Alpine Mountain Ranch Water Master Plan
Preliminary Engineering Report

(with addendum edits)

PREPARED: April 2025

PREPARED FOR: Alpine Mountain Ranch Metropolitan District

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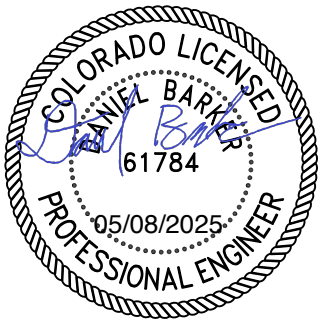

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Executive Summary

Statement of Purpose

This study/analysis was requested by the Alpine Mountain Ranch Metropolitan District to determine improvements to the existing Alpine Mountain Ranch and Priest Creek water systems as more houses are built in the district. Sunrise Engineering compiled this preliminary engineering report which investigates the required and recommended improvements to the supply, treatment, distribution, and storage of water in the combined Alpine Mountain Ranch and Priest Creek system. This report analyzed the system at the current buildout and full buildout. The results of this study indicated that the goal of reaching full buildout and remaining in compliance with CDPHE DW005 can be achieved with the recommendations listed below.

Recommended Improvements

1. Connect Well 5 to the Source Water System.
2. Improve Treatment Capacity
3. Improve the backwash settling pond.
4. Add Cartridge filtration to treatment process
5. Increase the system storage capacity depending on assumed Priest Creek water usage. Storage increase is split between the Priest Creek tank location and the Alpine Mountain Ranch tank location.
6. Install between 2900' and 5400' of 8" diameter pvc pipe to increase fire flow.
7. Increase the flow rate from the booster station from 52 gpm to 100 gpm.
8. Install fire suppression systems in the Alpine Mountain Ranch Owners Lodge and Ranch Managers buildings.

Benefits and Impacts

Some key benefits of the proposed upgrades to the existing water system include:

1. Full compliance with CDPHE DW005 and DW0011.
2. A dedicated transmission main to the Alpine Mountain Ranch tank to help with surge protection, water hammering, and to provide uniform pressure to the Alpine Mountain Ranch High Tank Zone.
3. Lower Booster Pump runtimes and increased booster pump lifetime.
4. Increased Treatment Capacity.
5. Increased Fire Flow.
6. Improved Water Quality/Consistancy
7. Decreased maintenance

Section 1: Background

Alpine Mountain Ranch Metropolitan District ("AMR") has requested that Sunrise Engineering ("Sunrise") analyze the combined AMR and Priest Creek ("PC") water systems' current and future flow requirements.

AMR is a water district located in Rural Colorado, south of Steamboat Springs. The community currently has 21 homes but will have 63 at full buildout. Alpine Mountain shares an infiltration gallery, wells, and a treatment facility with the Priest Creek development, so the two systems are intertwined, and data from both communities must be looked at together to form the complete picture.

Sunrise has been tasked with creating a 5-year plan analyzing the existing system, as well as data collected by the district and the sanitary survey to determine recommended improvements. The main focus of the improvements will be to provide good, clean water, in suffient supply for every resident, including future residents. The methods recommended will conform/adhere to CDPHE guidelines and requirements to ensure compliance with the governing agency.

Section 2: Existing Infrastructure

Existing Infrastructure Overview

The water system starts with source water from wells and infiltration galleries located within the Priest Creek subdivision. At the moment there are some temporary conditions that have 2 pumps non-functional, but the remaining sources are currently providing enough water to meet the needs of the system through the singular treatment facility. The treated water goes directly into the Priest Creek portion of the distribution system (rather than going directly to a storage tank). The potable water storage supply is alongside the distribution, with one lower storage unit (Priest Creek Tank), and one higher storage (Alpine Mountain Tank). Near the top of the Priest Creek System there is a booster pump station to help push the water from the lower pressure zone up to the Alpine Mountain Tank. On the upper (elevation) end of the system, the water flows back down to the system, going through pressure-reducing valves to help maintain appropriate pressure for the different pressure zones. This distribution line eventually circles back to the pipe network that is connected to the booster station, thus creating a loop where water can keep from stagnating.

