Lidstone and Associates, Inc.
Engineering, Geology and Water Resource Consultants

December 31, 2013

Mr. Bret Icenogle, Engineering Review Section Manager
Mr. Robert Pohl, Enforcement Specialist
Water Quality Control Division
Colorado Department of Public Health and Environment
4300 Cherry Creek Drive South
Denver, Colorado 80246

Re: CDPHE Enforcement Order DC-110829-1
Meadow Mountain Water Supply Company
December 31, 2013 Preliminary Engineering Report

Dear Mr. Icenogle:

Per Colorado Department of Public Health and the Environment (CDPHE) Enforcement Order DC-110829-1 dated August 29, 2011, the treatment system utilized by the Meadow Mountain Water Supply Company (MMWSC) for its drinking water treatment process is required to be upgraded, improved, or better controlled or maintained to ensure compliance with the treatment technique limits for turbidity, specifically addressing the seasonal high turbidity levels experienced each spring.

Seasonal spring runoff inundates the facility with particles smaller in size than those which the existing facility can remove. These particles are smaller than 5 μm. While turbidity itself is not considered a health risk, it can harbor pathogens from both UV inactivation and chlorine disinfection. Therefore, the goal of the recommended alternative is to comply with all Primary Drinking Water Regulations, specifically turbidity regulations, thereby providing greater protection for MMWSC customers. The recommended treatment alternative consists of the current sedimentation basin (minor improvements recommended), a new Innovative Water Technologies ultrafiltration system, in-line chlorination, and improvements to the existing clearwell. The enclosed Preliminary Engineering Report contains the above scope of recommendations.

We appreciate the opportunity to work with you on this project. If you have questions or require additional information, please contact us.

Sincerely,
LIDSTONE AND ASSOCIATES, INC.

Kari Sholtes, EIT MSEE
Project Engineer

Ryan Duve, PE
Senior Engineer

KAS:rce

Enclosure
Sent via: Hand Delivery and Email

K:\OPEN\COMMW102\FINAL PER\Transmittal letter.docx

4025 Automation Way, Building E, Fort Collins, Colorado 80525-3448 (970) 223-4705 fax: (970) 223-4706 e-mail: water@lidstone.com

Meadow Mountain Water Supply Company

Preliminary Engineering Report

Prepared by:

Lidstone and Associates, Inc.
4025 Automation Way, Bldg. E
Fort Collins, CO 80525

December 2013

Table of Contents

Tables

Figures

Maps

Attachments

1. Executive Summary

The Meadow Mountain Water Supply Company (MMWSC) is currently under enforcement order for turbidity violations. The existing treatment facility consists of sedimentation, pre- and final filtration, UV inactivation, and chlorine disinfection. Seasonal spring runoff inundates the facility with particles smaller in size than those which the facility can remove, resulting in seasonal turbidity violations. While turbidity itself is not considered a health risk, it can harbor pathogens from both UV inactivation and chlorine disinfection. Therefore, the goal of the recommended alternative is to comply with all Primary Drinking Water Regulations, specifically turbidity regulations, thereby providing greater protection for MMWSC customers. The recommended treatment alternative consists of the current sedimentation basin (minor improvements recommended), a new Innovative Water Technologies ultrafiltration system, in-line chlorination, and improvements to the existing clearwell. The current sludge pond will require an expansion for the new backwashing regime.

2. Planning Conditions

2.1 Planning Area

Map 1 identifies all environmental features and components of the MMWSC treatment and distribution system. The project area is not within a FEMA 100-year floodplain according to both the FEMA FIRM PANEL No. 08013C0200J and Boulder County mapping website. The National Wetlands Inventory - Wetlands Web Services identifies two designated wetlands within the project area as can be seen on **Map 1**.

2.2 Local and Regional Government Coordination

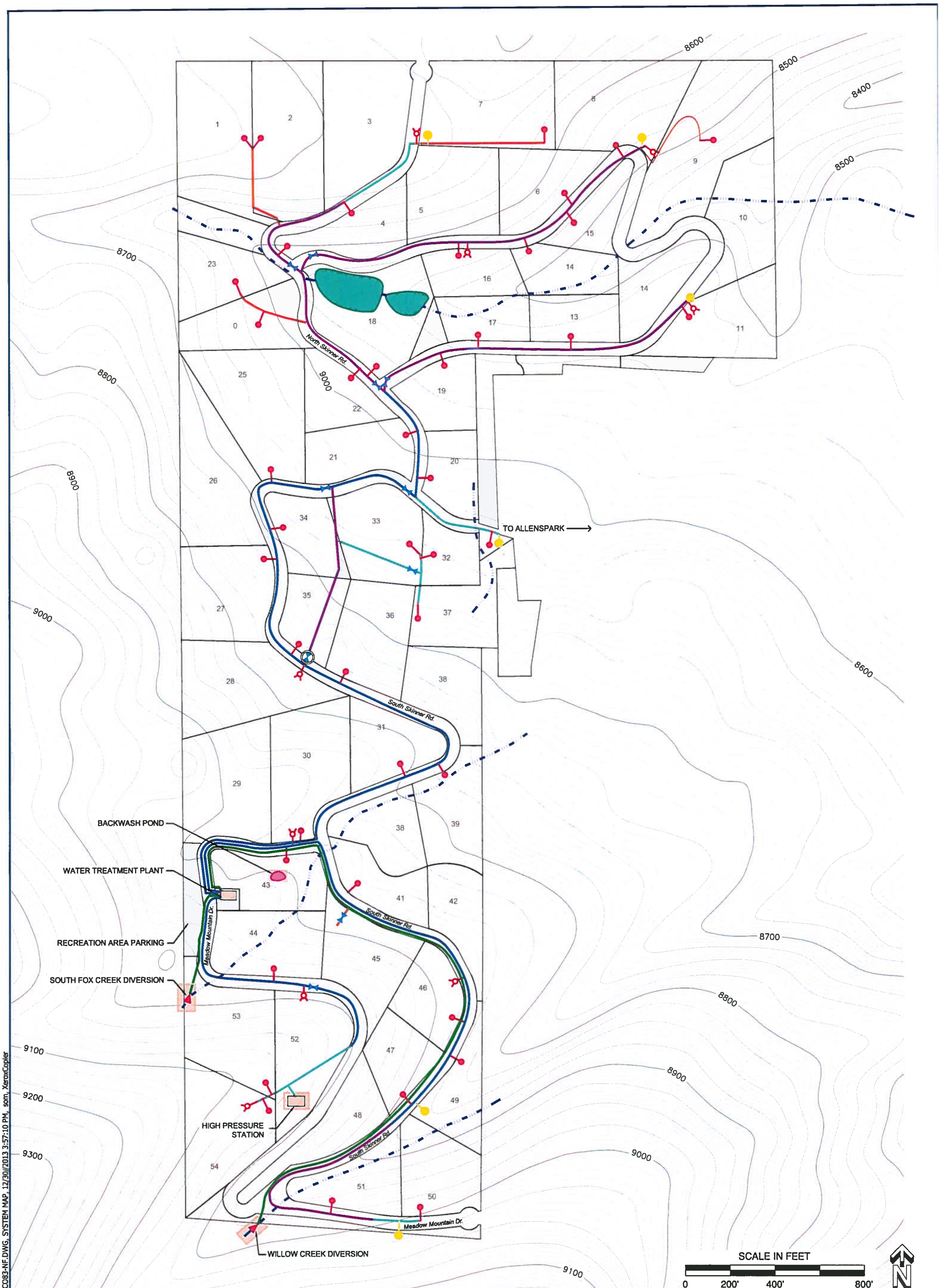
The project area is not within or near an urban growth boundary. Water supply and rights are sufficient. Absolute water rights are 1.35 cfs; 0.4 cfs from S. Fox Creek aka Wildwood Ditch #3 and 0.95 cfs from Willow Creek aka Wildwood Ditch #4 (see **Attachment 1**). The water system is operating within its adjudicated permits. Water flow in both streams is of sufficient quantity throughout the year, regardless of seasonality and drought conditions.

2.3 Growth Areas and Population Trends

Currently, there are 41 developed lots in the service area, with an average of 2.4 residents per household (Boulder County average). This translates to a population of 100 residents in the service area (however, 80 residents is a more reasonable estimate based on known inhabitants). There are 13 additional lots which could be developed within the Triple Creek Ranch Subdivision; however, two of those lots are currently owned by an adjacent owner who has already built on one lot, so the likelihood of development on those two lots in the foreseeable future is low. For planning purposes, 11 additional lots will be considered. Lots cannot be further subdivided. Using the Boulder County estimate, if all 52 lots were developed with an average of 2.4 residents per household, then population could grow to 125 residents. However, this population projection seems unreasonable for this area of second home owners. According to the Colorado State Demography office, unincorporated areas of Boulder County have experienced a -4.5% growth rate from 2000 to 2010. Boulder County has experienced a 7% growth rate over the same decade, while Colorado experienced a 1.5% growth rate. Therefore, a factor of 20% growth will be applied to both the population (80 residents) and residential demand.

2.4 Drinking Water Supply

MMWSC has analyzed the production water data and the consumer usage data for the past 5 and 10 years, respectively. The production data consists of monthly readings of the totalized volume of



MEADOW MOUNTAIN WATER SUPPLY COMPANY

PROJECT NUMBER: COMMW102		ENGINEER:	KAS
		CHECKED:	KAS
DRAWN DATE: 11/14/13		APPROVED:	KAS

FILE: COMMW102-5FT CONT-BASE CO83-NF.DWG

SYSTEM MAP

MAP 1

REVISIONS:

Lidstone and Associates, Inc.
Engineering, Geology, & Water Resource Consulting

LEGEND

CRITICAL INFRASTRUCTURE

VALVE

BLEEDER

CREEK

MANHOLE

WETLANDS

SERVICE LINE

HYDRANT

INTAKE

PIPE LINES

4.0 IN.

2.5 IN.

2.0 IN.

1.5 IN.

0.75 IN.

L:\COMMW102\ACAD\BASE\COMMW102-5FT CONT-BASE CO83-NF.DWG, SYSTEM MAP, 12/30/2013 3:57:10 PM, som, XeroxCopier water diverted from the two source water streams, South Fox Creek and Willow Creek. The quantity of treated water is not recorded. Production data does not include any disaggregated data which could inform peak or average hourly demand calculations.

The consumer water usage data includes the water meter readings of functional meters for individual households (functional meters account for approximately 80% of households) and the water bled from functional meters for dead-end lines. Bleeding water from system dead-ends prevents pipe freezing during the winter months. Meter data for three of the five functional bleed lines are collected. In addition to the winter bleed average of 4.7 gallons per minute (gpm) per line (January, February, and March of 2009-2013), these lines are bled at an average of 0.7 gpm over the summer months of July, August, and September (2009-2013). The bleeding of these lines accounts for the majority of the water demand in the system.

Intake pipes are also bled during the winter. This water is recorded as having been diverted, but there is no further accounting of this water as it is wasted over the top of the sedimentation basin and discharged to the onsite pond. It is believed that this water accounts for a large amount of unaccounted water each winter.

The current residential demand is approximately 3,000 to 6,000 gallons per day (gpd) (based on available meter records extrapolated to homes with broken meters, not including bleed lines and unaccounted water). Applying a 20% growth, as discussed in Section 2.3 to the peak average daily demand yields a future peak average daily demand of 7,200 gallons. This results in an average hourly demand of 300 gallons and an average demand of 5 gpm. Under the most conservative conditions during the winter, a maximum of 30,000 gpd (20.8 gpm) are wasted through bleed lines. Also during the winter, unaccounted treated water appears to peak at around 5,000 gpd (3.5 gpm). In determining peak hourly demands for the system, bleed water and unaccounted water do not require a peaking factor, but will be considered at the peak levels. Therefore, hourly peaking factors will be applied only to the average residential demand at 20% population growth. With an hourly peaking factor of 5.3 (as determined by discussions with CDPHE, based on McGraw-Hill General Water Supply Design standards), the peak residential demand is 26.5 gpm. Applying the winter bleeding and treated, unaccounted water rate total of 24.3 gpm, a total peak demand of 50.8 gpm can be used as the design criteria (see **Table 1** and **Figure 1** below). This would translate to a daily usage of 72,000 gpd, which represent a 60% increase over the highest average daily usage of the current system.

Table 1 Water Consumption

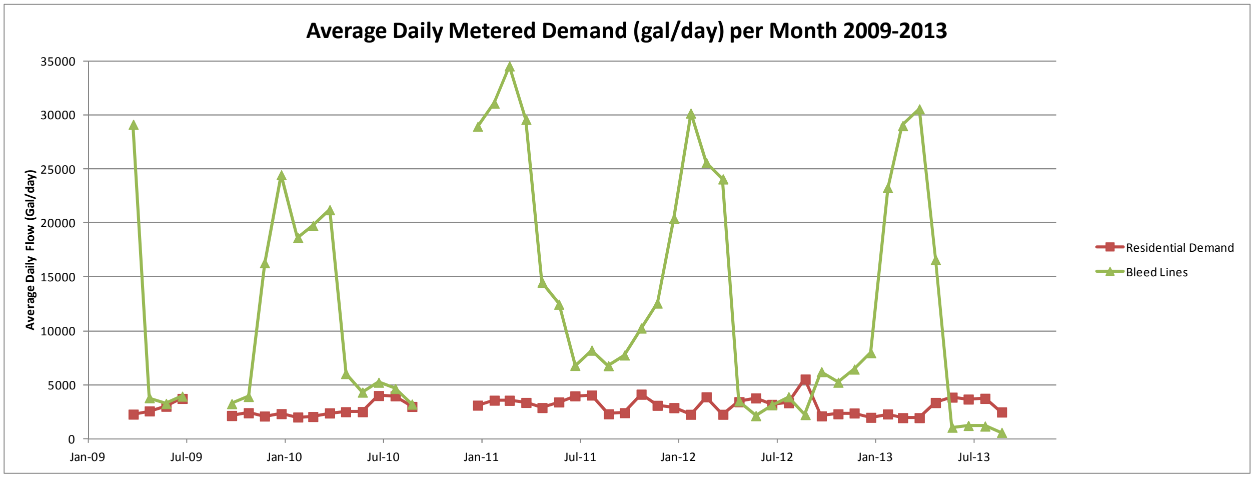
Water Use Category	Average Flow 1000 gpd	Peak Flow 1000 gpd	Peak flow gpm
Residential (future 20% growth)	7.2	38.2	26.5
Bleed lines	10.8	30	20.8
Unaccounted treated water	3	5	3.5
		Total	**50.8**

Yearly, during the summer and fall, unaccounted water drops to below 10% of the total water diverted or conveyed to the treatment facility. From 2009 to 2013, unaccounted water fluctuates from less than 5% (during summer) to 56% (during winter bleed conditions) of the water conveyed to the treatment facility.

Future plans for water conservation may include looping of distribution pipes to eliminate bleeder usage in winter months, potentially replacing pipes in the future to meet CDPHE Potable Water

Criteria for distribution systems and prevent freezing, and/or the insulation of pipes or portions of the distribution system to prevent freezing.

Figure 1 Average Daily Residential and Bleed Line Demand



The primary water quality parameter of concern is turbidity. While MMWSC is currently under CDPHE enforcement order for turbidity violations during high runoff events, they are fortunate to have excellent water quality from pristine watersheds.

3. Description of Existing Facilities

3.1 Service Area Features

The locations of existing drinking water treatment facility, water sources, major distribution lines, and storage facilities are shown on **Map 1**.

3.2 Facilities Layout and Description

Watersheds

MMWSC is located in Allenspark, Colorado and lies within the North St. Vrain Watershed. Two creeks feed the treatment facility: South Fox Creek and Willow Creek. South Fox Creek Watershed is fed entirely by Rocky Mountain National Park (RMNP); the MMWSC intake is located approximately 25 feet outside the park boundary. The South Fox Creek Watershed consists of evergreen forest in the lower watershed and meadow and rock outcroppings in the upper watershed, extending to the summit of Meadow Mountain. Willow Creek Watershed is fed mainly by drainages originating from RMNP, though a small fraction of the watershed consists of US Forest Service land. The Willow Creek Watershed consists of less dense evergreen forest in the lower watershed and steeper hill slopes. The upper watershed also extends to the summit of Meadow Mountain and consists of subalpine and alpine meadow and rock outcroppings. There are no anthropomorphic activities, roads, or residences in either watershed upstream of the intakes.

There is no record of mining, fires, or logging in either watershed; records extend to approximately 1915. According to the Rocky Mountain National Park Geologic Resource Evaluation Report, the predominant geology of each watershed is biotite gneiss, schist, and granite; lodgepole, limber, and ponderosa pines are the predominant overstory. Many large and small mammals inhabit the watersheds.

According to the 2004 CDPHE Source Water Assessment Report, the total susceptibility rating for the combined watershed was "moderately low." The watershed was characterized by "moderate susceptibility" to dispersed contamination from deciduous forest and "high susceptibility" to contamination from evergreen forest. There was no perceived risk from residential uses, septic systems, roads/transportation, resource extraction, agriculture, silviculture, or historical uses such as abandoned mines. The Physical Setting Vulnerability Rating for one water source (likely South Fox Creek) was "moderate" while the other water source (likely Willow Creek) was considered "moderately high." This is likely due to the close proximity of the intake structures to roads and the lack of restricted access.

Intakes

The areas around each intake are characterized by evergreen forests and underbrush. The steep hill slopes contain vegetation, fallen debris, and leaf litter, which protect against erosion and limit sediment transport. Each intake consists of a concrete diversion dam, which creates a small diversion pool. The water from the diversion pool percolates through approximately 2 to 3 feet of gravel substrate to reach the polyvinyl chloride (PVC) well screen "infiltration gallery". The gravel substrate consists of 1 to 1.5 feet of <0.25-inch gravel below 1 to 1.5 feet of 1.5-inch gravel. Each infiltration gallery, including the gravel media, was replaced in fall 2010. At that time, access and backwashing pipes at the diversion were also installed to ensure proper maintenance. Prior to replacement, the intakes had clogged due to sediment accumulation over the approximately 10 years since the previous cleaning. MMWSC is implementing a new maintenance schedule for infiltration gallery cleaning and backwashing. Conveyance pipes from the infiltration galleries to the water treatment facility are all PVC. Water is gravity-fed, and there are no air- or pressure-relief valves along the intake conveyance. A flush valve exists at the low point along the Willow Creek intake pipeline.

