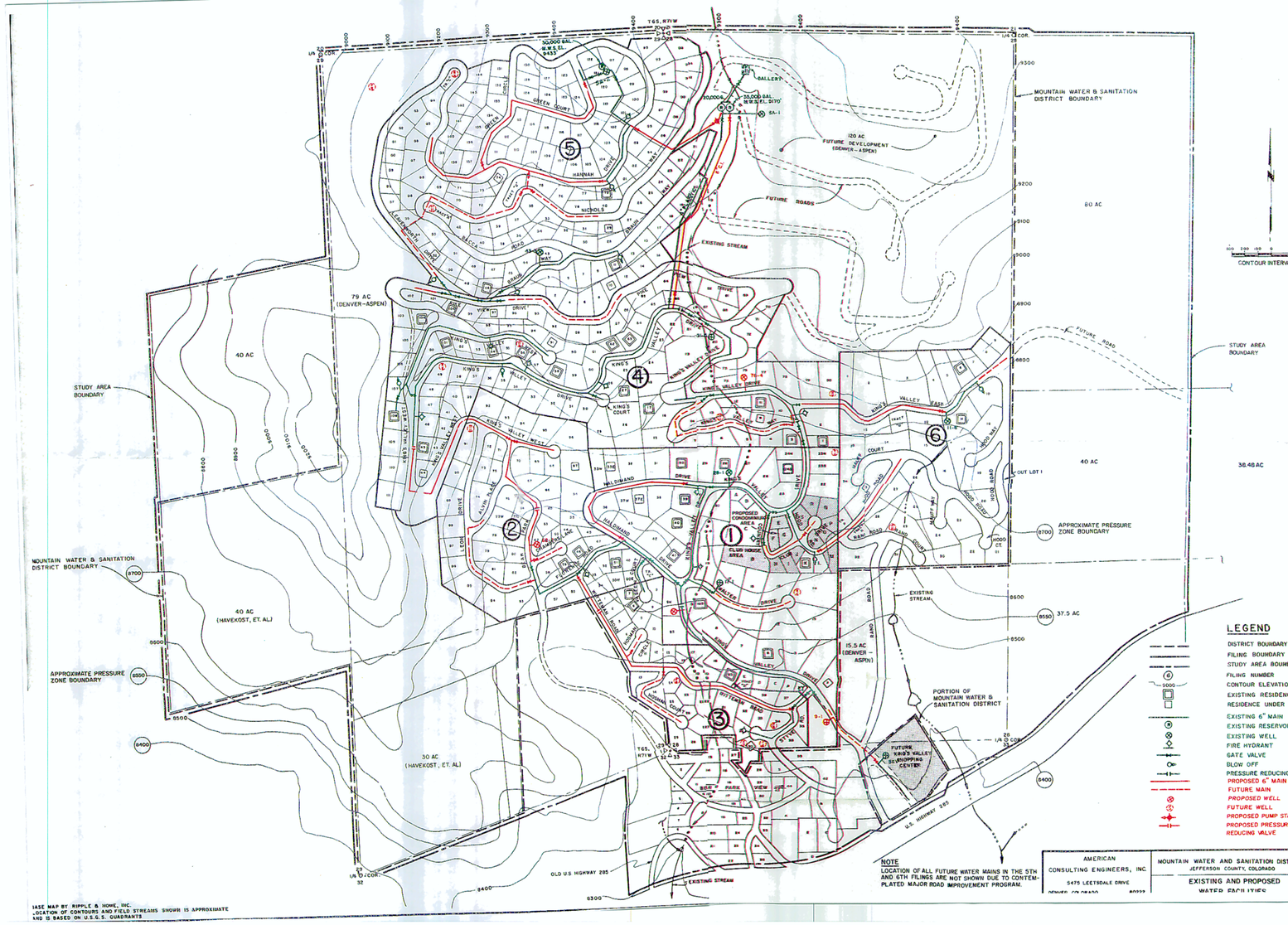
Attachments

cc. Ms. Theresa A. Miers, Mountain Water & Sanitation District (with attachments)

Engineer's Opinion of Probable Construction Costs

Client: **Mountain Water and Sanitation District**
Project: **Distribution System Improvements**
Date: **5/3/2011**

Number:	Item:	Quantity:	Unit Cost:	Item Cost:
1	**Replacement of Water Distribution Line**			
1.A	Replacement of 6" potable water distribution line	1,210	$ 230	$ 278,300
	Includes, mobilization, excavation, bedding materials, pipe & fittings, and compaction.			
2	**Replacement of Valves & Fittings**			
2.A	Replacement of Pressure Reducing Valves	5	$ 15,000	$ 75,000
2.B	Replacement of Miscellaneous Valves, Hydrants, and Appurtenances (allowance)	1	$ 10,000	$ 10,000
	Subtotal:			$ 363,300
	Overhead & Profit:	7%		$ 25,431
	Contingency:			$ 10,000
	Leak Detection Analysis			$ 5,000
	Engineering Evaluation & Construction Engineering:			$ 10,000
	Grand Total:			$ 401,731
Note:	*Opinion of probable costs is based upon a water distribution upgrade project undertaken by Mountain Water & Sanitation*			
	in 2010. The district was able to replace 1,528 lf of 6" water line for $350,000. The opinion is therefore based on a lf cost of			
	$230. Provisions for cost increases are included in the contingency and overhead & profit.			


MOUNTAIN WATER & SANITATION DISTRICT BOUNDARY
STUDY AREA BOUNDARY
APPROXIMATE PRESSURE ZONE BOUNDARY
PORTION OF MOUNTAIN WATER & SANITATION DISTRICT
FUTURE KING'S VALLEY SHOPPING CENTER
CLUB HOUSE AREA
PROPOSED CONDOMINIUM AREA
EXISTING STREAM
FUTURE ROADS
FUTURE DEVELOPMENT (DENVER-ASPEN)
79 AC (DENVER-ASPEN)
40 AC
40 AC (HAVEKOST, ET. AL.)
30 AC (HAVEKOST, ET. AL.)
15.5 AC (DENVER-ASPEN)
37.5 AC
80 AC
38.48 AC
OLD U.S. HIGHWAY 285
U.S. HIGHWAY 285
CONTOUR INTERVAL
LEGEND
DISTRICT BOUNDARY
FILING BOUNDARY
STUDY AREA BOUNDARY
FILING NUMBER
CONTOUR ELEVATION
EXISTING RESIDENCE
RESIDENCE UNDER
EXISTING 6" MAIN
EXISTING RESERVOIR
EXISTING WELL
FIRE HYDRANT
GATE VALVE
BLOW OFF
PRESSURE REDUCING
PROPOSED 6" MAIN
FUTURE MAIN
PROPOSED WELL
FUTURE WELL
PROPOSED PUMP ST
PROPOSED PRESSUR
REDUCING VALVE
NOTE
LOCATION OF ALL FUTURE WATER MAINS IN THE 5TH AND 6TH FILINGS ARE NOT SHOWN DUE TO CONTEMPLATED MAJOR ROAD IMPROVEMENT PROGRAM.
AMERICAN CONSULTING ENGINEERS, INC.
5475 LEETSDALE DRIVE
MOUNTAIN WATER AND SANITATION DIST
JEFFERSON COUNTY, COLORADO
EXISTING AND PROPOSED
WATER FACILITIES
BASE MAP BY RIPPLE & HOWE, INC.
LOCATION OF CONTOURS AND FIELD STREAMS SHOWN IS APPROXIMATE AND IS BASED ON U.S.G.S. QUADRANTS