In 2023 a sanitary survey of the Alpine Mountain Ranch Water System was completed by CDPHE. This survey looks at the system and comments on the effectiveness, as well as evaluationof compliance with required ordinances and codes. While the CDPHE survey did find some book-keeping violations, as well as some observations/recommendations, the system has not been deemed out of compliance. AMR has already taken some steps, and is continuing to take steps to ensure a smoothly operated and effective system is in place to handle all of AMR and PC needs. Some of these steps include AMR hiring CDC Engineers to improve the treatment facility via updated electronics, filters, and measuring devices. The majority of these improvements have already been implemented, but there are still aspects that are in process, mainly the utilization of a new filter media in the treatment filters.

Existing Source Water and Water Rights

Table 2.1 gives a brief synopsis of the water rights for AMR and PC. Currently, the main sources of domestic and irrigation water come from Wells 1-5(including the proposed well 5) and the infiltration

gallery. All of the source water information was analyzed from the "Summary of Water Rights of Alpine Mountain Ranch Metropolitan District" written on 02/03/2021.

AMR currently has 135 gpm in water right from wells 1-5 as an absolute water right and 65 gpm as a conditional water right. An absolute water right entails that the amount specified can be diverted and beneficially used, by the owner, in accordance with the terms of the water court decree and the prior appropriation system. A conditional water right sets an appropriation date for a certain flow, similar to an absolute water right, but before water can be diverted and put to beneficial use by the owner. Typically this is done when significant infrastructure improvements, time, and money are necessary for the water's use. Every six years, a diligence application is required to show that work has been done on the conditional water rights. During this diligence application, water rights can be changed from conditional to absolute. If a diligence report is not filed every six years, the conditional water right can be canceled.

Table 2.1 – Water Rights Snapshot

Water Rights Snapshot	
Source	gpm
Infiltration Gallery	50
Wells 1-5 (Absolute)	135
Wells 1-5 (Conditional)	65
Alpine Pond 1	40-acre ft

Existing Water Treatment Facility

The existing water treatment facility that serves both AMR and Priest Creek is located at latitude N40° 25' 59" longitude W106° 48' 29". The facility is supplied by a single inlet from the source water wells/infiltration gallery and outputs from its storage clearwell to the distribution system. Currently, the facility has two filters that are operating with approved filtration media, with each filter capable of producing approximately 80 gpm of treated flow. At the moment the 3rd filter (called "filter 2" based on as-built drawings), is not in use. Per CDPHE, the rated flow of a system is determined assuming that the highest producing filter is not in use. This means that currently the facility is only rated for 80gpm while filter 2 is not in use. CDC is currently in the process of having new media approved so that filter 2 can be operable with a higher flow rate to match filters 1 and 3.

The facility currently runs a direct filtration system that is supplemented with alum coagulation, polyphosphate for corrosion control assistance, aeration, and sodium hypochlorite for disinfection. A barrel of caustic soda is used for pH control, but this is not currently needed for water quality or improvement, and so is not in use. . After treatment, the water goes into an 18,024-gallon baffled clearwell, acting as a chlorine contact basin. The finished floor elevation is 6812 ft, with the clearwell located under the treatment plant.

Per CPDHE, the treatment filters need to have water flow backwash through the filter media to clean them from debris buildup. In this particular system, this backwash is frequently triggered by the turbidity of the filtered water being over the allowed standard. The lines are then backwashed until the filters are assumed clean enough to run again. This backwash water is sent to a surface detention pond behind the facility. This pond is (currently) covered with snow, but older pictures show the site as over-vegetated and is suspected to not be lined with any barrier material. This lack of a liner is one of the current issues that needs to be addressed.

After the filters, if the turbidity is within acceptable limits, the water goes through an open air aerator, and then is sent into its clearwell under the treatment plant. This clearwell acts as a storage, as well as a chlorine contact basin – ensuring that the water has met CDPHE requirements of disinfection. The water is then pumped from the clearwell to the distribution system via pumps located in the treatment plant.