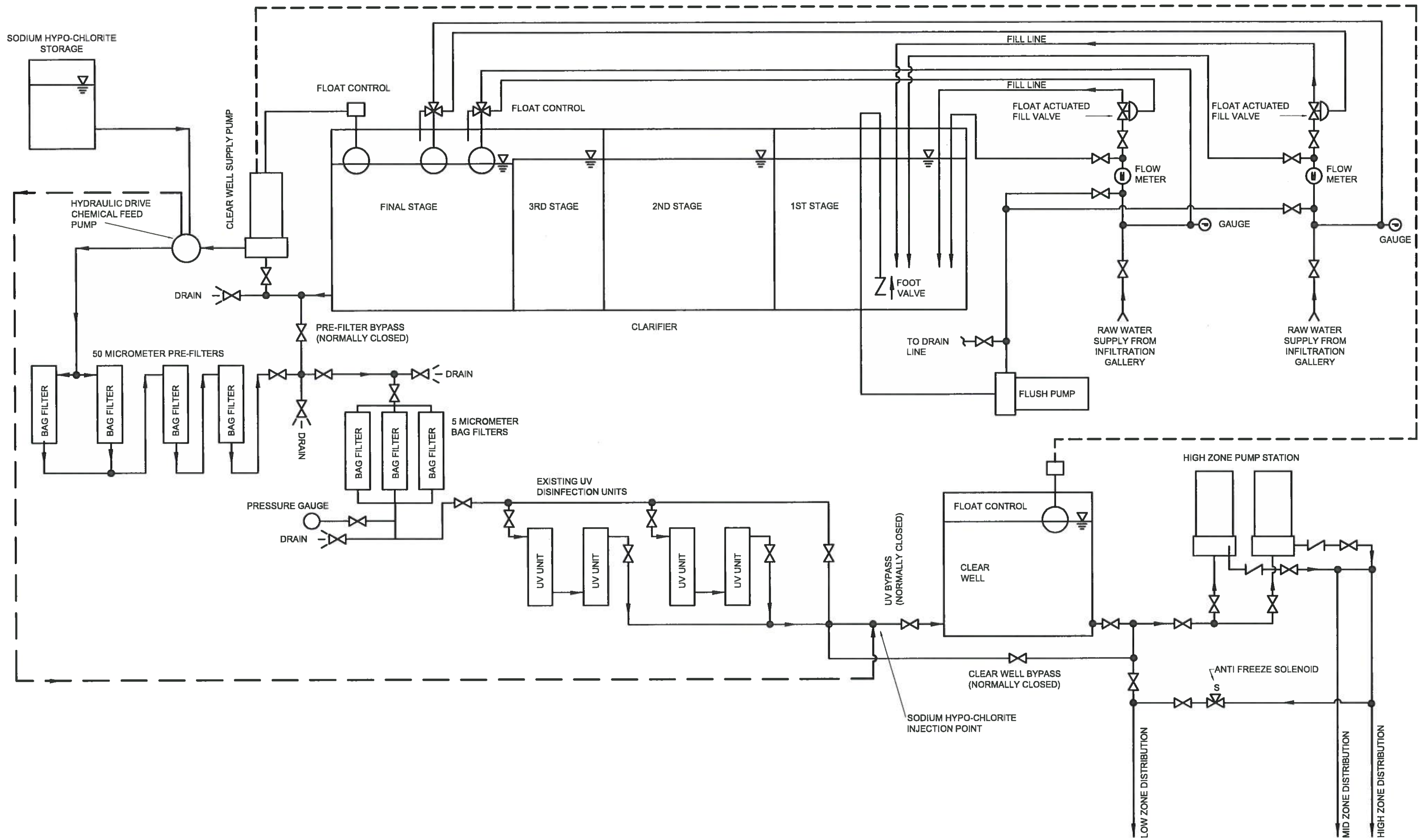
Water Treatment

The Class D MMWSC treatment facility is in operation for approximately four to twenty hours a day, seven days a week, depending on the season and water demand. A certified Class C operator visits the facility daily to monitor and record water quality, check processes and equipment, and operate and maintain the infrastructure. An automated, phone-based system allows the operator to check alarms remotely. The facility is on the electrical grid with an onsite automated, propane-powered generator that is used for backup. Propane is also used to heat the treatment facility during the winter.

The facility treats an average of 25 gpm during the summer and 35 gpm during the winter. During the winter, "bleed lines" help prevent pipe freezing/bursts and account for additional water use. The treatment facility consists of the following treatment processes: sedimentation, bag filtration, UV inactivation, and sodium hypochlorite injection (see **Figure 2** for existing schematic). The flow rate through the system is dictated by clarifier influent valves.

Sedimentation Basin

The metal, dual-chamber, horizontal-flow sedimentation basin structure has four distinct compartments: the influent chamber, two settling chambers, and an effluent chamber. Influent and effluent pipes use submerged orifices. The influent zone has been designed to decrease the velocity of influent water and distribute it evenly throughout the influent zone. The settling zone consists of two settling chambers with a maximum surface overflow rate of 0.43 gpm/ft^2 (see **Table 2** for all calculations) and depth of 56 inches or 1.4 meters. Settled particles collect at the bottom of both



\\sbserver\project\COMMW102\ACAD\COMMW102-Filter and Process PID_UPDATE.dwg, WATER PROCESS DIAGRAM BASE, 12/30/2013 2:46:09 PM, som, Bluebeam PDF10 Printer HighRes.pc3

LEGEND/NOTES

Lidstone and Associates, Inc.
Engineering Geology & Water Resource Consulting

MEADOW MOUNTAIN WATER SUPPLY

PROJECT NUMBER: COMMW102	ENGINEER: KAS
DRAWN DATE: 12/30/13	CHECKED: KAS/CDL
	APPROVED: CDL
ACAD FILE: COMMW102-FILTER AND PROCESS PID UPDATE.DWG	

WATER TREATMENT PROCESS DIAGRAM

REVISIONS:

FIGURE 2

settling chambers and can be removed with a manually controlled vacuum. Clarified water discharges with a free fall from the settling zone over an 8-foot-long weir at a maximum rate of 4.4 gpm/ft. The velocity through the sedimentation basin is maintained below 0.15 ft/min. This sedimentation design can theoretically settle particles larger than 25 µm (see **Table 3** for Stokes' Law analysis). Particles smaller than 25 µm will advance to the filters. CDPHE sedimentation basin standards are intended for conventional treatment when coagulation and flocculation have occurred; therefore, the application of CDPHE standards may be limited under MMWSC operating conditions.

Table 2 Settling Calculations

Surface area of sedimentation basin	81.0 ft^2		
Volume of sedimentation basin	348.0 ft^3		
	MMWSC	**CDPHE Regulatory Limit**	**Units**
Minimum flow rate	25		gpm
Maximum flow rate	35	58	gpm
Minimum detention time	74	240 with exceptions	Min
Maximum detention time	104		Min
Minimum surface overflow rate	0.31	0.7	gpm/ft^2
Maximum surface overflow rate	0.43	0.7	gpm/ft^2
Velocity	<0.15	<0.5	ft/min
Rate of flow over outlet weirs	4.4		gpm/ft weir

Table 3 Stokes' Law Analysis

Stokes Law	$v_t = \frac{g(\rho_p-\rho_f)*d^2}{18*\mu}$		**Settling Distance at Maximum Detention Time**	**Settling Distance at Minimum Detention Time**	**Units**
v_t = terminal settling velocity of minimum-sized settleable particle (25 µm)	1.22	m/h	2.11	1.51	m
Where					
g = gravitational constant	9.81	m/sec^2			
p_p = density of particle	2765	kg/m^3	Average particle density for suspended soils		
p_f = density of fluid	999.9	kg/m^3			
d = diameter of sphere min settleable	25 µm	m			
µ = viscosity of liquid	1.78E-03	kg/m-s	at 32 deg F		

The lifespan of the sedimentation tank can be extended indefinitely with proper maintenance including painting/coating.

Filtration System

The pre-filtration system consists of two 3M cloth bag filters in parallel followed by two 3M cloth bag filters in series. The initial 50 µm pore size equivalency of these cloth filter bags has likely enlarged due to repeated washing and reuse. The final filter system consists of three 5 µm HPM99-CCX-2-SR Final Filter Bags and vessels, including the AQC-1 Compression Devices, in parallel. In May 2009, CDPHE granted MMWSC temporary approval for the use of the three existing Strainrite vessels with the Strainrite HPM99-CCX-2-SR Final Filter Bag and AQC-1 Compression Device.

Particles smaller than 5 μm can pass through the filters. Small and ultrafine particles can be of concern in historically glacier-influenced systems and have been shown to exist in this system (see Section 5.1 for particle size distribution analysis).

UV Inactivation System

The Ultra Dynamics Ultra-Violet municipal water purification system (model no. 6000 SF) was installed in 1986. The design UV dose is 30 mJ/cm^2 at a maximum flow rate of 120 gpm. The germicidal wavelength is 253.7 nm; maximum working pressure is 100 pounds per square inch (psi). Four UV units are grouped in two sets in series. Each set consists of two units in series. Each unit houses four bulbs. Each bulb has a 7,500-hour service life. Maintenance plans call for quartz sleeves to be replaced when broken. One UV intensity meter is available for the system; it has an analog display and remote alarm capabilities.

While the design UV dose is 30 mJ/cm^2 at a maximum flow rate of 120 gpm, the actual flow rate varies between 25 and 35 gpm. Because the actual flow rate is lower than the design flow rate, the actual UV dose is higher than the design dose. Below are the two equations which govern UV Dose:

Flow Rate = Area * Velocity = (Area * distance) / time
UV Dose = Intensity * time
Therefore: UV Dose = (Intensity * Area * distance) / Flow rate

With a set reactor volume and UV intensity, the flow rate is inversely proportional to the UV dose. Therefore, under proper maintenance conditions, UV doses of 100-145 mJ/cm^2 (corresponding to flow rates of 25 and 35 gpm) are experienced during summer, fall, and winter when only one set of units (two units, eight bulbs) is in use. In the spring runoff event when both sets of units (four units, sixteen bulbs) are in use, UV doses of 200-290 mJ/cm^2 are experienced. Particles in the water can absorb and scatter UV light; therefore turbidity may reduce these values. Conservatively, a UV dose between 60-175 mJ/cm^2 is ultimately applied to the water with the combined aging and fouling factor (0.6 for mechanical sleeve wiping system and possible lower end of lamp life output). However, maintenance plans call for each bulb to be run for only 5,400 hours of the 7,500 hour lifespan. The lifespan of quartz sleeve are expected to be approximately 5 years. The ballast life is expected to be approximately 15 years and likely need to be replaced.

Chlorination

Sodium hypochlorite solution is injected into the clarified, filtered, and UV-inactivated water by a pacer pump. Two parts of 8.25 percent sodium hypochlorite are added to three parts water in a continually mixed 25-gallon tank to make a solution of approximately 3.3 percent sodium hypochlorite. This solution is fed by the pacer pump into the water at a rate controlled by the operator. The operator adjusts the chlorine feed rate if needed immediately after testing for the chlorine residual. The chlorine pacer pump is monitored daily and replaced yearly with a newly calibrated pacer pump. Contact time varies between 140 and 240 minutes, depending on consumption and production. The log inactivation for viruses is maintained above 4.8 with a chlorine residual of 1.2 mg/L, baffling factor of 0.1, and peak flow of 37 gpm (using EPA CT calculator). The peak flow was determined by a peaking factor of 5.3 (McGraw-Hill General Water Supply Design) applied to the average flow (10,000 gpd or 7 gpm). MMWSC has a strong record of chlorine residual monitoring and compliance.

Water Storage, Distribution, and Use

Chlorinated water is stored in the 6,000-gallon below ground concrete storage tank located at the treatment facility prior to distribution. The storage tank doubles as the clear well. The distribution system consists of metal pipe and various levels of pumping control in the summer and winter (some houses are not occupied in the winter). Approximately 40 households are supplied during the summer, and demand is always met.

Metal pipes in the distribution system are buried to the depth of bedrock, which possibly varies between 3 to 8 feet (no as-builts exist for the system). Therefore, pipe freezing is a seasonal risk mitigated by maintaining high flows through the system via pumps in one service area and bleed lines at the dead ends throughout the rest of the system. There are no looped pipes. Extent of pipe corrosion is unknown at this point as no records have been kept of previous distribution pipe replacement/repair. The age of the pipes is assumed to be between 35 to 45 years. While the expected age of iron pipes can range from 60 to 100 years, corrosion can significantly reduce this life time.

The visible infrastructure of the storage tank/clear well appears to be in good condition. Concrete walls appear to be structurally sound from the inside with no visible root intrusion. The tank has not been drained, cleaned, or inspected in a number of years and no as-builts or other records exist regarding the design or construction. However, the tank will be emptied this winter or spring, cleaned, and baffling will be installed to improve contact time (please see Section 5.1 regarding baffling design). The age of this tank is assumed to be between 35 to 45 years. The design life of concrete water storage tanks can be 50 to 80 years. The wood components (wooden doors, etc.) of the storage tank are degrading and need to be removed or replaced. A new distribution operator was recently hired and is in the process of establishing proper operations and maintenance schedules for the distribution system.

Adequacy of Existing Central Facilities

Water supply is currently sufficient. Absolute water rights are 1.35 cfs (0.4 cfs from S. Fox Creek and 0.95 cfs from Willow Creek). The water system is operating within its adjudication. Water flow in both streams is of sufficient quantity throughout the year, regardless of seasonality and drought conditions. No stream gauges exist above or near the intakes, so actual flow data are not available. Water storage has not been a concern because the production rate (25-35 gpm, seasonally) of water is typically higher than the consumption rate (varies between 4-24 gpm, seasonally). Currently, there are 41 households which are connected to the MMWSC system. There are 13 additional lots which could be developed; however, two of those lots are currently owned by an adjacent owner who has already built on one lot, so the likelihood of development on those two lots is low. For planning purposes, a 20% increase in population and residential demand will be considered.

The 6,000-gallon underground storage tank is approximately equivalent to the average daily residential demand when bleeding is not considered. Source and treatment facilities have sufficient capacity with standby power to supplement peak demands of the system. The storage tank has an alarm at 3,000 gallons which alerts operator to low storage conditions and possible conditions of inadequate chlorine CT compliance. However, these conditions are rare, and MMWSC has a strong record of chlorine residual monitoring and compliance.

By most CDPHE design criteria for potable water systems, the distribution system design is inadequate. The maximum pipe diameter throughout the system is 2.5 inches and the system has several dead ends. Pipes are currently placed at the elevation of bedrock, which may vary between 3 and 8 feet. Seasonal freeze risk is reduced by continual bleeding of finished water at dead ends, which results in approximately four times the water usage in the winter than in the summer. Flushing hydrants appear capable of providing flows at a minimum velocity of 2.5 feet per second. Meeting fire demand is not required as part of system design. Pressure throughout the distribution system is generally higher than the minimum requirement of 35 psi. However, the pressure on the intake line from Willow Creek may fall below or approach 35 psi, but this section of the line feeds only the facility and is not part of the distribution system. Static pressures vary between 80 and 170 psi at the distal ends of the distribution system. The tap closest to the treatment facility experiences a static pressure of approximately 35 psi (see **Table 4**). In the low pressure zone and at the low point in the medium pressure zone, there is likely the need for pressure reducing valves under static conditions as residential pressure should be maintained below 90 psi. Approximately ten valves are located throughout the 3.5 miles of distribution mains. No valves have been exercised in a decade or more, and their ability to operate is questionable. All valves are buried under the road, and access is poor.

As discussed in Section 2.4, during the summer and fall, unaccounted water drops to below 10% of the total water diverted or conveyed to the treatment facility. From 2009 to 2013, unaccounted water fluctuates from less than 5% to 56% of the water conveyed to the treatment facility. The high unaccounted water percentages are assumed to occur when water is conveyed to the treatment facility at approximately 50 gpm in order to ensure that the intake conveyance pipes do not freeze then wasted prior to treatment. Because the facility is operated at a maximum of 35 gpm, 15 gpm of this intake water may be wasted prior to treatment. However, these flow data cannot be verified.

3.3 Financial Status and Users

A thorough analysis has been made of the expenses of the company over the past 10 years, and the average annual costs of operating the plant are as follows (see **Attachment 2** for cost summary):

- Operating Costs $13,900
- Operator Costs $6,100
- Capital Expenditures $12,300
- Total Yearly O&M $32,200

Operating costs include the cost of filters, laundry of pre-filters, chlorine, water testing, heating and electricity, communications, licenses and fees, insurance, water augmentation, trash disposal, and winter maintenance such as snow plowing and heating the distribution lines when pipes freeze. Maintenance costs include replacement of parts, materials, and labor. However, prior to 2013, a maintenance schedule has not been utilized for maintenance of sedimentation basin or clearwell, UV components, pumps, distribution or intake components, etc. In 2013, MMWSC developed an operations and maintenance plan, and its implementation has begun. MMWSC does not have any existing debt, capital improvement plans, or required reserve accounts.

Water system usage is residential with the exception of one residence which runs a vacation cabin management company. The usage at this location is significantly more than other lots in the subdivision by up to a factor of 10, depending on seasonality. For the year October 2012 through September 2013, the consumer average usage for the developed lots in the sub-division is 68,000 gallons per month (2,300 gpd); however, the average bleed line usage for MMWSC is 232,500 gallons per month (7,750 gpd). The commercial usage of water represents approximately 11% of the average monthly water usage. There are no industrial uses of MMWSC water (see **Attachment 3** for 2012-2013 water usage summary).

Table 4 Pressure Analysis

1554	lb/ft^2	atmospheric pressure
62.4	lb/ft^3	gamma
32.2	ft/sec^2	

Service Line	Location in System	Q cfs	D ft	C Hazen Williams	v ft/sec	L ft	z ft	p/ gamma ft	v^2/2g (negligable) ft	hf Hazen Williams ft	Estimated minor losses (25% of hf) ft	Pressure psi
Intake 1	S. Fox Creek Intake			PVC			8993	24.9	0.000			
	Treatment Facility	0.039	0.33	130	0.447	631	8912	105.7	0.003	0.2	0.05	45.8
Intake 2	Willow Creek Intake			PVC			8965	24.9	0.000			
	Treatment Facility	0.039	0.33	130	0.447	3035	8911	77.8	0.003	0.9	0.23	33.7
Low Pressure	Treatment Facility			old iron			8910	24.9	0.000			
	Closest Tap	0.022	0.21	65	0.654	500	8845	87.5	0.007	1.9	0.47	37.9
	Distal End	0.022	0.21	65	0.654	6693	8517	383.8	0.007	25.4	6.34	166.3
Medium Pressure	Top of Highline System			old iron			9086	184.6	0.007			
	Distal End of Medium Pressure System	0.022	0.21	65	0.654	5680	9010	233.7	0.007	21.5	5.38	101.3
High Pressure	Highline pumps are set to maintain pressure of between 80-160 psi at the top of the pipelines. The max working pressure at the pressure tanks is 125 psi											

In low pressure zone, there is the likely need for pressure reducing valves under static conditions.

At the low point in medium pressure zone, there is the likely need for pressure reducing valves.

Residential pressure should ideally be maintained below 90 psi.