Existing Finished Water Storage

The AMR and PC systems use two water storage locations for finished water. The three PC Tanks are located East Northeast of the treatment plant at latitude N40° 26’ 04.56” longitude W106° 48’ 02.11”. The PC Tanks are connected to the distribution system and do not have a dedicated transmission main. The PC Tanks have a combined inlet/outlet pipe. The PC Tanks base elevation is approximately 7118’ in elevation with a Normal Operating Level of 7130’. The PC Tanks have a storage capacity of 30,000 gallons.

The AMR Tank is located East Northeast of Rockledge Road at latitude N40° 25’ 53.87” longitude W106° 47’ 01.95”. The AMR Tank is connected to the distribution system and does not have a dedicated transmission main. The AMR Tank has a combined inlet/outlet pipe. The AMR Tank bottom is at an approximate elevation 7575’ with a High Water Level of 7584.67’. The AMR Tank has a storage capacity of 75,000 gallons.

Existing Transmission and Distribution

The AMR and PC water distribution system is made up of two parts. The PC waterlines are 6” Ductile Iron Pipe and connect the treatment plant pumps to the PC Tank and the AMR distribution system. The AMR waterlines are 6” and 4” PVC pipes. The AMR distribution system has a pressure booster station to boost the water to the AMR Tank. The two systems are interconnected and rely on each other to supply water for the system's demands.

The combined system has four pressure zones: The AMR High Tank Zone, the AMR Mid Tank Zone 1, the AMR Tank Zone 2, and the PC Tank Zone. These pressure zones are controlled by the two water storage locations and four pressure relief valves. The AMR High Tank Zone pressure is fed from the AMR Tank and has a pressure between 60 psi and 135 psi. The AMR Mid Tank Zone 1 pressure is fed from the AMR Tank and is controlled by PRV 1 and PRV 2 to set the pressure between 45 psi and 118 psi. The AMR Mid Tank Zone 2 pressure is fed from the AMR Tank and is controlled by PRV 3 and PRV 4 to set the pressure between 45 psi and 132 psi. The PC Tank Zone pressure is fed from the AMR Tank and the PC Tank and provides pressures between 20 psi and 130 psi. A map of the water system and which pressure zone each lot is can be seen in Figure A1, in Appendix A.

Section 3: Current and Future Water Demand Projections

Analysis

AMR currently has 21 lots with water connections, as well as the owner's lodge, guest cabin, new guest cabin, and barn. PC currently has 11 lots with water connections, as well as the barn and one lot named CT. Currently, AMR residents have a fee schedule to deter large water usage. PC does not have a fee schedule based on usage and residents receive unlimited water for a flat fee. PC and AMR have an agreement that when AMR reaches 75% buildout, PC will adopt the same fee schedule as AMR.

According to the "Alpine Mountain Ranch Water System Design Guidelines and Specifications", AMR has a maximum daily water demand of 2,500 gallons per day per connection. Assuming a full AMR buildout of 63 lots and 4 ranch buildings, the AMR system would have a theoretical maximum demand of 167,500 gallons per day. PC doesn't have the same limitations, so the theoretical maximum demand of unlimited is assumed. Using the provided water usage data from AMR, a projected maximum day demand was calculated. For all lots not yet developed, the average flow of the developed lots was used. A 15% contingency was added to each flow, as no data was provided for each hour of the max and average day demands, and no diurnal curve could be created. The projected max day demand for AMR was determined to be 82,000 gallons and 96,000 gallons for PC with these assumptions. These values are summarized in Table 3.1 below.

After discussions with AMR, when AMR reaches 75% buildout and PC adopts the same water fee schedule, it is assumed that PC water usage will fall, but there aren't any codes or calculations to estimate this decrease. AMR has asked us to assume that water usage of every PC home will be that of 120% that of the average AMR home. This may increase some lots' use, but it will drastically decrease the overall usage of the PC taps as a whole. The overall demand based on this assumption lowers the required volume of the PC storage at full buildout significantly. However, just before the new rates apply, we assumed that the usage per tap for PC would remain the same. This means that the controlling case for sizing the PC tanks is actually at the 75% buildout stage, just before the new water rates are enforced. The required total storage at that point is 85,500 gallons. AMR should watch the water demand after 75% buildout to ensure that Priest Creek's usage does not exceed the assumed rates.

Table 3.1 – Current and Projected Water Demand

Current and Projected Water Demands				
Stage	Entity	Max Day Demand (gal)	Max Day Factor	Average Day Demand (gal)
Current	Alpine Mountain Ranch	25,431.40	3.13	8,118.32
	Priest Creek	66,490.40	7.50	8,861.11
74% Buildout	Alpine Mountain Ranch	63,119.93	3.31	19,060.89
	Priest Creek	76,463.96	7.50	10,190.28
100% Buildout	Alpine Mountain Ranch*	81,889.11	3.19	25,675.45
	Priest Creek**	95,579.95	7.50	12,737.85
	Priest Creek Adjusted***	23,031.31	3.19	7,221.22
*AMR max and average flows for undeveloped lots were assumed to be the average of the developed lots. (Max = 1,169.84 gpd) (Average = 373.44 gpd)				
**PC max and average flows for undeveloped lots were assumed to be the average of the developed lots. (Max = 9558.00 gpd) (Average = 1273.79 gpd)				
*** AMR Assumed PC Flow = 1.2 times the AMR Average and Max Day Flow				

See Appendix E for a visual diagram of how these numbers are obtained.

AMR asked us to include the estimated numbers from Civil Design Consultants' 2023 BDR report. They are as follows:

PC full buildout = 72,790 gpd
AMR full buildout = 131,800 gpd
Total at full buildout = 204,590 gpd

Recommended Design Criteria

Table 3.2 – Design Criteria

Design Criteria	
Assumption	Reference(s)
Minimum (Normal Operating Pressure in the Distribution System = 35 psi	10 States States Standards - Recommended Standards for Water Works, 2012 Edition
Max Zone Fire Surpression Zone Flow = 85 gpm	Alpine Mountain Ranch Water System Design Guidelines and Specification, March 2023
Max Instantaneos Turf Irrigation Flow = 10 gpm	Alpine Mountain Ranch Water System Design Guidelines and Specification, March 2023
Max Instantaneos Domestic Demand Flow = 15 gpm	Alpine Mountain Ranch Water System Design Guidelines and Specification, March 2023
Maximum daily water demand = 2,500 gallons	Alpine Mountain Ranch Water System Design Guidelines and Specification, March 2023
Fire Sprinkler Systems are required for all residential construction	Alpine Mountain Ranch Water System Design Guidelines and Specification, March 2023
Burried Finished Water Storage	Match AMR and PC existing tanks
Design Finished Water Storage for future maximum day demand + Fire Flow Storage	CDPHE DW005 Design Criteria for Potable Water Systems
Fire Flow required for buildings between 11,301 and 13,400 SF = 3000 gpm for 3 hr	International Fire Code 2021 - Table B105.1(2)
Fire Flow for buildings with greater than 3601 SF with automatic sprinklers = 1/2 of table B105.1(2) flow for 1 hr	International Fire Code 2021 - Table B105.1(1)
Priest Creek water rates will be changed to match Alpine Mountain Ranch at 75% buildout	Discussions with Alpine Mountain Ranch
Must meet Regulation 11	CDPHE DW005 Design Criteria for Potable Water Systems
4-Log Removal of Viruses	EPA Surface Water Treatment Rules
3-Log Removal of Giardia Lamblia	EPA Surface Water Treatment Rules
2-Log Removal of Cryptosporidium	EPA Surface Water Treatment Rules
Filter Flow rate = 8 gpm / ft^2	CDC BDR (2023) Request for Filter Media
Filter Backwash rate = 8 gpm / ft^2	CDC BDR (2023) Request for Filter Media
Post Filtration Turbidity <= 0.3 NTU	EPA Long Term 1 Enhanced Surface Water Treatment Rule
Number of filters minus 1 must be able to meet design flow	CDPHE DW005 Design Criteria for Potable Water Systems

Section 4: Source Water Analysis

Analysis

AMR is working on the addition of well 5 to the source water system. AMR asked that Sunrise not analyze the source water system, but to make the assumption that flow can be provided to the treatment plant (max 200 gpm per AMR water rights).