The MMWSC rate structure consists of a base rate for 10,000 gallons per month of $105 per quarter for undeveloped lots (13) and $210 per quarter for developed lots (41). The fee for additional usage is $0.50/100 gallons. This results in an average annual income of approximately $39,000. Because average annual costs are approximately $32,200, the amount saved per year is approximately $6,800. With that said, system maintenance costs have been minimal over the past 10 years, and these costs (costs to operate the system) are expected to increase with improved operations and maintenance.

3.4 Technical, Managerial, and Financial Capacity

MMWSC is the active recipient of the Small System Training and Technical Assistance (SSTTA) grant, and as a condition of the grant, MMWSC will complete the entire Technical, Managerial, and Financial (TMF) assessment during the first quarter of 2014. However, a short summary of mandatory and recommended facility improvements criteria are detailed below (Section II C of the TMF Capacity Worksheet):

- The goal of this PER is to bring MMWSC into compliance with all drinking water standards, and where applicable, into compliance with the new State design criteria.
- Water rights certification exists, and the facility is operating within its adjudication.
- Operator is currently certified to a Class C while the facility is a Class D. The recommended facility will either be a Class C or Class B; if necessary, improved certification will be sought or a new operator will be hired. New responsibilities will be delineated.
- System ownership, management, operation, and organizational chart for the improved facility will be established depending on the operator classification and responsibilities as discussed above.
- System and personnel performance monitoring will be improved and established.
- Record keeping is in the process of being improved and formalized.
- Access to records for appropriate personnel will be formalized.
- Cross connection control program has been submitted and will be updated based on system improvements.
- Financing and accounting will ensure adequate revenues for O&M and system improvements, in terms of both cash-flow and loans or additional funding.
- A reserve account for emergencies and planned improvements will be established.

4. Project Purpose and Need

4.1 Health and Compliance

MMWSC is required to ensure the safety of the water treated and supplied to consumers and to ensure compliance to CDPHE Drinking Water regulations. MMWSC is currently under enforcement order for violation of treatment technique limits for turbidity which typically occur annually during the spring run-off with most violations occurring in the months of April and May. Sometimes violations have extended into June if high, spring run-off flows persist. The water system has a strong record of compliance with Primary and Secondary Drinking Water Regulations. The protected, pristine watershed is not anticipated to experience additional risks in the foreseeable future.

4.2 Security

MMWSC is located near Allenspark, Colorado bordering both RMNP and the US Forest Service lands. The water supply is defined as surface water supply and the sources flow directly from the RMNP and the Roosevelt National Forest. The two water sources were categorized as Moderately Low Risk assessment in the Colorado Source Water Assessment (SWAP) Report. The SWAP Report indicates the potential risks of the water sources to a variety of discrete and dispersed contaminant source types. It was determined that the two MMWSC sources are not susceptible to any discrete contaminant sources such as but not limited to hazardous waste, industrial, or abandoned mine sites. MMWSC source water supply has been identified as at moderate risk of contamination from deciduous forests and at high risk of contamination from evergreen forest contaminants. Both sources are within walking distance of local roads in the area; the area is remote and there are no defined trails near the sources. Neither of the sources is protected by fencing. The water plant is locked and only the water plant operator and applicable board members have keys for access.

4.3 Operation and Maintenance

Current and historic operational constraints can be summarized by a lack of turbidity control, a lack of monitoring and record keeping, and a lack of treatment and distribution system maintenance. However, as the operation and maintenance plan, including record keeping improvements, is implemented, these constraints will diminish. Turbidity control in the current treatment system is limited by the system's capability to remove very fine particles and problems associated with system operations and maintenance. The water treatment facility is not designed to remove particles smaller than 5 μm under optimal conditions. MMWSC is currently in the process of developing and implementing a more rigorous operation and maintenance schedule. Such a schedule has not existed in the past.

Various system components and operations can limit turbidity loading, including source water intake sequencing, sedimentation flow rate, filtration system operations, and clearwell/storage tank maintenance. Infiltration gallery sequencing and water source decision making is largely dictated by historical seasonal trends recalled from memory or in response to water quality already being experienced in the facility. The flow rate and therefore settling rate of particles within the sedimentation basin is controlled by influent and effluent flow rates which are controlled by system logic but undermined by short circuiting. This short circuiting is occurring because the bottom of the sedimentation basin is sagging, allowing flow under the main baffle. Lastly, the sedimentation basin is not cleaned or maintained on a regular basis, and this likely contributes to turbidity. Similarly, the clearwell is not cleaned or maintained, and evidence from September 2013 flood emergency response data collection suggests that the clearwell is contributing to turbidity loading of finished water.

During normal operations, filtration system efficacy depends on proper pressure control and bag replacement schedules. The filtration system should be operated based on dedicated pressure gauges for each filter; the filters should be replaced when the pressure differential across a single bag exceeds the acceptable level. Currently, only combined system pressure is monitored, and the condition of individual bags is not analyzed independently. Due to lack of data and record keeping (replacement schedule, pressures, volume of water treated, associated operations and maintenance, etc.), it is unknown how effective the filter bag replacement schedule has been.

The only daily water quality monitoring and record keeping which occurs is final water turbidity and chlorine concentration. While new operation, maintenance, and record keeping procedures are being implemented, current maintenance activity records are limited to some operations, financial records, and operator memory. There is no record of daily operations and maintenance activities for the following: pressures at the time of filter bag replacement, chlorine addition, bleed line operations, treated water flow rates, interruptions in operations, daily operating time of treatment facility, storage tank levels, etc. There is also no record of scheduled or unscheduled maintenance tasks such as UV bulb replacement, cleaning of any tanks or pipelines, pipe freezes or failures, pipe conditions, valve exercising, hydrant flushing, replacement or calibration of pumps, etc. The system is also lacking a number of residential water meters (approximately 20% of meters are broken at any given time over the past 5 years) and record of treated and distributed water volume is not maintained. An accurate water balance (comparison of produced/treated and delivered water) cannot be conducted.

There are operations and maintenance activities which require more attention or improved planning and record keeping. For example, the sedimentation basin is short-circuiting due to a lack of structural support at the base, the UV intensity meter requires recalibration, and the UV low intensity alarm needs to be reconnected until the ultrafiltration system is installed and the UV system is removed.

There are no records that allow one to determine the frequency of turbidimeter calibration. Water chlorination is also of concern. The chlorine metering pump provides a normalized reading and actual dosing cannot be established. When changes are required in the chlorination system, the operator adjusts concentrations and flows without proper calibration curves. As part of this PER, recommendations have been made to retrofit the sedimentation basin, remove the UV system from the treatment chain (recommended ultrafilters render this step obsolete), and install an automated chlorine pump and analyzer. An inline turbidimeter will be installed as part of the system as well.

As for the distribution system, there are no accessible isolation valves in the distribution system as all access boxes have been sheared off and/or rendered useless because they are so inaccessible due to packed dirt. Furthermore, the valves are not accurately mapped and have not been exercised in decades. The condition of the distribution system and its components is unknown. However, a valve replacement schedule and valve exercising schedule is under development and will be implemented starting when the ground thaws in the spring of 2014. Valve replacement will also create the opportunity to identify and document pipe conditions around the valves throughout the system; this information will allow prioritization of future pipe replacement.

4.4 Growth

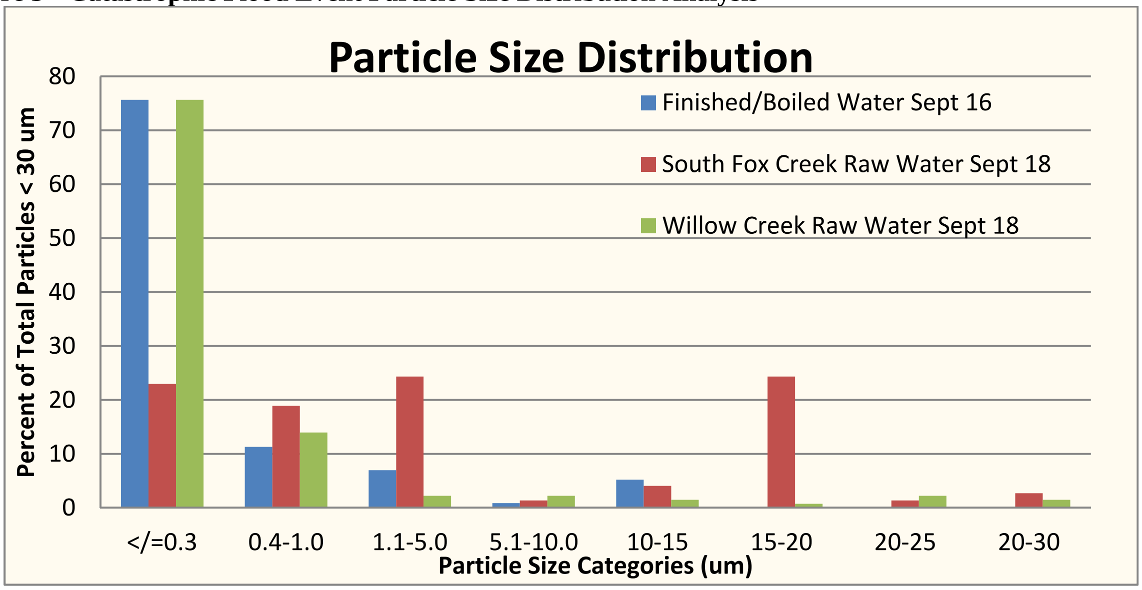
MMWSC has a potential for growth up to 54 lots, currently 41 are fully developed, although only half are inhabited year-round. It is likely that approximately three lots will be developed in the next 2-3 years. There are two lots that are owned by adjacent owners who have no intention to develop their second lot. According to the Colorado State Demography office, unincorporated areas of Boulder County have experienced a -4.5% growth rate from 2000 to 2010. Boulder County has experienced a 7% growth rate over the same decade, while Colorado experienced a 1.5% growth rate. Therefore, a factor of 20% growth will be applied to both the population (of 80 residents) and residential demand. This growth rate has been taken into consideration in this report.

5. Assessment of Alternatives

5.1 Description

Various treatment and filtration technologies have been compared along with connection to the Allenspark Water and Sanitation District in order to meet MMWSC's goal of economical compliance with EPA and CDPHE turbidity limits. The five main design criteria for the comparison of treatment technologies are as follows: 1) peak demand of 50 gpm, 2) treatment efficacy in removal of ultrafine particles smaller than 0.3 µm, 3) minimization of backwash volume due to site size constraints, 4) optimization of existing building and components, and 5) minimization/avoidance of the addition of "chemicals" beyond chlorine. A particle size distribution analysis was conducted in September 2013, during the catastrophic flood event. This analysis illustrated the presence of ultrafine particles, and high loading of particles smaller than 0.3 µm. **Figure 3** illustrates the findings.

Figure 3 Catastrophic Flood Event Particle Size Distribution Analysis



While particles transported during the catastrophic flooding event may vary slightly in size from those transported during seasonal spring runoff events, the size distribution can be used as an approximation for the particles experienced throughout the year. Due to the known pore size of the existing final filters (5 µm) and the particle sizes experienced by the system (75%-92% particles smaller than 5 µm), "no action" was not considered a reasonable option/alternative. Likewise, all bag and cartridge filtration technologies were eliminated from consideration due to the larger pore sizes (minimum pore size of 0.2 µm) and the inability to add a coagulant due to excessive filter replacement costs. Conventional treatment (coagulation, flocculation, sedimentation, filtration, and disinfection) was not considered a reasonable alternative due to the site footprint size limitations, operator requirements, large amount of backwash and waste water, and relatively high raw water quality.

The reasonable alternatives which were compared are direct filtration, microfiltration, ultrafiltration, alternative filtration technologies, and connection to Allenspark Water and Sanitation District. Design criteria and comparisons can be found in Section 5.2.

Direct filtration can be used for high quality water supplies such as MMWSC source water. A typical direct filtration chain would consist of the addition of a coagulant, rapid mixing, limited flocculation, and filtration (see example schematic in **Figure 4**). The benefits of direct filtration include low capital costs, low coagulant dosages, and short duration of flocculation. The limited flocculation ensures a pinpoint floc which can penetrate the filter depth and optimize filter storage

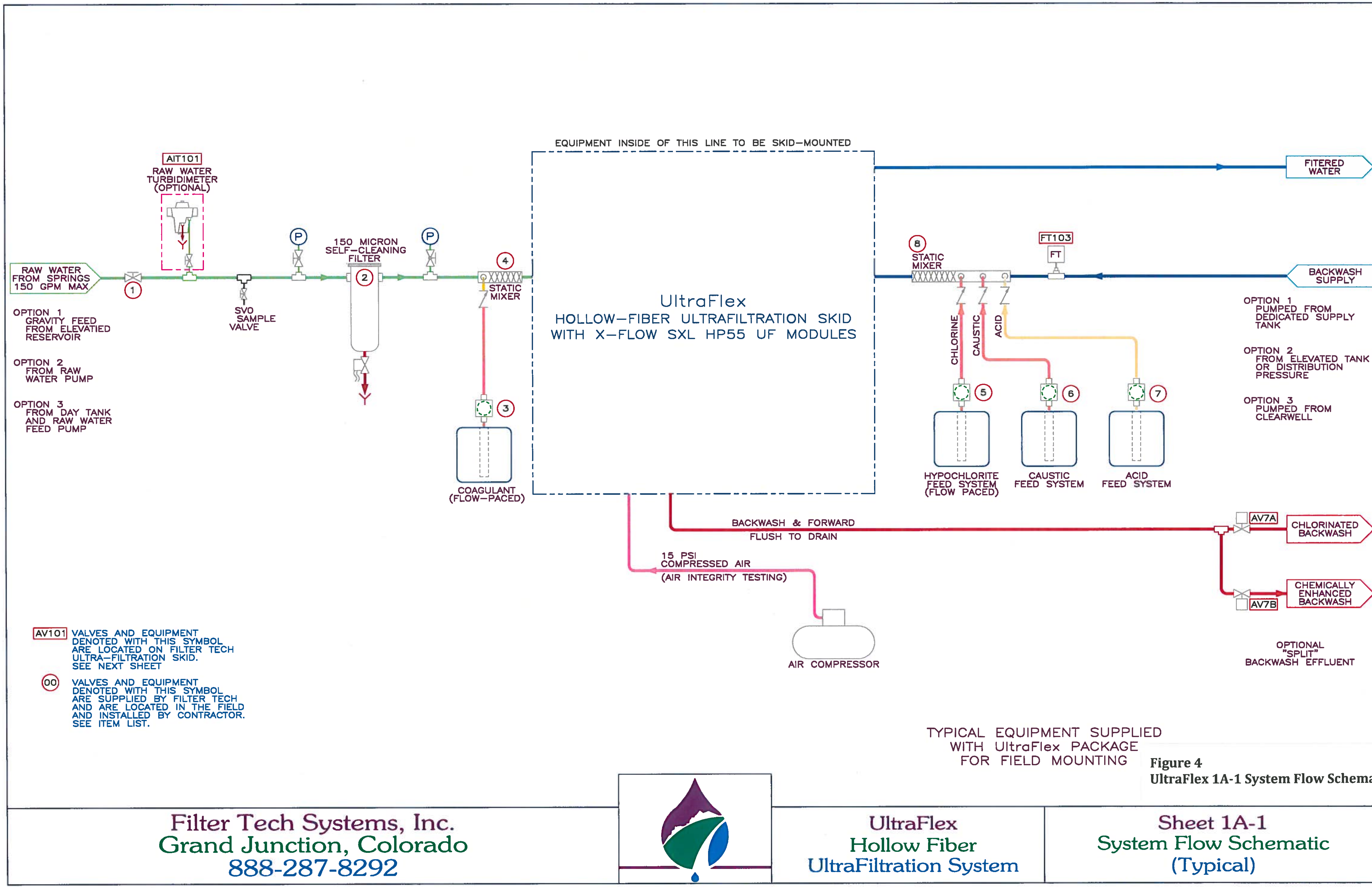


Figure 4
UltraFlex 1A-1 System Flow Schematic

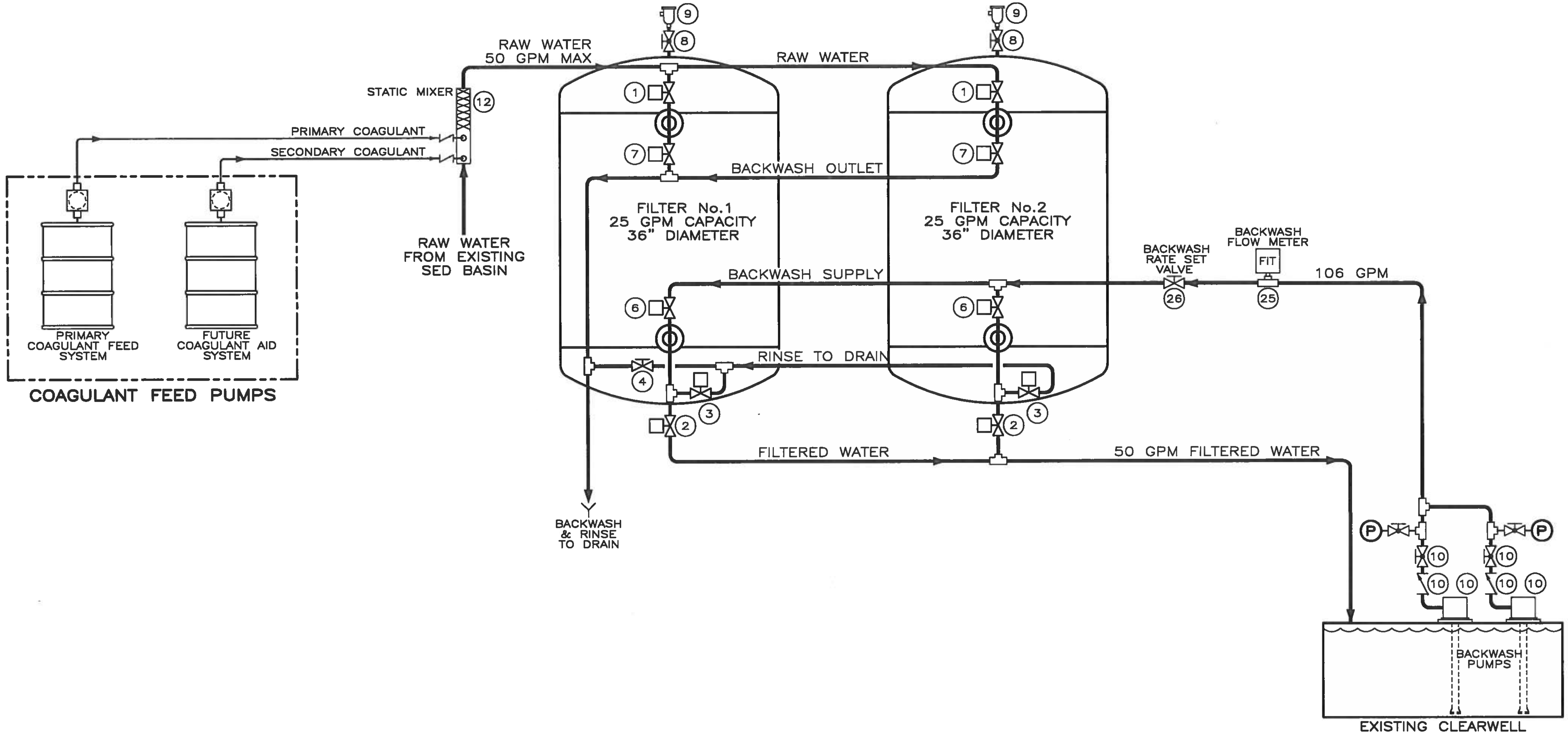
and backwashing. The entire treatment system would consist of the existing intake lines and sedimentation basin (basin would be stripped, repainted, and repaired), followed by the direct filtration chain as described above. A new in-line turbidimeter and an in-line chlorine feed and analyzer system would be required and would be sequenced following filtration and prior to the existing clearwell. The clearwell would be retrofitted with baffling. The waste system would consist of a backwash supply pump which would ultimately pump backwash water through the filter media to the existing overflow and sludge pond. The pond would be retrofitted to meet 10-day retention volume with 2 feet of freeboard. Such a pond would be exempt from SEO permitting and review requirements. An NPDES permit would be required for surface discharges.