After discussing with the current water Operator for AMR, it has been determined that currently there are 2 water pumps that are non-functional due to an electrical problem that is currently being worked on.

The latest available flow data for each well has been put in a table is shown below:

Table 4.1 – Source Water Current Flow Rates

Pump	Measured Flow (gpm)
Well 1	Not functioning currently
Well 2	53
Well 3	44
Well 4	Not functioning currently
Infiltration 1	20
Infiltration 2	44

Section 5: Treatment Analysis and Recommended Improvements

Analysis

In 2023 improvements to the treatment facility were made based on CDC Engineering's recommendations/design. One aspect of CDC's design included getting a filter media approved for higher flow, which has not yet been approved. CDC is currently still working with CDPHE to find a solution for filter media in the current filters. CDC's plans seem to address most of the items mentioned in the sanitary survey performed by CDPHE. The item that appears to have not been addressed for the sanitary survey is the backwash pond. As a note, the survey had comments for the backwash pond in the observations/recommendations category, not in the violations category. Our analysis assumed that CDC's filter media proposal will be approved for the increased flow of the treatment system, but we will also consider some implications of it does not get approved.

Based on current usage projected out to full buildout, Sunrise recommends that the treatment facility be improved such that the rated flow is increased to 200 gpm. The current rated production of 80 gpm has been sufficient to provide the current needs of existing homes and buildings. However, at full buildout, the expected daily maximum water usage (including fire flow) would be around 185 gpm for the entire day. This value is based on the max-day usage assuming a max day factor of 7.5 for Priest Creek (as seen in Table 3.1). However, based on discussions with AMR, if we assume a max day factor of 4.5, (this would mean a significant decrease in water usage by PC), then 150 gpm from the facility is enough to satisfy the demands of the entire system. To reiterate, if the usage from Priest Creek can be reduced sufficiently, Sunrise recommends 150gpm for the treatment plant rated flow. If the Priest Creek usage is not curtailed, then Sunrise recommends 200gpm to meet the required needs of the system.

The treatment facility is currently producing quality water, but has some potential inefficienices due to non-optimal equipment/set-up. The system currently operates by shutting down the whole facility when turbidity limits coming off the filters is too high. However, due to the surge flow style (not in 24/7

continuous production) the turbidimeters that check the water leaving the filters are occasionally throwing false-high results, resulting in required down time and backwashing of the filters.

If the CDC filter media adjustment request is not approved/accepted, then the treatment facility will only being rated for ≈80 gpm from the two operating filters. These filters are operating with media that has been approved by CDPHE to operate at higher flows than typical media. Unfortunately this media is no longer commercially available, and equivalent media has not yet been approved by CDC for the same flow rates. If CDC is unable to obtain said approval, then additional steps may be required to reach required flow rates from the facility.

Based on the 2023 sanitary survey, previous work done by Sunrise, and our investigative work for this PER, the backflow detention pond is inadequate to perform its intended purpose. The pond may not adequately contain contaminants from the filter backwash and is a potential hazard that could lead to regulatory violations in the future (although not currently listed as non-complient).

The current water operator mentioned that he believes there could be a leak in the clear well under the treatment facility. Sunrise has not confirmed this claim, but an inspection when possible is recommended .

Recommendations

Sunrise's recommendation, regardless of whether CDC's proposed filter media adjusted flow rate is approved or not, is that the treatment plant is improved to provide additional flow. If the Priest Creek subdivision doesn't curb their water usage at 75% to full buildout, then Sunrise recommends a plant that is rated to produce 200gpm. If PC does reduce their usage (based on AMR's assumption on usage), then Sunrise recommends a plant that can produce 150gpm. In the case of providing 200gpm, or in the case of providing 150gpm but CDC's filter media adjusted flow rate isn't approved, meeting these flow requirements will very likely require including an increase in the number of filters required. This increased number of filters, will require an increase in the footprint (building addition) to house the added filters and possibly adding volume to the clearwell for adequate contact time (in the case of 200gpm). A figure showing what the potential improvements look like can be seen in Figure D.1 in Appendix D.

To continue to produce quality water, as well as reduce inefficiency in the system, Sunrise recommends adding CDPHE-approved cartridge filtration. The new cartridge filters will need to be installed after the existing filters, as they are a more precise filtration process. The existing filters would act as a prefiltration for the new cartridges, reducing the load/stress on the new filters and allowing them to produce more quality water before maintenance is needed. These filters would ensure quality water production for a wider range of influent, meaning the addition of a new well or seasonal changes are less likely to require process changes to meet all potable water standards. In addition, these filters allow for a higher turbidity limit that comes out of the existing filters (1 NTU vs 0.3 NTU). Currently, even with the surge flow scenario, the turbidimeters aren't hitting 1 NTU (the limit for cartridge filters). This would reduce the downtime associated with the current backwashing requirements by requiring less cycles. An additional benefit is a reduction in material lifespan loss. Everything from the filters and their media to the aerator that's located on the process line is being significantly stressed by the method and frequency of the backwash cycle. By reducing the cycles, all the equipment will last longer, including the remaining high-flow media for filters 1 and 3, which are no longer commercially available.

Sunrise recommends improvements to the backwash pond. The pond was flagged in the sanitary survey as hazardous water potentially polluting the nearby river with unpermitted, contaminated water. The survey did not list it as a "violation", but it is Sunrise's opinion that there is a high potential for future regulatory enforcement if the pond is left as-is. To mitigate these chances, Sunrise recommends either of two options. The first option would be making improvements to the existing pond such as increasing it's size, lining it, and either permitting it to discharge into the nearby stream, or designing it to be an evaporative system. The second option would be to abandon the pond, and instead utilize an underground tank (concrete, fiberglass, plastic, etc) that acts as a settling basin and includes the ability for the water to recirculate back into the influent that gets fed back into the treatment plant. This method has the benefits of ensuring no contamination of nearby water sources, as well as negating monitoring and reporting of a potential pond/leach field.

Section 6: Finished Water Storage Analysis and Required Improvements

Analysis

Based on the Pre-Design Criteria outlined in Table 3.2, water needs to be sufficient to supply the existing and proposed homes with sufficient water pressure during a maximum day demand with fire flow. As the system has two water storage locations that feed into each other, a balancing act was determined to determine the amount of water storage needed at each location. The AMR Tank feeds the AMR High Tank Zone, AMR Mid Tank Zones 1 and 2, and a portion of the PC Tank Zone, while the PC tank feeds a portion of the PC Tank Zone and sends water to the AMR tank through a booster station as needed. Because the AMR tank is able to feed every pressure zone, all of the fire flow storage needs to be stored at the AMR tank, minus what can be provided by the booster station from the PC tank. Equations 1 and 2 were used to determine the total system storage and the storage locations. The required fire flow, as shown in the Pre-Design Criteria, is 1500 gpm for one hour, as long as each house has fire sprinklers. After discussions with AMR, every house is required to have fire sprinklers, but the Lodge and ranch managers' house do not have fire sprinklers. Per the international fire code, for systems without fire sprinklers, this system would require a fire flow of 3000 gpm for 3 hours. If this is the case, the required fire storage in the finished water tank would increase by 450,000 gallons from the significantly less requirements with sprinklers.

$$V1 = Q_1 + Q_2 + Q_3 + Q_f - Q_B \qquad \text{EQ1}$$

$$V2 = Q_4 - Q_T \qquad \text{EQ2}$$

Where,

V1 = volume needed at the AMR Tank location (gallons)

V2 = volume needed at the PC Tank location (gallons)

Q_1 = max day flow demand for the AMR High Tank Zone (≈33,900 gallons)

Q_2 = max day flow demand for the AMR Mid Tank Zone 1 (≈6,900 gallons)

Q_3 = max day flow demand for the AMR Mid Tank Zone 2 (≈20,000 gallons)

Q_4 = max day flow demand for the PC Tank Zone (≈116,800 gallons)

Q_f = fire flow demand (≈90,000 gallons) (discussed in Section 7)

Q_B = booster station flow to the AMR Tank (≈6,000 gallons) (discussed in Section 7)

Q_T = max flow from the treatment plant (≈12,000 gallons) (discussed in Section 5)

Using Equation 1 and 2, it was determined that the required storage at the AMR tank site is ≈145,000 gallons and the required storage at the PC tank site is ≈105,000 gallons.