Microfiltration typically consists of multiple 0.1 to 0.3 μm absolute pore size filters in parallel. Whereas ultrafiltration consists of multiple 0.02 to 0.03 μm absolute pore size filters in parallel. Both microfiltration and ultrafiltration are considered membrane technologies and consist of similar components. Microfiltration would need to be considered with coagulant addition due to inability to remove particles smaller than 0.3 μm. Membrane technologies can be used on a wide variety of waters and provide an absolute barrier for microorganisms and possible suspended contaminants. A typical membrane system would consist of pre-filtration (20-300 μm, depending on the system); membrane filtration units; a backwashing system; and a Clean-In-Place (CIP) system (see general schematic in **Figure 5**). The benefits of a membrane system are high recovery rates (limited waste water), effective particle removal, and small footprint. The remainder of the treatment system would be similar to the direct filtration treatment system discussed above with the existing intake lines, retrofitted sedimentation tank, membrane skid, new chlorine feed pump and analyzer, retrofitted clearwell, and the retrofitted pond. An NPDES permit may be required for surface discharges.

The last filtration system under consideration is a buoyant media clarifier with pressure filter. The upflow clarifier and downflow media filter provide high recovery rates due to improved clarification and less particle loading on the filter. Such a system would consist of a particle strainer, buoyant media clarifier, filter media (anthracite, sand, and garnet), and airwash backwash system. The benefits of such a system are the lack of chemical addition, small footprint, and water recovery efficiency. The upflow clarifier and filter would not require maintenance of the existing sedimentation basin. The system would be followed by a new chlorine feed pump and analyzer, retrofitted clearwell, and the retrofitted pond. An NPDES permit would be required for surface discharges.

Lastly, connection to Allenspark Water and Sanitation District (Allenspark) was considered. However, the piped connection (including pumping station) could not be considered in isolation as Allenspark would not consider supplying MMWSC without major distribution system upgrades. Therefore, in addition to the connection to the Allenspark system, three levels of distribution system upgrades were considered and discussed in Section 5.2.

Infiltration gallery improvements were considered as a possible turbidity reduction measure due to the success of the Allenspark infiltration galleries in reducing raw water turbidity by an order of magnitude below the MMWSC raw water. The source of Allenspark raw water is also Willow Creek. Improved infiltration gallery design could discourage the flow of fine particles into the intake conveyance and encourage the settling of larger particles. Expansion of the infiltration galleries was considered up to the 25 cubic yard minor dredging threshold for USACE Nationwide permitting. While removal of particles larger than 20 μm theoretically could be achieved, the improvement of this over a retrofitted sedimentation basin and 20 μm pre-filtration is insignificant.



FILTER TECH SYSTEMS, Inc.
DESIGNERS & MANUFACTURERS OF
AquaFloc FILTERS
& WATER TREATMENT SYSTEMS

888–287–8292
GRAND JUNCTION, COLORADO

Figure 5
Flow Schematic AquaTech Pressure Filters

FLOW SCHEMATIC
AquaTech PRESSURE FILTERS
MOUNTAIN MEADOW

#	DATE	BY	DESCRIPTION
1	03NOV13	DDJ	REVISED FOR CLARITY

DRAWN:	CHCKD:	DATE	SCALE	Sht.No.	REV
DDJ		27 OCT 13	– NONE –	1A	1
PROPOSAL No. 13–826		PROJECT No.			

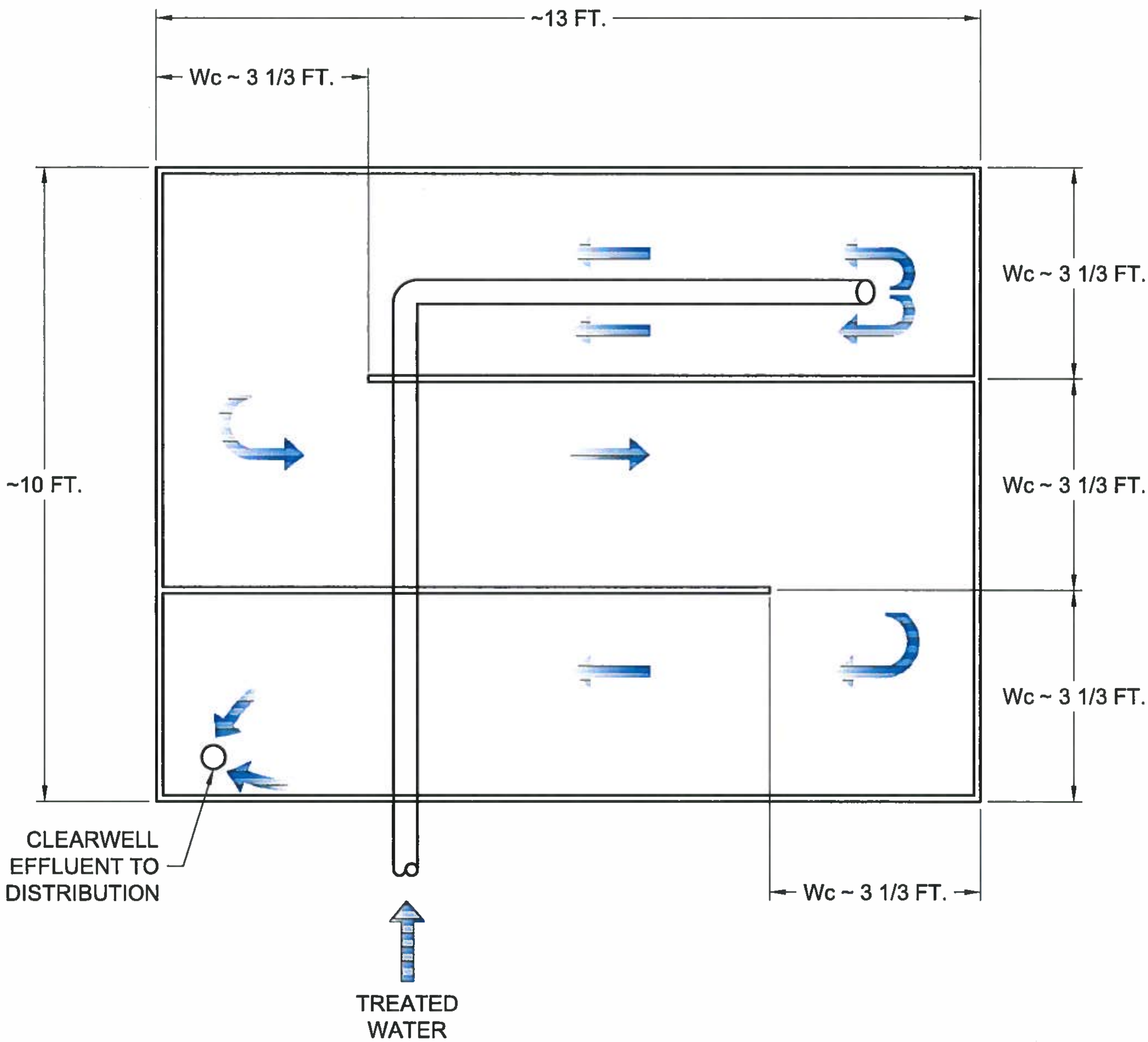
During the September 2013 catastrophic flood event, MMWSC was able to pilot an ultrafiltration system with nominal pore size of 0.02 µm. The technology used by this system is equivalent to an Innovative Water Technologies UF 50 Ultrafilter; however, it is marketed under a different name: the SunSpring. Turbidity results were tracked over a two week period, and data show effluent turbidity results consistently below 0.2 NTU (see **Attachment 4**). Drinking water regulations require turbidity to be less than 0.3 NTU for 95% of samples taken in a month. Filtered water effluent turbidity ranged from 0.09 NTU to 0.18 NTU with no correlation to influent water conditions. This lack of correlation may be related to the calibration of the turbidimeter. With the proposed new system, a new in-line turbidimeter will be installed. Given the Board mandate that O&M and record keeping shall comply with the recently adopted manual, calibration of equipment and record keeping procedures will be implemented with any proposed system upgrades.

Baffling of the clearwell is needed to maximize contact time for chlorine, and given the large water demand in the winter, reduce the minimum volume of water needed in the clearwell to meet virus log-reduction requirements. In order to achieve a baffling factor of 0.3, a horizontal serpentine baffling configuration with two walls and three channels is needed (see **Figure 6**). The baffling opening will equal the channel width, assumed to be approximately 3.3 feet. The total width (~10 feet) and length (~15 feet) of the clearwell need to be verified when the tank is empty as no as-builts exist and access is not possible with water in the tank. These baffling features will provide for a baffling factor of 0.3, and allow for 1,500 gallons to be maintained in the clearwell while meeting the 4-log virus reduction requirement at the design flow of 50 gpm (1.2 mg/L residual chlorine, 5 deg C) (using EPA CT calculator).

5.2 Design Criteria

As explained in Section 5.1, feasible options have been compared in order to meet MMWSC's goal of economical compliance with EPA and CDPHE turbidity limits. The five main design criteria for the consideration of treatment technologies are as follows: 1) peak demand of 50 gpm, 2) treatment efficacy in removal of ultrafine particles smaller than 0.3 um, 3) minimization of backwash volume due to site size constraints, 4) optimization of existing building and components, and 5) minimization/avoidance of the addition of "chemicals" beyond chlorine. As discussed in Section 5.1, if the above criteria were not met, then the technologies were eliminated from consideration. Therefore, direct filtration, micro- and ultrafiltration, and alternative filtration technologies were considered. All comparative criteria for treatment have been included in the comparison table provided on the following page. An attempt was made to monetize all operational and maintenance costs associated with the turbidity reduction technologies in **Table 5** in Section 5.7 (grey cells indicate estimated costs and blue cells indicate lowest costs).

In addition to turbidity reduction technologies, connection to Allenspark was considered in conjunction with distribution system improvements. Since the piped connection (including pumping station, see Section 5.1 of this report) could not be considered in isolation, three levels of distribution system upgrades were addressed as part of this option as follows: 1) new distribution system laid in bedrock below frost line; 2) new distribution system insulated at current depth above bedrock; and 3) use of existing distribution system, elimination of dead-ends, insulation of high-risk freeze-prone areas, and installation of functional valves. Capital costs were compared to see if any connection options could be considered as economically feasible (see Section 5.7 for cost comparisons).



PROJECT: COMMW102
DATE: 12/30/13
ENGINEER: KAS
CHECKED: CDL
REVISIONS:
FILE: COMMW102_STRG-TNK.DWG

FIGURE 6
PROPOSED 6,000 GALLON
CLEARWELL / STORAGE TANK

Lidstone and Associates, Inc.
Engineering Geology & Water Resource Consulting

5.3 Environmental Impacts

One of the major design criteria was to optimize the existing facilities. Because the treatment facility footprint will not change, there will be limited and only very short term construction impacts at the treatment facility. It is anticipated that there may be increased traffic to the facility over a one week period. There are no anticipated impacts to floodplains, wetlands, wildlife, or adjacent property. Very limited expansion of the backwash/sludge pond will be required, but this expansion will not take place in a waterway and its net increase will be smaller than 1/3 ac-ft under all design options. An NPDES permit likely will be required.

Since there is no proposed construction associated with the infiltration gallery expansion, no permits will be required for this activity and there will be no environmental impacts. No environmental impacts are anticipated as part of the options which are considered as part of this PER.

In the case of distribution system upgrades for connection to Allenspark, additional land may be disturbed associated with looping to eliminate dead-ends. However, connection to Allenspark and associated distribution system improvements is not recommended as part of this PER.

5.4 Land Requirements

No additional sites or easements will be required for the treatment techniques considered. No additional permits (beyond a possible NPDES permit) will be required. Currently, there is a legal agreement with the owners of the land on which the sludge pond is located. The Agreement allows for the existence, operation, and maintenance of the pond in exchange for the use of the driveway which is owned and maintained by MMWSC. In the case of distribution system upgrades for connection to Allenspark, easements for looping to eliminate dead-ends would have to be sought. However, connection to Allenspark and associated distribution system improvements are not recommended at this time based on prohibitive costs (see Section 5.7).

5.5 Construction Problems

The existence of subsurface rock was factored into the cost estimates for the distribution system and infiltration gallery upgrades. There are no anticipated impacts due to the subsurface rock or groundwater on the treatment facility upgrades. In the evaluation of all alternatives, seasonal access must be factored into the construction and implementation schedule due to high elevation, frozen and snow covered conditions.

5.6 Operational Aspects

Operational aspects were incorporated into the cost comparison in **Table 5**. Labor costs were estimated based on average guides to estimating staffing hours and discussions with manufacturers. Currently MMWSC is categorized as a Class D facility and the operator currently maintains a Class C certification. Upgrades as described above will require either a Class C or a Class B certification. Automated system control is a component of all alternatives with the exception of some manual cleaning procedures required monthly for two of the membrane systems. Allenspark operators are familiar with direct filtration (as that is the treatment process employed in their facility), and both Allenspark and MMWSC operators have been trained on the Innovative Water Technologies Ultrafilter which was installed at MMWSC in response to the catastrophic flooding in September 2013. Upon approval and installation, additional training will be provided by the recommended filter company.

Criteria	Units/components	AquaTech MultiMedia	Pall Corporation	UltraFlex Hollow Fiber	Siemens	Innovative Water Technologies	Tonka Water
		Direct Filtration	Microfilter	UltraFiltration	MECOR Ultrafilter	UF 50 Ultrafilter	Buoyant media clarifier with filter
Capital Cost	$	$ 62,555	$ 217,000	$ 147,900	$ 240,000	$ 82,500	$ 166,000
Installation Cost	$	$ 18,400	$ 15,000	$ 18,400	$ 15,000	$ 6,700	included
Pore Size	um	N/A	0.1	0.01	0.04	0.02	N/A
Number of Filter Units		2	8	4	12	10	2
Equipment Height	ft	8	10	8	7	7	10
Equipment Foot Print	ft	8 x 6	9 x 5	3 x 3.5	4 x 7	4 x 6	4 x 7
Operator Level Required		B	B	B	B	B	B or C
Pretreatment Method		Coagulant	300 um filter, possible coagulant desirable	150 um filter, Coagulant	None required though coagulant desirable	20 um filter	none
Coagulant Feed Rate	ppm Coag	`5 - 10	`1 - 2	`1 - 2	`1 - 2	`1 - 2	none
Backwash Flow Rate	gpm	106		240			
Pressure Required (max)	psi	15		40			
Backwash Volume per cycle	gal per filter	1060		120 treated, 75 raw		20	
Backwashes per Day (max)	x per day	3		36	40	16	
Backwash Duration	min per filter	10		1.5	4		
Total Time per day	total min per day	60		54			
Treated Water Recovery		91%	95%	94%	96%	95%	85-91%
Total Backwash Volume	gal/day	6630	3600	7020 (4320 treated, 2700 raw)	2880	3200	2000
Backwash Pond Size	ac-ft	0.20	0.11	0.22	0.09	0.10	0.06
Chemical Cleaning		none	heat, chlorine, acid	acid, caustic, chlorine	heat, chlorine, acid	chlorine	none
Expected Filter Effluent Turbidity	NTU	0.1	0.1	0.02	0.1	0.1	0.1
Membrane/Media Replacement Cost per unit	$	$ 2,500	$ 8,000	$ 12,000	$ 10,000	$ 4,000	$ 7,000
Media Life Span	years	`10 - 20	`7 - 10	`7 - 10	`7 - 10	10	10-15
	Filter media or membrane	X	X	X	X	X	X
	Gauges, valves, piping	X	X	X	X	X	X
	Influent turbidimeter		X	X	X		X
	Effluent turbidimeter	X	X	X	X	X	X
	Sample valves	X	X	X	X	X	X
	Coagulation feed/mixer	X		X			N/A
	Backwash physical/chemical feed systems	X	Backwash feed needed	X	X	X	X
Included equipment	CIP system	N/A	CIP feed system needed	CIP feed system needed	X	Manual	N/A
	Pre-filter strainer	N/A	X	N/A		Existing 3M	N/A
	Finished water flow meter			X	X		
	Control panel	X	X	X	X	X	X
	Piped connection to existing system	X	Piped connection needed	X	Piped connection needed	X	Piped connection needed

	Additional needs		Hot water feed required		Hot water feed required		
			CIP neutralization needed	CIP neutralization needed	CIP neutralization needed		
Additional cost of equipment needed ($	Chlorine analyzer w/ pump	$ 2,000	$ 2,000	$ 2,000	$ 2,000	$ 2,000	$ 2,000
	Hot water heater		$ 1,000		$ 1,000		
	CIP System and neutralization		$ 3,000	$ 3,000	$ 1,500		
	Backwash physical/chemical feed systems/pumps	$ 3,000	$ 3,000				
	Piped connection to existing system		$ 100		$ 100		
Total additional estimated equipment costs	$	$ 5,000	$ 9,100	$ 5,000	$ 4,600	$ 2,000	$ 2,000
Building modifications (minor: $2000, major: $10,000)	$	$ 2,000	$ 10,000	$ 2,000	$ 2,000	$ 2,000	$ 10,000
Sedimentation basin modifications	$	$ 7,000	$ 7,000	$ 7,000	$ 7,000	$ 7,000	
Pond modifications (freeboard and/or expansion)	$	$ 1,000	$ 1,000	$ 1,000	$ 1,000	$ 1,000	$ 1,000
Storage/clearwell modifications (baffling and improvements)	$	$ 3,000	$ 3,000	$ 3,000	$ 3,000	$ 3,000	$ 3,000
Capital Costs		**$ 98,955**	**$ 262,100**	**$ 184,300**	**$ 272,600**	**$ 104,200**	**$ 182,000**
Tax	10%	$ 9,896	$ 26,210	$ 18,430	$ 27,260	$ 10,420	$ 18,200
Engineering fees	20%	$ 19,791	$ 52,420	$ 36,860	$ 54,520	$ 20,840	$ 36,400
Contingincies	15%	$ 14,843	$ 39,315	$ 27,645	$ 40,890	$ 15,630	$ 27,300
Total Capital Costs	**$**	**$ 143,485**	**$ 380,045**	**$ 267,235**	**$ 395,270**	**$ 151,090**	**$ 263,900**
Operational Costs							
Current Annual operating costs as applicable to improvements	$ 21,000	$ 21,000	$ 21,000	$ 21,000	$ 21,000	$ 21,000	$ 21,000
Additional Electricity Consumption of Treatment	Kilowatts = (volts * amps)/1000	0.8	6.9	4.9	6	1.8	3
	$/yr (if operating for 16 hrs a day)	$ 286	$ 2,418	$ 1,724	$ 2,102	$ 631	$ 1,051
Direct Labor	hrs/yr from guide to estimating staffing	659	646	672	646	594	633
	$/yr	$ 16,475	$ 16,150	$ 16,800	$ 16,150	$ 14,850	$ 15,825
Pond cleaning	$/yr	$ 500	$ 500	$ 500	$ 500	$ 500	$ 500
Additional Consumables Cost of Treatment	$/yr	$ 913	$ 683	$ 683	$ 237	$ 237	$ -
Membrane/Filter media replacement	$/yr	$ 500	$ 6,400	$ 4,800	$ 12,000	$ 4,000	$ 1,400
NPDES	$330/yr	$ 330	$ 330	$ 330	$ 330	$ 330	$ 330
Total Operating Costs	**$/yr**	**$ 40,004**	**$ 47,480**	**$ 45,837**	**$ 52,319**	**$ 41,547**	**$ 40,106**
Interest rate	0.06						
Present value of annuity	11.46992122						
Total Cost of System over 20 years, Net Present Value		**$ 602,329.27**	**$ 924,641.52**	**$ 792,977.35**	**$ 995,364.00**	**$ 627,633.68**	**$ 723,914.95**

25 lb/yr alum 5 ppm 20k/day

5.7 Cost Estimates

The capital costs, operating costs, and net present value of each treatment alternative are presented in **Table 5**. The direct filter and the Innovative Water Technologies Ultrafilter have comparable capital cost, operating cost, and net present value and are most affordable in terms of short- and long-term when compared with all other options, including all options for the connection to Allenspark (see **Tables 6A, 6B, and 6C**).

Table 6A Cost to Connect to Allenspark and Replace Distribution System and Lay Below Frost Depth

Item #	Description	Estimated Quantity	Unit	Unit Price	Total Price
1	Mobilization/Demobilization	1	L.S.	$119,536	$119,536
2	Trenching/Backfill/Compaction	23000	L.F.	$55	$1,265,000
3	Blasting	10000	L.F.	$12	$120,000
4	4" Dia. C900 PVC Distribution	23000	L.F.	$8	$187,680
5	4" Connection to Allenspark	1500	L.F.	$80	$120,000
6	Pumping Station for connection to Allenspark	1	L.S.	$70,000	$70,000
7	4" Valve	10	EA.	$1,026	$10,260
8	Miscellaneous Fittings	1	L.S.	$10,000	$10,000
9	3/4" Service Line Reconnection	45	EA.	$636	$28,611
10	3/4" Curb Stop Installation and Reclamation	5	EA.	$1,309	$6,547
11	Air Relief Valve	3	EA.	$400	$1,200
12	Manhole	3	EA.	$3,500	$10,500
13	Dead-end Pumping	3	E.A.	$12,500	$87,500
14	Easements	2000	L.F.	$5	$12
15	Gravel Resurfacing	2500	YD^2	$7	$16,888
16	Grass Revegetation	300	YD^2	$10	$3,071
17	Traffic Control	1	L.S.	$5,000	$5,000
18	Force Account	$50,000	L.S.	$50,000	$50,000
				Total	**$2,111, 803**

Table 6B Cost to Connect to Allenspark and Replace Distribution System at Current Depth and Insulate

Item #	Description	Estimated Quantity	Unit	Unit Price	Total Price
1	Mobilization/Demobilization	1	L.S.	$113,536	$113,536
2	Trenching/Backfill/Compaction	23000	L.F.	$55	$1,265,000
3	Pipe Insulation	10000	L.F.	$2	$20,000
4	4" Dia. C900 PVC Distribution	23000	L.F.	$8	$187,680
5	4" Connection to Allenspark	1500	L.F.	$80	$120,000
6	Pumping Station for connection to Allenspark	1	L.S.	$70,000	$70,000
7	4" Valve	10	EA.	$1,026	$10,260
8	Miscellaneous Fittings	1	L.S.	$10,000	$10,000
9	3/4" Service Line Reconnection	45	EA.	$636	$28,611
10	3/4" Curb Stop Installation and Reclamation	5	EA.	$1,309	$6,547
11	Air Relief Valve	3	EA.	$400	$1,200
12	Manhole	3	EA.	$3,500	$10,500
13	Dead-end Pumping	3	E.A.	$12,500	$87,500
14	Easements	2000	L.F.	$5	$12
15	Gravel Resurfacing	2500	YD^2	$7	$16,888
16	Grass Revegetation	300	YD^2	$10	$3,071
17	Traffic Control	1	L.S.	$5,000	$5,000
18	Force Account	$50,000	L.S.	$50,000	$50,000
				Total	**$2,005,803**

Table 6C Cost to Connect to Allenspark and Address High-Risk Freeze-Prone Areas, Eliminate Dead Ends, and Install Functional Valves

Item #	Description	Estimated Quantity	Unit	Unit Price	Total Price
1	Mobilization/Demobilization	1	L.S.	$32,297	$32,297
2	Trenching/Backfill/Compaction of Freeze-Prone Areas	2000	L.F.	$55	$110,000
3	Pipe Insulation of Freeze-Prone Areas	2000	L.F.	$2	$3,000
4	4" Dia. C900 PVC Distribution of Freeze-Prone Areas	2000	L.F.	$8	$16,320
5	4" Connection to Allenspark	1500	L.F.	$80	$120,000
6	Pumping Station for Connection to Allenspark	1	L.S.	$70,000	$70,000
7	4" Valve	10	EA.	$1,026	$10,260
8	Elimination of Dead-ends (looped pipe network)	2000	L.F.	$80	$160,000
9	Dead-end Pumping	3	E.A.	$12,500	$37,500
10	Easements	2000	L.F.	$5	$10,000
11	Gravel Resurfacing	100	YD^2	$7	$700
12	Grass Revegetation	50	YD^2	$10	$500
				Total	**$570,577**

As can be seen above (**Table 5**), Direct Filtration and Ultrafiltration can be installed and maintained at reasonable costs and are both likely to achieve the project goals. Although desirable on the basis of operator certification and regionalization, connection with Allenspark at this time is not feasible-given that the least expensive connection option included the use of the existing distribution system with pipe insulation along the high-risk freeze-prone sections as described in Table 6C. The capital costs of this system would be approximately $570,000 for minimal improvements. Due to the high capital costs, all options for connection to Allenspark are eliminated from consideration at this time.

Lastly, cost estimates for infiltration galleries were developed and can be seen in **Table 7**

Table 7 Infiltration Gallery Cost Estimate

Item #	Description	Estimated Quantity	Unit	Unit Price	Total Price
1	Mobilization/Demobilization	1	L.S.	$10,000.00	$10,000.00
2	Dredging	25	YD^3	$70.00	$1,750.00
3	Blasting	25	YD^3	$4,000.00	$4,000.00
4	4" Dia. C900 PVC Distribution	30	L.F.	$50.00	$1,500.00
5	Baffling, Weirs, etc.	1	L.S.	$1,000.00	$1,000.00
6	Concrete Structure and Overflow	1	L.S.	$5,000.00	$5,000.00
7	Gallery Material/Media	25	YD^2	$40.00	$1,000.00
8	Grass Revegetation	1	L.S.	$500.00	$500.00
9	Tree Replacement	1	L.S.	$500.00	$500.00
10	Fencing	60	L.F.	$10.24	$614.10
				S. Fox Creek	$24,750.00
				Willow Creek	$24,750.00
				Total	**$49,500.00**

As previously noted, due to limited particle removal potential, infiltration gallery improvements, by themselves will not likely meet project goals.

5.8 Advantages/Disadvantages

The Direct Filtration system and the Innovative Water Technologies Ultrafiltration system share the advantage of being most cost effective in both the short- and long-terms when compared to all other filtration options, infiltration gallery improvements, and connection to Allenspark. Beyond the large cost advantage, there are many advantageous similarities between all the technologies explored in the cost comparison, including the following:

- All systems will require a Class C or B operator.
- All systems will fit with the footprint of the existing building with some modifications, including possible door reconfiguration. Some systems would require a limited roof expansion.
- All systems except the buoyant media clarifier with filter require the retrofitting of the existing sedimentation basin.
- All systems require cleaning and baffling of the clearwell.
- All systems require a limited pond expansion and likely an NPDES permit.
- All systems include an in-line filter effluent turbidimeter.
- All systems would benefit from an in-line chlorine analyzer and pump.
- All systems can meet the current and future projected demands of the system without cost-prohibitive distribution system upgrades to eliminate or reduce winter bleeding.

The advantages of most membrane technologies are the lower backwash volumes and avoidance of or limited addition of coagulant. Another advantage of membrane technologies is that numerous membranes could be taken off-line in low-demand conditions such as summer and fall, extending membrane life and reducing power demands. Redundancy (large number of membranes) can be maintained. The advantage of the Innovative Water Technologies (IWT) ultrafiltration system is that it requires less chemical cleaning and neutralization systems than other membrane technologies. Furthermore, it optimizes low capital and operation/maintenance costs, efficacy, ease of operation, and familiarity, while avoiding the addition of a coagulant. IWT ultrafiltration system does not require the use of a coagulant for pre-treatment while other ultrafilter manufacturers recommend the addition of a small dose of coagulant for pre-treatment when needed. A major design criterion of the consumers and Board of MMWSC is to avoid the addition of any "chemicals" beyond chlorine, if possible. A disadvantage of the Direct Filtration system is the expected use of coagulant year-round.

6. Selected Alternative

6.1 Justification of Selected Alternative

When compared to all other feasible filtration technologies, the capital, operating, and net present value costs of the direct filtration system and the IWT ultrafiltration system are the lowest. Efficacy of all treatment systems are expected to be similar with removal of ultrafine particle by coagulation and filtration in the case of direct filtration and removal of ultrafine particles by absolute pore size in the case of membrane technologies. The IWT ultrafiltration system is the recommended alterative due to limited or possibly avoided coagulant addition when compared with the direct filtration system and fewer chemical systems when compared to other membrane technologies. When comparing the filtration technologies with the connection to Allenspark alternatives, the capital costs are much lower for filtration technologies. Infiltration gallery expansion is not recommended at this time due to high cost and limited benefits. Ultrafiltration is considered the Best Available Technology (BAT) by the State, design criteria exist for guidance, and CDPHE has granted approval for the skid (see **Attachment 5**). The IWT Ultrafiltration system is the recommended technology because it optimizes efficacy, reliability, State BAT, low capital and operating costs, familiarity, optimization of existing treatment infrastructure, ease of operation, and avoidance of the addition of a coagulant. The Board and System Operator are familiar with its use.

6.2 Technical Description

Source Water

MMWSC water sources will not change and a full description is located in Section 3 of this report. Two creeks feed the treatment facility: South Fox Creek and Willow Creek. South Fox Creek Watershed is fed entirely by RMNP; the MMWSC intake is located approximately 25 feet outside the national park boundary. Willow Creek Watershed is fed mainly by drainages originating from RMNP, though a small fraction of the watershed consists of US Forest Service land.

Treatment System

The MMWSC treatment facility will remain in operation for approximately two to fifteen hours a day, seven days a week, depending on the season and water demand. A certified operator will visit the facility daily to monitor and record water quality, check processes and equipment, and operate and maintain the infrastructure. An automated, phone-based system will allow the operator to check alarms remotely. Operations will require either a Class C certification (currently held by treatment operator) or a Class B certification (currently held by the distribution operator who could be hired into the treatment position or which could be achieved by the current treatment operator). The facility is on the electrical grid with an onsite automated, propane-powered generator that is used for backup. Propane is also used to heat the treatment facility during the winter.

The facility will be designed to treat 50+ gpm. However, membranes can be taken off line during periods of low use. See Section 5 for discussion of design demand. The treatment facility will consist of the following treatment processes: sedimentation, bag pre-filtration, ultrafiltration, and sodium hypochlorite injection (see **Figure 7**). Ultrafilter backwash water will be pumped to the backwash pond on site. The backwash pond will require an enlargement to meet 10 day storage capacity and provide two feet of freeboard. The required pond size will be approximately 1/10 ac-ft (10 day storage of 20 gal/filter/backwash cycle for 10 filters at a maximum of 16 planned backwash cycles per day) with an expansion needed to meet the two feet of freeboard criterion. Four planned backwash cycles were employed per day during the flood emergency response. An NPDES permit will be obtained, if needed. The intakes will not be altered.

Sedimentation

As discussed in Section 3, the metal, dual-chamber, horizontal-flow sedimentation basin structure has four distinct compartments: the influent chamber, two settling chambers, and an effluent chamber. Influent and effluent pipes use submerged orifices. The influent zone has been designed to decrease the velocity of influent water and distribute it evenly throughout the influent zone. The settling zone consists of two settling chambers with a maximum surface overflow rate of 0.43 gpm/ft^2 (see **Table 2** for all calculations) and depth of 56 inches or 1.4 meters. Settled particles collect at the bottom of both settling chambers and can be removed with a manually controlled vacuum. Clarified water discharges with a free fall from the settling zone over an 8-foot-long weir at a maximum rate of 4.4 gpm/ft. The velocity through the sedimentation basin is maintained below 0.15 ft/min. This sedimentation design can theoretically settle particles larger than 25 μm (see **Table 3** for Stokes' Law analysis). Particles smaller than 25 μm will advance to the filters. CDPHE sedimentation basin standards are intended for conventional treatment when coagulation and flocculation have occurred; therefore, the application of CDPHE standards may not be appropriate under MMWSC operating conditions. The sedimentation basin will be retrofitted to eliminate short circuiting and stripped/painted to extend the operational life of the basin.

Filtration System

The pre-filtration system will consist of two 20 μm 3M cloth bag filters in parallel followed by two 20 μm 3M cloth bag filters in series. A pore size equivalency of 20 μm is required pre-filtration for the ultrafilters and will protect them from particle bombardment and unnecessary loading. The current pre-filtration housing chambers will be used in the final design.

The IWT UF 50 consists of 10 GE Homespring membrane modules on an aluminum skid (see **Figures 7, 8, and 9**). The UF 50 consists of a modular system of hollow fiber, self supporting, non-woven, porous media, composed of a polymeric material, capable of being individually integrity tested, with automatically programmed backwashes. Each membrane module is rated at 4.5 gpm continuous flow and up to 11 gpm maximum flow rate. Each membrane module operates independently of the others and has its own isolation valves so that it can be taken on or offline independently of all the others for maintenance or repairs. In addition, each membrane module can be programmed to backwash independently of the others. Each membrane can also be MIT (Membrane Integrity Tested), CIP (Cleaned in Place), and maintained while the others are still in operation. All wetted components are NSF 61 approved and/or approved for use with drinking water. The new treatment plant will be controlled by the existing level controls in the raw water settling tanks and the clear well levels.

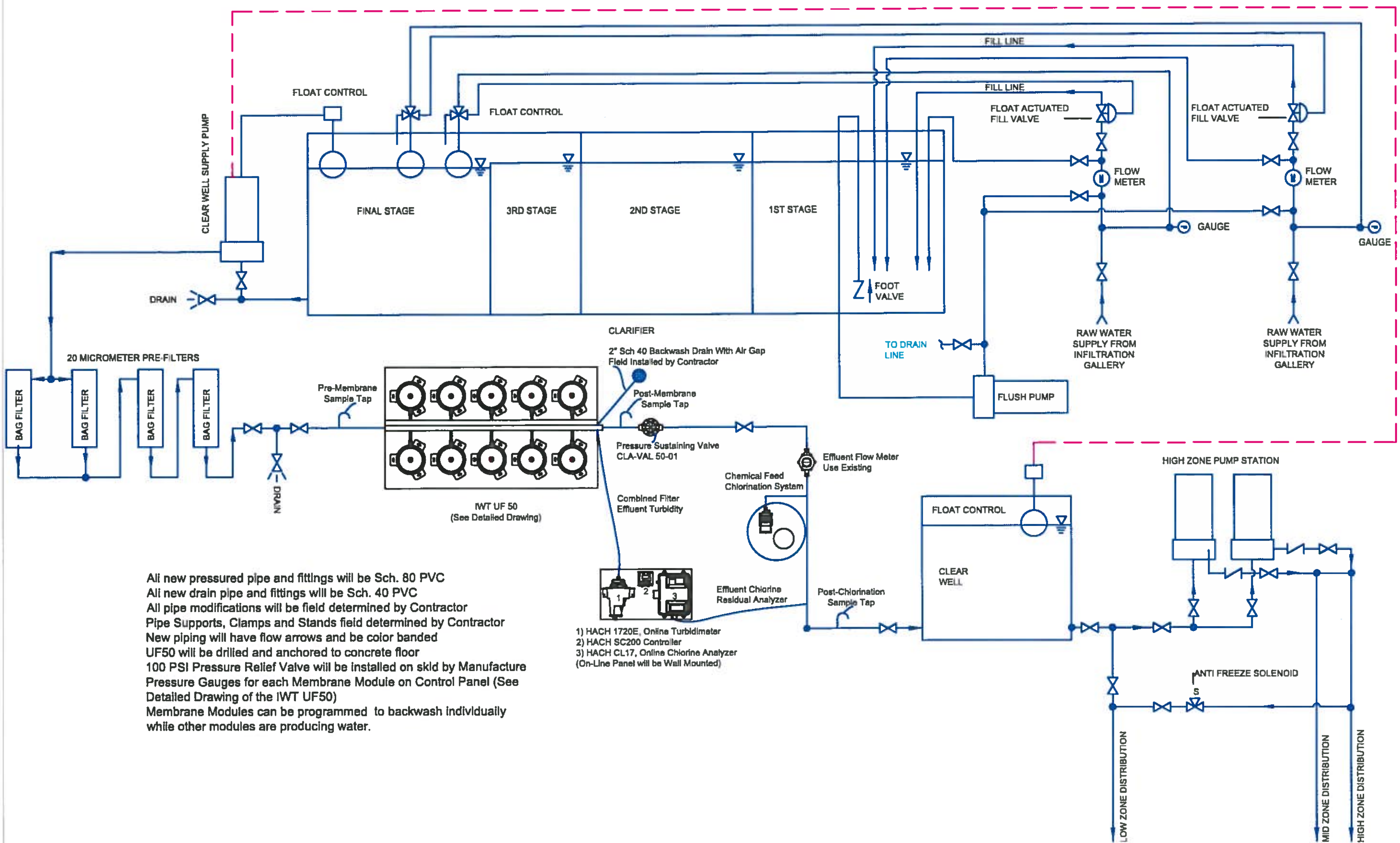
Through a system pressure of at least 45 psi, the water is applied to a header connected to the membrane modules that are preplumbed on an aluminum skid. This pressure forces water through the UF membranes producing filtrate water. Intermittent backwashes (likely four per day) will be programmed for each membrane module for preset backwashes of the membrane module hollow fibers. This water pressure scouring action re-suspends rejected solids away from the membrane surface and flushes them to waste. During the backwash filtered water is to be systematically reversed through the membranes. Membranes are to be periodically cleaned utilizing chlorine on an as needed basis. An online continuous turbidimeter (Hach 1720E) with an SC 200 controller will be installed to monitor effluent turbidity.

Chlorination

The existing water-driven chlorinator will be replaced with an electric hypo-chlorinator and double walled solution tank. Additionally, a continuous online chlorine analyzer (Hach CL17) will be installed. The storage tank/clearwell will be cleaned, and baffling within the clearwell will be improved to provide for increased contact time and therefore lower storage volume required. A baffling factor of 0.3 will be achieved. The log inactivation for viruses will be maintained above 4.0 with a chlorine residual of 1.2 mg/L, baffling factor of 0.3 (longitudinal, serpentine baffling), and peak flow of 50 gpm (using EPA CT calculator). The peak design flow was discussed in Section 2.4 and **Table 1**. Average demand is expected to be approximately 10,000 gallons per day or 7 gpm.

Water Storage, Distribution, and Use

Chlorinated water will continue to be stored in the 6,000-gallon below ground concrete storage tank located at the treatment facility prior to distribution. Storage tank/clearwell improvements are discussed in Section 5.1 and 6.2. The distribution system consists of metal pipe and various levels of pumping control in the summer and winter (some houses are not occupied in the winter). Approximately 40 households are supplied during the summer, and demand is always met.



All new pressured pipe and fittings will be Sch. 80 PVC
All new drain pipe and fittings will be Sch. 40 PVC
All pipe modifications will be field determined by Contractor
Pipe Supports, Clamps and Stands field determined by Contractor
New piping will have flow arrows and be color banded
UF50 will be drilled and anchored to concrete floor
100 PSI Pressure Relief Valve will be installed on skid by Manufacture
Pressure Gauges for each Membrane Module on Control Panel (See Detailed Drawing of the IWT UF50)
Membrane Modules can be programmed to backwash individually while other modules are producing water.

Figure 7
Proposed Water Treatment Process Diagram

rethinking water
Innovative Water Technologies

MATL	Machine Number: IWT UF50
	Meadow Mountain Water Supply
Drawn By / Date: CSP 12/26/13	Revised drawing of COMWW102 by IWT
Approved By / Date: JEB 12/26/13	Scale: No Scale — Sheet 1 of 1

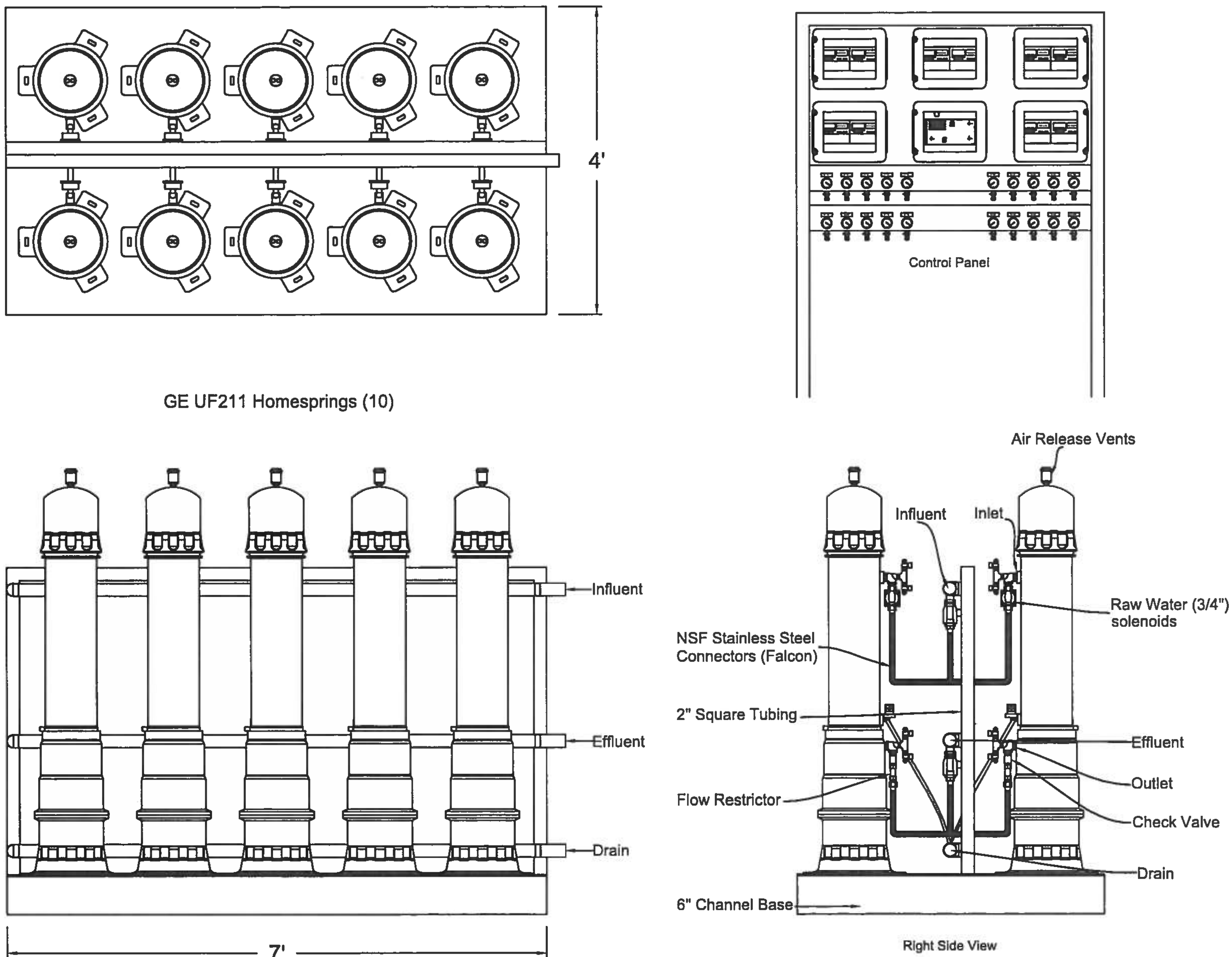


Figure 8
Proposed Meadow Mountain UF50 Skid

rethinking water
Innovative Water Technologies

MAT'L Aluminum	Meadow Mountain Water Supply
Revised / Date	Part Description: IWT UF 50
Drawn By / Date CSP12/26/13	Part Number:
Design Approval / Date JEB 12/26/13	Scale: Sheet 1 of 1

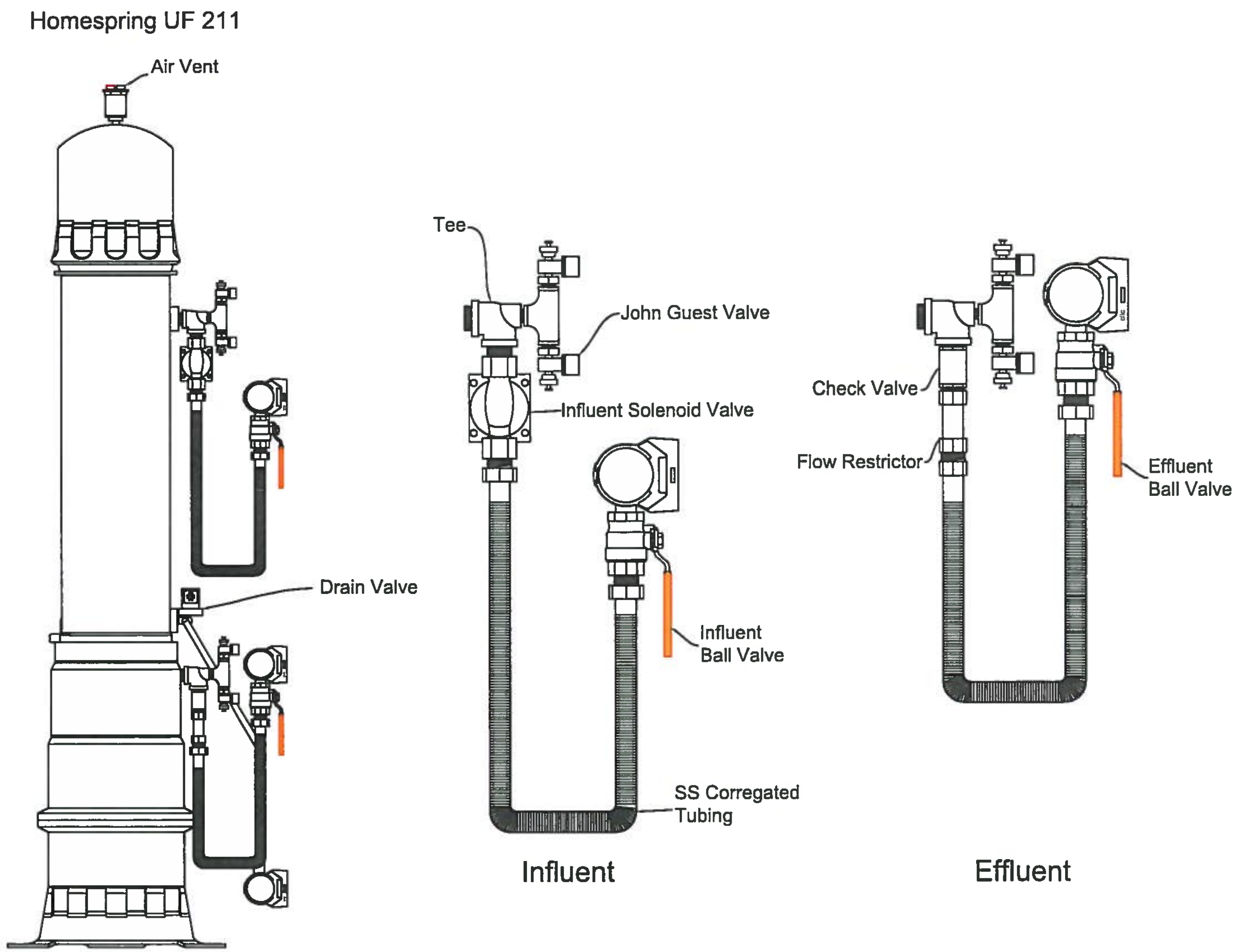


Figure 9
Meadow Mountain UF50 Housing Detail

ethinking water
Innovative Water Technologies

MATL	Meadow Mountain Homespring Detail
Checked By Date	Part Description: UF211 GE Homespring
Drawn By Date CSP12/26/13	Part Number:
Design Approval Date JEB 12/26/13	Scale: Sheet 1 of 1

Although there are recommendations for improvement, the existing distribution system will supply future demand as identified in this report.

6.3 Environmental Review of Selected Alternative

As discussed in Section 5.3, one of the major design criteria was to utilize the existing footprint and optimize the use of the existing facilities. Because the treatment facility footprint will not change, there will be limited construction impacts at the treatment facility. There are no anticipated impacts to floodplains, wetlands, wildlife, or property. The expansion of the backwash/sludge pond is not in a waterway. The required pond size will be approximately 1/10 ac-ft (10 day storage of 20 gal/filter/backwash cycle for 10 filters at a maximum of 16 planned backwash cycles per day) with an expansion needed to meet the two feet of freeboard criterion. An NPDES permit likely will be required.

6.4 Green Project Reserve

This project is not on the State Revolving Fund prioritization list; furthermore, project objectives do not align with Green Project Reserve objectives.

6.5 Costs

Overall project costs (capital, operations and maintenance as assessed over a 20-year time horizon, and net present value over 20 years) are presented in **Table 8**. Total capital costs are approximately $152,000, yearly operations/maintenance costs are approximately $42,000, and the net present value over 20 years is approximately $630,000. Included in **Table 8** are project-related capital costs, operation and maintenance budget, staffing, materials, electricity, replacement costs, and other anticipated costs and fees. Various current operating/maintenance costs which are not expected to increase were included in a line item entitled "current annual operating costs as applicable to improvements." Such costs include laboratory analyses, training, trash collection, snow removal, communications devices, etc. The 20-year cash flow projection spreadsheet can be found in **Table 9.**

It is recommended that MMWSC maintain reserves of 15% of annual operating costs; this equates to approximately 60 days of operations. Annual operating costs are projected to be approximately $42,000 (current value). Therefore, reserves should be maintained above $6,500/yr (current value). Because current income is approximately $40,000/yr and is slightly below projected operating costs, rates will need to be increased to ensure operations and reserves can be met. Additional money may be required to address future capital improvements. Rate increases of 24% ($130/quarter for undeveloped lots and $260/quarter for developed lots) will cover this reserve and operating cost increase; however, additional distribution system needs and long-term planning will likely be considered in setting the final rates. As discussed above, this project and future distribution system improvements are not on the State Revolving Fund prioritization list and should be included.

6.6 Project Implementation

Under the By-Laws of the MMWSC, the Board has the right to make decisions for the community as they pertain to public health, regulatory compliance and system improvements. Following the next Board meeting in mid-January and assuming CDPHE approval, community members will be updated regarding the PER concepts, proposed-approval outcomes and

Table 8 Capital, O&M, and Net Present Value

Component	Units	Cost
Capital Cost of System	1	$ 82,500
Installation Cost	1	$ 6,700
Number of Filter Units	10	
Membrane/Media Replacement	$/unit	$ 4,000
Media Life Span	10 years	
Pulsa Tron Chemical feed pump/double walled chemical	1	$ 2,000
2" pressure sustaining valve	1	$ 2,500
Building modifications (door/stairway)	1	$ 2,000
Sedimentation basin modifications	1	$ 7,000
Pond modifications (freeboard and/or expansion)	1	$ 1,000
Storage/clearwell baffling modifications	1	$ 3,000
Capital Costs		**$ 104,700**
Tax	10%	$ 10,470
Engineering fees	20%	$ 20,940
Contingency	15%	$ 15,705
Total Capital Costs	**$**	**$ 151,815**
Operation/Maintenance Costs		
Current Annual operating costs as applicable to improvements	$/yr	$ 21,000
Additional pre-filtration costs	$/yr	$ 2,000
Additional Electricity Consumption of Treatment	Kilowatts = (volts * amps)/1000	1.8
	$/yr (if operating for 16 hrs a day)	$ 631
Direct Labor	hrs/yr from guide to estimating staffing	594
	$/yr	$ 14,850
Pond cleaning	$/yr	$ 500
Additional Consumables Cost of Treatment	$/yr	$ 237
Membrane/Filter media replacement	$/yr	$ 4,000
NPDES	$330/yr	$ 330
Total Operating Costs	**$/yr**	**$ 41,547**
Interest rate	0.06	
Present value of annuity	11.46992122	
Total Cost of System over 20 years, Net Present Value		**$ 628,358.68**

Table 9 Projected Cash Flow Analysis

CASHFLOW STATEMENT	2013 **Year 0**	2014 **Year 1**	2015 **Year 2**	2016 **Year 3**	2017 **Year 4**	2018 **Year 5**	2023 **Year 10**	2028 **Year 15**	2033 **Year 20**
STARTING CASH BALANCE	$ 60,000	$ 62,239	$ 68,308	$ 71,608	$ 72,438	$ 70,798	$ 122,076	$ 208,271	$ 324,158
SOURCES OF CASH									
Revenue Developed Lots	$ 5,460	$ 6,760	$ 6,760	$ 6,760	$ 6,760	$ 6,760	$ 13,200	$ 28,000	$ 60,000
Revenue Undeveloped Lots	$ 34,440	$ 42,640	$ 42,640	$ 42,640	$ 42,640	$ 42,640	$ 120,400	$ 264,000	$ 528,000
User Fee		$ 155,000							
TOTAL CASH INFLOWS	**$ 39,900**	**$ 204,400**	**$ 49,400**	**$ 49,400**	**$ 49,400**	**$ 49,400**	**$ 133,600**	**$ 292,000**	**$ 588,000**
EXPENDITURES									
Operating Costs									
Filter Costs	$ 1,633	$ 1,000	$ 1,060	$ 1,120	$ 1,180	$ 1,240	$ 2,000	$ 5,000	$ 11,470
Laundry of Filter Bags	$ 788	$ 1,000	$ 1,060	$ 1,120	$ 1,180	$ 1,240	$ 2,000	$ 5,000	$ 11,470
Water Testing	$ 1,644	$ 1,644	$ 1,743	$ 1,842	$ 1,940	$ 2,039	$ 3,288	$ 8,221	$ 18,859
Electricity	$ 1,912	$ 2,562	$ 2,716	$ 2,870	$ 3,023	$ 3,177	$ 5,125	$ 12,811	$ 29,389
Propane	$ 2,539	$ 2,539	$ 2,692	$ 2,844	$ 2,996	$ 3,149	$ 5,078	$ 12,696	$ 29,124
Telephone	$ 529	$ 529	$ 561	$ 592	$ 624	$ 656	$ 1,058	$ 2,645	$ 6,067
Postage	$ 240	$ 240	$ 255	$ 269	$ 283	$ 298	$ 480	$ 1,201	$ 2,755
Licenses and Fees	$ 104	$ 104	$ 110	$ 117	$ 123	$ 129	$ 208	$ 521	$ 1,194
Association Dues	$ 111	$ 111	$ 118	$ 124	$ 131	$ 138	$ 222	$ 556	$ 1,274
Chlorine	$ 591	$ 1,091	$ 1,157	$ 1,222	$ 1,288	$ 1,353	$ 2,182	$ 5,456	$ 12,516
Insurance	$ 2,881	$ 2,881	$ 3,054	$ 3,226	$ 3,399	$ 3,572	$ 5,761	$ 14,403	$ 33,041
Snow Plowing	$ 108	$ 108	$ 114	$ 121	$ 127	$ 134	$ 215	$ 538	$ 1,235
Freeze Costs	$ 563	$ 563	$ 597	$ 631	$ 665	$ 699	$ 1,127	$ 2,817	$ 6,462
Water Augmentation	$ 194	$ 194	$ 205	$ 217	$ 229	$ 240	$ 388	$ 969	$ 2,224
Trash Removal	$ 14	$ 14	$ 15	$ 16	$ 17	$ 18	$ 29	$ 72	$ 166
Membrane removal		$ 4,000	$ 4,240	$ 4,480	$ 4,720	$ 4,960	$ 8,000	$ 20,000	$ 45,880
NPDES		$ 330	$ 350	$ 370	$ 389	$ 409	$ 660	$ 1,650	$ 3,785
Pond cleaning		$ 500	$ 530	$ 560	$ 590	$ 620	$ 1,000	$ 2,500	$ 5,735
	$ 13,852	**$ 19,411**	**$ 20,576**	**$ 21,741**	**$ 22,905**	**$ 24,070**	**$ 38,823**	**$ 97,056**	**$ 222,646**
Operator Costs									
Wages	$ 5,237	$ 15,000	$ 15,900	$ 16,800	$ 17,700	$ 18,600	$ 30,000	$ 75,000	$ 172,049
EE With'g Tax	$ (272)	$ (779)	$ (826)	$ (873)	$ (919)	$ (966)	$ (1,558)	$ (3,895)	$ (8,936)
ER With'g Tax	$ 722	$ 2,067	$ 2,191	$ 2,315	$ 2,439	$ 2,563	$ 4,133	$ 10,333	$ 23,705
Pager	$ 85	$ 85	$ 90	$ 96	$ 101	$ 106	$ 171	$ 427	$ 979
Training	$ 89	$ 89	$ 94	$ 100	$ 105	$ 110	$ 178	$ 444	$ 1,020
FUTA Tax	$ 147	$ 147	$ 156	$ 165	$ 173	$ 182	$ 294	$ 735	$ 1,686
Unemployment Ins	$ 49	$ 141	$ 149	$ 158	$ 166	$ 175	$ 282	$ 705	$ 1,616
	$ 6,057	**$ 16,750**	**$ 17,755**	**$ 18,760**	**$ 19,765**	**$ 20,770**	**$ 33,499**	**$ 83,749**	**$ 192,118**
Capital Expenditure									
Treatment	$ 5,200	$ 130,000	$ 2,000	$ 2,240	$ 2,360	$ 2,480	$ 4,000	$ 10,000	$ 22,940
Distribution Upgrade	$ 4,000	$ 16,000	$ 2,000	$ 2,240	$ 2,360	$ 2,480	$ 4,000	$ 10,000	$ 22,940
Engineering Costs	$ 3,000	$ 20,000	$ 1,000	$ 1,120	$ 1,180	$ 1,240	$ 2,000	$ 5,000	$ 11,470
	$ 12,200	**$ 166,000**	**$ 5,000**	**$ 5,600**	**$ 5,900**	**$ 6,200**	**$ 10,000**	**$ 25,000**	**$ 57,350**
Total Costs	**$ 32,110**	**$ 202,161**	**$ 43,331**	**$ 46,100**	**$ 48,570**	**$ 51,040**	**$ 82,322**	**$ 205,805**	**$ 472,113**

timelines, project schedule, and financing options. This may be accomplished in the public meeting or community meeting forum. The Board is motivated to get the system installed and operational by the runoff event in spring 2014 subject to financing and CDPHE approval in a timely fashion. The Board hopes to work with CDPHE on a rapid PER approval and order the skid from the manufacturer by January 15, 2014. Assuming financing is available for engineering design and construction, MMWSC hopes to submit final designs towards the end of February 2014 thereby allowing the MMWSC Board to approve the plan and final cost estimate by early March 2014. Installation of the skid may happen concurrently with final approval April 1, 2014. The MMWSC Board understands that this timeline is very short, but is motivated to get the proposed new system on-line prior to spring runoff, 2014.

Attachments

1 Water Rights
2 Cost Summary
3 Usage Summary 2013
4 Sun Spring Turbidity Testing
5 2011 GE Homespring Acceptance

Attachment 1 - Water Rights

Water Right Name	Water Source	Q10	Q40	Q160	Sect	Twshp	Range	Adj Date	Padj Date	Appr Date	Use Type	Adj Type	Structure Type	Rate Amount (CFS)
WILDWOOD DITCH 3	WILLOW CREEK	SW	SW	SW	26	3N	73W	1971-02-25	1951-07-23	1967-04-24	Municipal Domestic	Supplemental, conditional made absolute	Ditch	0.4000
WILDWOOD DITCH 4	FOX CREEK	NE	SE	SE	27	3N	73W	1971-02-25	1951-07-23	1967-04-24	Municipal Domestic	Supplemental, conditional made absolute	Ditch	0.9500

Attachment 2 - Cost Summary

Summary by Year

	2013	2012	2011	2010	2009	2008	2007	2006	2005	2004	2003	Total Costs By Category	Average Costs
Item													
Filter Costs	$ 230.28	$ 643.34	$ -	$ 3,596.73	$ 3,817.76	$ -	$ -	$ 6,359.72	$ 279.23	$ -	$ 106.01	$ 15,033.07	$ 1,632.98
Laundry of Filter Bags	$ 1,492.82	$ 1,267.10	$ 1,040.05	$ 1,399.20	$ 758.00	$ 586.00	$ 368.50	$ 397.45	$ 792.25	$ 484.36	$ 83.72	$ 8,669.45	$ 788.10
Water Testing	$ 1,488.92	$ 723.00	$ 1,281.00	$ 2,128.00	$ 1,025.00	$ 2,733.00	$ 2,492.00	$ 1,819.00	$ 1,177.00	$ 1,420.00	$ 281.00	$ 16,567.92	$ 1,644.22
Electricity	$ 2,222.30	$ 3,090.25	$ 3,402.52	$ 2,909.67	$ 1,322.36	$ 1,348.07	$ 1,350.69	$ 1,449.63	$ 1,109.86	$ 1,227.24	$ 321.77	$ 19,754.36	$ 1,912.25
Propane	$ 2,302.51	$ 3,621.52	$ 4,883.58	$ 2,396.40	$ 1,988.99	$ 2,357.82	$ 1,967.20	$ 2,705.56	$ 1,817.70	$ 1,113.63	$ 226.20	$ 25,381.11	$ 2,539.16
Telephone	$ 340.13	$ 581.85	$ 717.48	$ 482.06	$ 429.21	$ 472.40	$ 469.40	$ 519.66	$ 594.01	$ 494.69	$ 179.30	$ 5,280.19	$ 528.97
Postage	$ 194.84	$ 352.10	$ 431.09	$ 232.98	$ 180.13	$ 120.00	$ 161.00	$ 239.07	$ 262.48	$ 182.79	$ 79.53	$ 2,436.01	$ 240.18
Licenses and Fees	$ 85.00	$ -	$ 125.00	$ 75.00	$ 322.00	$ -	$ 75.00	$ 10.00	$ 30.00	$ 300.00	$ 100.00	$ 1,122.00	$ 104.11
Association Dues	$ 125.00	$ 125.00	$ 125.00	$ 125.00	$ 125.00	$ -	$ 125.00	$ 125.00	$ 125.00	$ 125.00	$ 50.00	$ 1,175.00	$ 111.11
Chlorine	$ 668.10	$ 775.69	$ 1,020.17	$ 713.88	$ 666.12	$ 481.02	$ 401.93	$ 262.06	$ 336.87	$ 662.79	$ -	$ 5,988.63	$ 591.17
Insurance	$ 3,480.00	$ 3,277.00	$ 2,649.00	$ 4,893.00	$ 2,735.00	$ 2,656.00	$ 2,702.00	$ 2,392.00	$ 2,340.00	$ 2,282.00	$ -	$ 29,406.00	$ 2,880.67
Snow Plowing	$ 113.75	$ 140.00	$ 166.25	$ 140.00	$ 106.60	$ 35.00	$ 81.25	$ 112.50	$ 81.25	$ 106.25	$ -	$ 1,082.85	$ 107.68
Freeze Costs	$ -	$ 134.55	$ -	$ 3,589.27	$ -	$ 200.00	$ -	$ -	$ 507.00	$ 640.00	$ -	$ 5,070.82	$ 563.42
Water Augmentation	$ 182.29	$ 182.29	$ 182.29	$ 390.63	$ 390.63	$ 156.25	$ 156.25	$ 104.17	$ 104.17	$ 78.12	$ -	$ 1,927.09	$ 193.87
Trash Removal	$ -	$ -	$ -	$ -	$ 50.00	$ -	$ -	$ 40.00	$ -	$ 40.00	$ -	$ 130.00	$ 14.44
	$ 12,925.94	**$ 14,913.69**	**$ 16,023.43**	**$ 23,071.82**	**$ 13,916.80**	**$ 11,145.56**	**$ 10,350.22**	**$ 16,535.82**	**$ 9,556.82**	**$ 9,156.87**	**$ 1,427.53**	**$ 139,024.50**	**$ 13,852.34**
Operator Costs													
Wages	$ 4,875.00	$ 6,000.00	$ 7,500.00	$ 5,903.00	$ 4,608.50	$ 4,500.00	$ 4,724.00	$ 4,800.00	$ 5,400.00	$ 3,700.00	$ 2,000.00	$ 54,010.50	$ 5,237.28
EE With'g Tax	$ (352.95)	$ (229.00)	$ (573.75)	$ (451.58)	$ (352.32)	$ (344.25)	$ 116.59	$ (367.20)	$ (407.30)	$ 160.66	$ 153.00	$ (2,648.10)	$ (272.02)
ER With'g Tax	$ 798.00	$ 798.00	$ 979.66	$ -	$ 946.45	$ 75.00	$ 734.40	$ 183.60	$ 2,027.44	$ 749.70	$ 183.60	$ 7,475.85	$ 721.58
Pager	$ 53.76	$ 92.16	$ 115.20	$ 84.48	$ 69.12	$ 69.12	$ 76.80	$ 92.16	$ 99.84	$ 69.12	$ 38.40	$ 860.16	$ 85.33
Training	$ -	$ -	$ -	$ -	$ 450.00	$ -	$ -	$ -	$ -	$ 350.00	$ -	$ 800.00	$ 88.89
FUTA Tax	$ 36.00	$ 83.11	$ 51.22	$ 982.98	$ 49.49	$ -	$ 38.40	$ 39.00	$ 40.20	$ 38.80	$ -	$ 1,359.20	$ 147.02
Unemployment Ins	$ 74.44	$ 117.00	$ 112.50	$ 27.92	$ 23.03	$ 23.43	$ 21.30	$ 42.00	$ 49.69	$ 25.90	$ -	$ 517.21	$ 49.20
	$ 5,484.25	**$ 6,861.27**	**$ 8,184.83**	**$ 6,546.80**	**$ 5,794.27**	**$ 4,323.30**	**$ 5,711.49**	**$ 4,789.56**	**$ 7,209.87**	**$ 5,094.18**	**$ 2,375.00**	**$ 62,374.82**	**$ 6,057.29**
Capital Expenditure													
Filter/Housing	$ -	$ -	$ -	$ -	$ 1,531.97	$ -	$ -	$ 6,675.97	$ 4,920.90	$ 7,609.67	$ 159.58	$ 20,898.09	$ 2,304.28
Distribution Upgrade	$ 460.00	$ 202.24	$ 2,713.28	$ 12,276.00	$ 4,443.34	$ 2,115.56	$ -	$ 2,781.40	$ 4,875.95	$ 2,259.75	$ 107.33	$ 32,234.85	$ 3,518.61
Maintenance Costs	$ 2,980.37	$ 1,077.83	$ 474.16	$ 3,285.34	$ 1,355.92	$ 182.67	$ 1,960.10	$ 844.64	$ 1,814.23	$ 4,565.00	$ 355.08	$ 18,895.34	$ 1,728.88
Engineering Costs	$ 5,978.09	$ 9,707.87	$ -	$ -	$ 1,000.00	$ -	$ -	$ 3,358.57	$ 2,007.83	$ -	$ -	$ 22,052.36	$ 1,786.03
Investment	$ -	$ -	$ -	$ -	$ -	$ 8,000.00	$ 8,000.00	$ 3,000.00	$ 8,000.00	$ -	$ -	$ 27,000.00	$ 3,000.00
	$ 9,418.46	**$ 10,987.94**	**$ 3,187.44**	**$ 15,561.34**	**$ 8,331.23**	**$ 10,298.23**	**$ 9,960.10**	**$ 16,660.58**	**$ 21,618.91**	**$ 14,434.42**	**$ 621.99**	**$ 121,080.64**	**$ 12,337.80**
Total	**$ 27,828.65**	**$ 32,762.90**	**$ 27,395.70**	**$ 45,179.96**	**$ 28,042.30**	**$ 25,767.09**	**$ 26,021.81**	**$ 37,985.96**	**$ 38,385.60**	**$ 28,685.47**	**$ 4,424.52**	**$ 322,479.96**	**$ 32,247.42**
Yearly Savings (income less costs)	**#REF!**	**#REF!**	**#REF!**	**#REF!**	**#REF!**	**#REF!**	**#REF!**	**#REF!**	**#REF!**	**#REF!**	**#REF!**	**#REF!**	**#REF!**

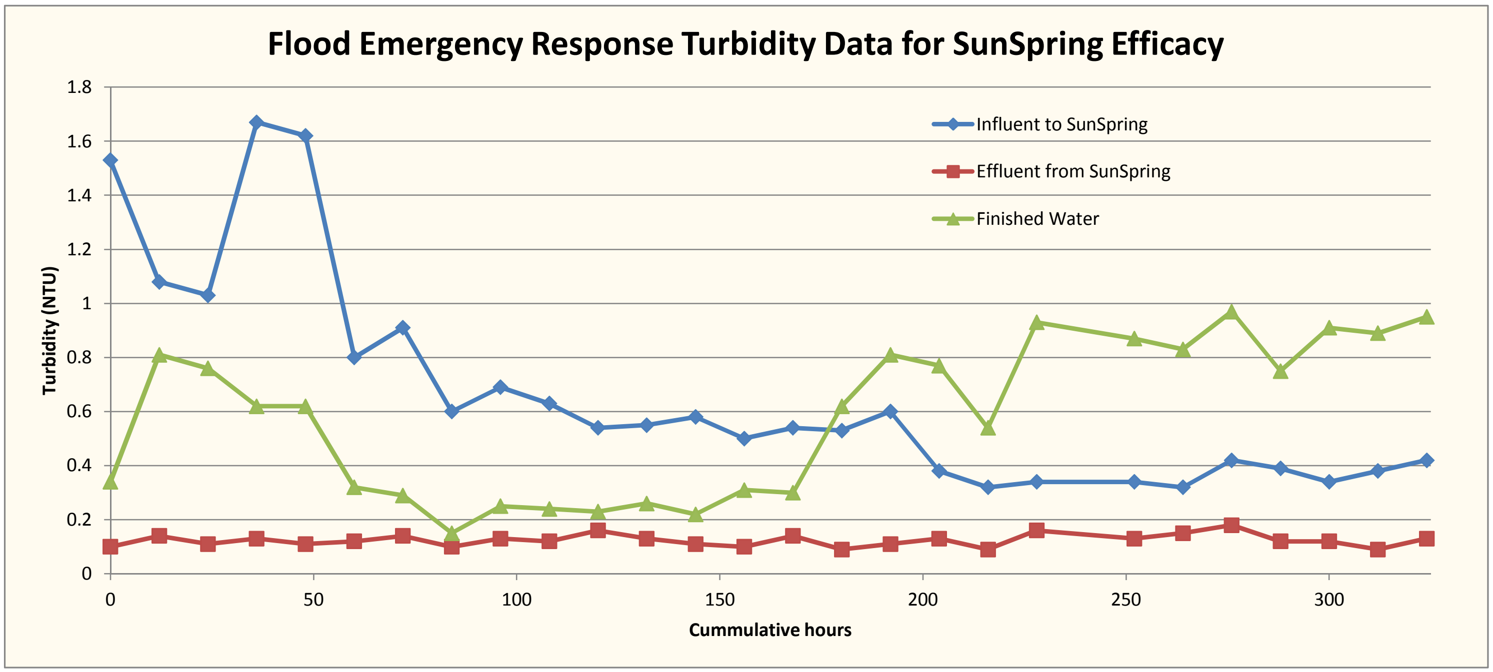
Attachment 3 - Usage Summry 2013

LOT #	Last Name	OCT Usage	NOV Usage	DEC Usage	JAN Usage	FEB Usage	MAR Usage	APR Usage	MAY Usage	JUN Usage	JUL Usage	AUG Usage	SEP Usage	Total	Monthly Average	Daily Average
		2012			2013											
55	Krise	0	0	0	0	0	0	0	0	2,500	2,500	1,700	1,500	8,200	683	23
37 - 38	Tonkinson	0	0	0	0	0	0	0	10	0	0	0	0	10	1	0
33	Oppermann	0	0	0	0	0	0	0	0	0	0	0	3,900	3,900	325	11
32	Hartigan	0	0	0	0	0	0	0	0	100	0	0	0	100	8	0
34	Biebel	3,900	2,500	2,300	2,900	5,800	4,100	3,800	6,600	5,500	0	5,000	2,800	36,500	3,767	126
35	McGuire	0	0	0	0	0	0	300	1,900	2,500	1,400	2,500	1,200	9,800	817	27
36	Cargill	900	1,200	600	900	0	200	700	600	1,400	1,500	1,300	900	7,500	850	28
39	Strom	900	700	2,100	800	1,000	1,500	400	1,500	1,700	0	0	0	6,900	883	29
41	Landwer	2,700	1,800	0	0	0	0	0	0	11,000	4,800	1,400	0	17,200	1,808	60
46	Turner	100	1,100	1,700	200	1,300	4,400	500	300	2,200	4,500	2,200	3,000	18,600	1,792	60
47	Johnson	2,000	2,700	2,500	1,700	1,800	1,800	1,700	1,800	3,400	2,800	2,600	1,900	19,500	2,225	74
49	Hames	400	100	100	100	0	100	200	100	400	400	200	200	1,700	192	6
51	Kesson	0	100	200	100	100	100	400	0	400	900	800	100	2,900	267	9
54	Lake	3,900	3,300	3,900	2,500	4,200	3,400	3,700	5,100	7,300	5,000	5,500	3,000	39,700	4,233	141
53	Todd	1,300	0	0	500	1,400	800	1,500	1,600	4,700	0	800	1,300	12,600	1,158	39
44	McLaughlin	0	0	0	0	0	0	0	0	0	0	1,200	4,600	5,800	483	16
43	Doyle	0	400	200	0	700	200	0	400	0	3,200	2,000	300	6,800	617	21
30-31	Hill	0	0	0	0	0	0	0	0	0	0	0	2,000	2,000	167	6
27	Leister	0	0	0	0	0	800	400	300	3,900	6,900	4,200	800	17,300	1,442	48
25	Connolly	300	0	0	2,100	100	100	200	0	0	100	3,600	1,200	7,400	642	21
21	Stewart	3,300	3,900	4,100	4,000	2,900	4,900	3,400	34,200	4,500	4,400	4,200	3,700	66,200	6,458	215
18	Kovner	0	1,100	900	0	0	1,500	0	0	0	900	1,000	0	3,400	450	15
22	Miller	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
24	Brock	1,700	1,000	800	1,300	1,000	1,000	1,000	900	2,100	1,200	1,100	400	10,000	1,125	38
4	Peirce	4,400	10,300	6,400	7,900	8,500	5,600	7,000	8,400	5,200	4,700	4,700	3,200	55,200	6,358	212
1	Dedreu	0	0	0	0	0	0	0	1,900	700	1,700	2,900	0	7,200	600	20
7	Warren	0	0	0	0	0	0	0	1,500	2,300	2,700	2,300	600	9,400	783	26
5	Ruch	2,300	3,300	9,100	2,900	1,600	1,900	1,900	2,100	1,900	2,000	1,500	1,600	17,400	2,675	89
16	Lewis	3,200	4,800	0	2,000	0	0	0	0	0	0	1,900	2,300	6,200	1,183	39
14	Geppinger	2,400	1,800	2,500	2,000	2,200	1,700	2,100	2,100	1,900	2,600	2,900	1,300	18,800	2,125	71
6	Novic	1,100	2,500	4,000	1,800	2,400	2,300	1,900	3,300	3,000	3,600	2,700	3,200	24,200	2,650	88
15	Nelson	6,500	2,700	2,500	1,900	2,100	1,300	1,600	2,600	14,600	21,400	21,100	13,400	80,000	7,642	255
8	Mauerman	4,900	4,500	6,000	3,700	4,300	4,500	4,400	5,300	7,100	4,500	6,100	4,400	44,300	4,975	166
9	Newton	1,800	1,000	900	1,000	1,500	1,100	1,100	1,600	2,400	1,700	1,400	1,100	12,900	1,383	46
10	Morris	400	400	400	400	200	0	500	300	0	1,000	500	100	3,000	350	12
11	Kostohryz	400	100	1,900	2,200	1,200	0	400	500	2,500	3,200	1,800	1,700	13,500	1,325	44
13	Stein	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
17	Lawrence	1,000	3,000	6,010	3,990	4,000	2,000	3,000	3,000	2,000	2,000	2,000	3,000	24,990	2,917	97
19	Mark	0	0	0	0	0	0	0	0	0	0	1,300	2,200	3,500	292	10
20	Hans	1,100	300	200	0	1,300	700	1,800	1,500	3,600	5,000	3,200	500	17,600	1,600	53
50	Ross										2,700	3,700	3,300	9,700	3,233	108
	Sum of all Users	**50,900**	**54,600**	**59,310**	**46,890**	**49,600**	**46,000**	**43,900**	**89,410**	**100,800**	**99,300**	**101,300**	**74,700**	**816,710**	**68,059**	**2,269**
	Approximated extra useage 20% (for residences with broken meters)	10180	10920	11862	9378	9920	9200	8780	17882	20160	19860	20260	14940	163342	13612	454

Bleeders	Bleeder LOC	OCT Usage	NOV Usage	DEC Usage	JAN Usage	FEB Usage	MAR Usage	APR Usage	MAY Usage	JUN Usage	JUL Usage	AUG Usage	SEP Usage	Total Usage	Monthly Ave	Daily Ave
Total		61,080	65,520	71,172	56,268	59,520	55,200	52,680	107,292	120,960	119,160	121,560	89,640	980,052	81,671	2,722
#1	**Shelby**	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
#2	**Evenson**	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
#3	**Warren**	79,500	80,500	91,100	3,900	208,000	218,600	218,900	124,900	16,700	20,300	19,900	11,800	843,000	91,175	3,039
#4	**Newton**	21,700	18,400	20,900	103,000	180,400	212,400	213,300	118,200	0	0	0	1,100	828,400	74,117	2,471
#5	**Morris**	36,600	13,400	31,000	69,500	76,800	211,200	222,400	124,700	6,300	7,200	6,400	0	724,500	67,125	2,238
#6	**Johnson**	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Sum of all bleeders		**137,800**	**112,300**	**143,000**	**176,400**	**465,200**	**642,200**	**654,600**	**367,800**	**23,000**	**27,500**	**26,300**	**12,900**	**2,789,000**	**232,417**	**7,747**
Approximated extra useage 40% (for bleed lines with broken meters)		**55,120**	**44,920**	**57,200**	**70,560**	**186,080**	**256,880**	**261,840**	**147,120**	**9,200**	**11,000**	**10,520**	**5,160**	**1,115,600**	**92,967**	**3,099**
Total		**192,920**	**157,220**	**200,200**	**246,960**	**651,280**	**899,080**	**916,440**	**514,920**	**32,200**	**38,500**	**36,820**	**18,060**	**3,904,600**	**325,383**	**10,846**
Input to Plant	**FOX #4**	135,400	121,000	138,200	196,000	519,600	496,000	488,900	342,300	65,100	66,600	39,400	49,700	2,263,600	188,633	6,288
	WILLOW #3	140,700	128,000	232,400	317,300	426,000	502,900	510,300	303,300	186,000	129,600	152,900	56,500	2,584,800	215,400	7,180
Sum of all intake		**276,100**	**249,000**	**370,600**	**513,300**	**945,600**	**998,900**	**999,200**	**645,600**	**251,100**	**196,200**	**192,300**	**106,200**	**5,744,100**	**404,033**	**13,468**
		6430.7	5240.7	6673.3	8232.0	21709.3	29969.3	30548.0	17164.0	1073.3	1283.3	1227.3	602.0		10846.1	
		3.2	2.6	3.3	4.1	10.8	14.9	15.2	8.5	0.5	0.6	0.6	0.3		5.4	
		5.3	4.3	5.5	6.8	17.9	24.8	25.3	14.2	0.9	1.1	1.0	0.5		9.0	
		4.5	3.6	4.6	5.7	15.1	20.8	21.2	11.9	0.7	0.9	0.9	0.4		7.5	

Attachment 4 - Sun Spring Turbidity Testing

		Turbidity (NTU)																										
	Day	21-Sep	22-Sep		23-Sep		24-Sep		25-Sep		26-Sep		27-Sep		28-Sep		29-Sep		30-Sep		1-Oct	2-Oct		3-Oct		4-Oct		5-Oct
	Time	16:00	8:00	16:00	8:00	16:00	8:00	16:00	8:00	16:00	8:00	16:00	8:00	16:00	8:00	16:00	8:00	16:00	8:00	16:00	8:00	8:00	16:00	8:00	16:00	8:00	16:00	8:00
Sampling Location	Willow Creek Influent at Treatment Facility		1.06	1.11	0.96	1.09	0.81		0.63	0.61	0.67	0.56	0.59	0.56	0.47	0.49	0.4	0.43	0.42	0.45	0.36	0.29	0.32	0.28	0.25	0.42	0.44	0.32
	S. Fox Creek Influent at Treatment Facility	1.49	2.73	1.82	1.31	1.36	1.01	0.95	0.59	0.55	0.6	0.62	0.57	0.63	0.55	0.58	0.53	0.54	0.51	0.54	0.42	0.36	0.41	0.39	0.38	0.46	0.46	0.4
	Influent to SunSpring	1.53	1.08	1.03	1.67	1.62	0.8	0.91	0.6	0.69	0.63	0.54	0.55	0.58	0.5	0.54	0.53	0.6	0.38	0.32	0.34	0.34	0.32	0.42	0.39	0.34	0.38	0.42
	Effluent from SunSpring	0.1	0.14	0.11	0.13	0.11	0.12	0.14	0.1	0.13	0.12	0.16	0.13	0.11	0.1	0.14	0.09	0.11	0.13	0.09	0.16	0.13	0.15	0.18	0.12	0.12	0.09	0.13
	Finished Water	0.34	0.81	0.76	0.62	0.62	0.32	0.29	0.15	0.25	0.24	0.23	0.26	0.22	0.31	0.3	0.62	0.81	0.77	0.54	0.93	0.87	0.83	0.97	0.75	0.91	0.89	0.95
	cummulative hours	0	12	24	36	48	60	72	84	96	108	120	132	144	156	168	180	192	204	216	228	252	264	276	288	300	312	324



Attachment 5 – 2011 GE Homespring Acceptance

STATE OF COLORADO

John W. Hickenlooper, Governor
Christopher E. Urbina, MD, MPH
Executive Director and Chief Medical Officer

Dedicated to protecting and improving the health and environment of the people of Colorado

4300 Cherry Creek Dr. S.
Denver, Colorado 80246-1530
Phone (303) 692-2000
Located in Glendale, Colorado

Laboratory Services Division
8100 Lowry Blvd.
Denver, Colorado 80230-6928
(303) 692-3090

http://www.cdphe.state.co.us

Colorado Department of Public Health and Environment

June 23, 2011

Jack Barker
Owner/CEO
Innovative Water Technologies
29625 Industrial Park Road
Rocky Ford, CO 81067

Subject: Updated acceptance of the GE/Zenon Homespring Model UF211 as an Alternative Filtration Technology to meet the *Colorado Primary Drinking Water Regulations* (CPDWR) requirements for *Giardia lamblia* and *Cryptosporidium* Removal

Dear Mr. Barker;

Per our meeting on June 1, 2011, the Water Quality Control Division (the Division) has received and reviewed the additional information for the GE/Zenon Homespring filtration system including its incorporation into the Sunspring filtration system in accordance with Article 1.11.2 and Article 7 of the *Colorado Primary Drinking Water Regulations* (CPDWR). The design meets or exceeds the requirements of the *State of Colorado Design Criteria for Potable Water Systems* and is accepted for use as an Alternative Filtration Technology subject to the performance conditions outlined in Table 1 and the Additional Design Criteria given in Table 2.

The acceptance was revised from both the March 16, 2007 letter to reflect current pre-filter products and membrane skids as well as correct other manufacturer requested modifications. The March 16, 2007 acceptance letter is therefore superseded.

This acceptance addresses the following items:

- GE/Zenon Homespring UF211 filter and housing
- IWT UF 5, 10, 20, 30, 40, 50 pre packaged filtration skids
- IWT Sunspring SS24 and SS36 skids

This acceptance applies only to the GE Homespring Filtration system and associated IWT filtration skids and does not constitute construction approval for installation in public water systems. **Review and construction approval for the design of any public water system proposing to use this technology will be handled on an individual basis by the Division as required by Article 1.11.2 of the *Colorado Primary Drinking Water Regulations* (CPDWR).**

As part of this review, the Division has evaluated the following documents:

- March 16, 2007 Colorado Acceptance of the GE Homespring Filtration Unit

  - June 2005 Bio Vir Laboratories Inc. Purifier Test Report
  - NSF Standard 53 Certification
- Specifications sheet and drawing for the IWT UF 5-50
- Specifications sheet for the Sunspring SS24 and SS36
- WQA Certificate of Compliance (gold seal) for Sunspring SS24 and SS36 (12/20/2010)

Any change orders or addenda that address treatment or piping must be submitted to this office for review and acceptance by the Division prior to use in Colorado by a regulated public water system. This includes any changes made to the UF211 or to the IWT skids including piping layouts and pre-filters. The Division will review any additional third party verification reports and issue a revised acceptance letter if appropriate.

Table 1. Homespring UF211 Conditions of Acceptance:

Compliance Credit Granted to meet the requirements of the CPDWR *	
Giardia lamblia	3.0 – Log
Cryptosporidium	3.0 – Log
Virus	no credit granted
*** NOTE:** Compliance credit awarded is simply for meeting minimum requirements of the CDPWR Article 7 (Surface Water Treatment Rules - SWTR) and does NOT reflect demonstrated performance of the micro or ultrafiltration system in any way. Actual removals in these types of systems can frequently exceed 4.5-5.0 log removal of *Giardia, cryptosporidium,* or testing surrogates. The Division highly recommends that water systems compare manufacturer literature to determine the absolute performance of any system selected. These filters may be used as final compliance filters as part of a multiple treatment barrier approach to meeting SWTR requirements (Article 7, CPDWR). In addition to the above filtration, the water system MUST provide a minimum of **4.0-Log virus inactivation** by disinfection. Also, please note that the Division will evaluate the filter log removal credit and compliance monitoring criteria for systems that are classified as Bin 2 or higher as part of Article 7.4 of the CPDWR on a case- by-case basis.	

Technical Specifications – Membrane Element

Filter Manufacturer	**GE/Zenon**
Filter Model	**UF211**
Maximum Flow Rate (per filter)	4.5 gallons per minute (valid over temperatures 0 – 30 °C)
Maximum Daily Production (gallons)	5000 gallons per day
Maximum Transmembrane Pressure	40 pounds per square inch differential (psid)
Maximum Inlet Pressure	100 pounds per square inch (psig)
Minimum Outlet Pressure (backpressure)	35 pounds per square inch (psig)
Turbidity Performance Standards	< 0.1 NTU 95% of the time Not to exceed 0.5 NTU

Pre-filtration	Pre-filtration is required when raw water turbidity exceeds **5 NTU.** • Submittals should include at least **<u>6 raw water turbidity measurements</u>**, **TWO** taken in April, **TWO** taken in May and **TWO** taken in June Pre-filtration may consist of filtration previously installed at a facility or proposed new pre-filtration. Individual design submittals will need to provide documentation that proposed pre filtration both: • Meets applicable ANSI/NSF 61 requirements • Removes sufficient turbidity to function as a pretreatment barrier (Can be a statement from the manufacturer).

Table 2: Pre-Accepted IWT Skids Conditions of Acceptance:

Technical Specifications – Skids								
Skid Manufacturer	**IWT**							
Skid Type	**IWT UF**						**Sunspring**	
Skid Model Number	**UF5 – 1 filter**	**UF10 – 2 filters**	**UF20 - 4 filters**	**UF30–6 filters**	**UF40 – 8 filters**	**UF50 – 10 filters**	**SS24 – 1 filter**	**SS36 – 2 filters**
Maximum Daily Production (gallons)	5,000	10,000	20,000	30,000	40,000	50,000	5,000	10,000

Table 3: Homespring/IWT Additional Design Criteria:

Additional Design Criteria

1. Bypass piping to divert water around the filter will not be approved.
2. All systems used for compliance with the CPDWR Article 7 (surface water treatment) shall have the following on EACH filter:
    a. Influent solenoid valve
    b. Effluent check valve
3. A means to restrict or control flow across each filter shall be provided (flow restrictor on the effluent of the filter is allowable).
4. A 20 micron prefilter is required for the Homespring units.
5. A means to measure the flow across the filtration process shall be provided.
6. Systems shall provide a discussion justifying how the design flow of 4.5 gpm per filter will be maintained. Water systems design documentation must take into account peaking factors and instantaneous demand for filtration and must not take the daily production (6500 gallons per day) unless there is evidence that the flow is consistent throughout the day.
    a. Example: If a school is a public water system (operating hours 7 AM to 7 PM daily) and provides the Division information that it utilizes 12,000 gallons per day; they may NOT

only provide two filtration units. While 12,000 gallons per day equates to about 8.5 gpm as an average flow, this doesn't take into account that the school is closed throughout the night and not using water. The school would need to provide justification as to why only two filters would be necessary – perhaps the water plant runs 24 hours per day and fills a tank which can handle the peak demand during the day. If on the other hand, the school only operates the water plant during business hours, they may need to provide three or even four filter units in order to meet the required demand.

7. Pressure gauges shall be installed to properly monitor differential pressure on each filter. The public water system may use differential pressure gauges or individual inlet and outlet gauges and calculate differential pressure. Pressure transducers are an acceptable alternative to permanent gauges. The method of pressure measurement must be called out as part of the design submittal.
8. A pressure relief valve is required on inlet to each set to deploy at 100 psi.
9. The overall water treatment system design shall include provisions for protection from water hammer and pressure surges.
10. Adequate backflow prevention must be provided for the waste line. "Clean in Place" waste shall be properly disposed of via permitted or accepted methods.

Additional Operations and Maintenance Criteria

1. An Integrity Test Kit must be available for each installation and an individual who has obtained the Certified Homespring Technician certificate will be required to conduct integrity tests. Alternately, the Division will waive this requirement if the public water system is operated by a contractor who has the necessary training certificate and possesses a single Integrity Test Kit for multiple systems.
    a. Maintenance and integrity testing shall be performed only by a Certified Homespring Technician. The PWS can either employ an individual who has obtained the Certified Homespring Technician certificate or must have a routine maintenance contract with a Certified Homespring Technician. Article 9 of Title 25, C.R.S., requires that every water treatment facility and water distribution system be under the supervision of a certified operator holding a certificate in a class equal or greater than the minimum class required for the classification of the facility or water system. Please see the CDPHE Water and Wastewater Operators Certification Requirements Regulation 100 for additional information.
2. Integrity tests must be performed at least once per calendar week that the membrane produces treated water for distribution. If a filter fails an integrity test, the filter shall be removed from service immediately and replaced with a functional filter. The Division shall be notified within 24 hours in the event of a treatment failure.
3. The water system shall keep records of the following operational parameters (to be reviewed during a Sanitary Survey):
    a. Integrity test date, results (pass or fail), and initials of person performing the test
    b. CIP dates
    c. Filter replacement date and reason for replacement.
4. Water systems must maintain an operation and maintenance manual for the Homespring filtration system. All integrity tests and CIP procedures shall follow manufacturer prescribed procedures.
5. Chemicals used for CIP shall be certified under ANSI/NSF 60.

Please be aware that any point source discharges of water from treatment facilities are potentially subject to a discharge permit under Colorado's State Discharge Permit System. Any point source discharges to state waters without a permit are subject to civil or criminal enforcement action.

Please direct any further correspondence regarding this acceptance to:

Tyson Ingels, P.E.
Colorado Department of Public Health and Environment
Water Quality Control Division
4300 Cherry Creek Drive South
Denver, CO 80246

If you have any questions or comments, please call Tyson Ingels at 303-692-3002.

Sincerely,

Tyson Ingels, P.E.
Lead Drinking Water Engineer
Engineering Section
Water Quality Control Division

cc: Chia Kung
Global Product Manager – Membranes
Pentair Residential Filtration, LLC
5730 North Glen Park Rd.
Milwaukee, WI 53209

ec: CDPHE-WQCD-ES
CDPHE-WQCD-CA