If the PC water usage is is lowered as described in Section 3, the required storage will decrease at the PC tank site. Q_4 will be changed from 116,800 gallons to 94,100 gallons. QT will be changed from 12,000 gallons to 9,000 gallons. This would lower the required storage at the PC tank location to ≈85,100 gallons (based on 75% buildout).

Recommendations

Sunrise's recommendation is to install multiple buried storage tanks at the AMR tank site with a combined volume of 70,000 gallons to add to the existing 75,000-gallon tank. A total storage of 145,000 gallons should be provided at this site.

Sunrise recommends installing buried storage tanks at the PC tank site with a combined volume of 55,500 gallons. This volume will provide the appropriate amount of storage for the current needs of the PC zone, as well as enough to cover and additional 6 lots from AMR (assumed for 75% buildout). Once the new water rates are implemented, Sunrise recommends monitoring the reduced water usage assumption, and add any additional storage as needed based on the actual usage. If the assumed reduction of water usage is obtained, then no additional storage is recommended.

Sunrise recommends installing fire protection sprinklers at the lodge and the ranch managers' house to avoid a system storage requirement of 745,000 gallons, instead of the 250,000 gallons (or less based on assumptions), that is recommended.

Section 7: Transmission/Distribution Analysis and Required Improvements

Analysis

Sunrise's analysis of the existing system shows that the current system is capable of meeting the current demand and providing a 500 gpm minimum fire flow to all points in the system. As the system moves toward full buildout, the system struggles to meet demand and fill the storage tank without the treatment plant and the booster pump running full-time during peak demand times. In addition, a large portion of the booster station flow, approximately eighty percent, would not go towards the tank, and would instead flow through the AMR system. With a pump providing the AMR high-pressure zone, pressures would be subject to spikes and hammers as the pumps turned on and off.

System pressures stabilize if the flow is gravity-based from a storage tank. Sunrise modeled a scenario with a dedicated transmission main from the booster station directly to the AMR storage tank. This dedicated transmission main improved pressures along the AMR High Tank Zone, improved water quality in the tank, and improved fire flow through the system.

Sunrise evaluated the existing booster station and determined that at full buildout, the existing booster station will provide an estimated 10 gpm surplus over the system demand, filling the tank at a rate of 600 gallons per hour, leading to long pump run times. Sunrise evaluated the booster station at different flow rates to determine if the tank filling rate can be increased, lowering pump runtimes and extending pump lifetimes. Through the analysis, the PC system and looped AMR system can provide 100 gpm to the pump station. The booster station can be upgraded to provide 100 gpm, increasing the future tank fill rate from 10 gpm to 60 gpm, increasing the tank fill rate from 600 gallons every hour to 3600 gallons. This would drastically decrease pump run times as well, potentially improving pump lifespans.

The final analysis on the system included fire flow to the existing fire hydrants. Routt County Fire uses the International Fire Code (IFC), 2021 edition, to set minimum flow rates to residences for a fire duration. For this system, with a max residence square footage of 12,500 SF, IFC dictates that 1500 gpm for one hour is required for residences with fire sprinklers. After discussions with Routt County Fire, 1500 gpm is recommended, but any increase in flow from 500 gpm is highly encouraged. To help with fire flow, scenarios were run with portions of the system upgraded to an 8” diameter pipe. The increased fire flow scenarios can be seen in Figures C.1 and C.2 in Appendix C

Recommendations

Sunrise recommends the addition of approximately 2900’ of 8” distribution pipe, the replacement of approximately 5400’ of 6” pipe with 8” pipe, transitioning the 6” waterline from PRV 2 to the AMR Tank to a dedicated transmission main, and replacing the 52 gpm booster pump station with a 100 gpm booster station.

Sunrise's preliminary analysis of this system shows improved water quality, the ability to handle the projected max day flow, and an increase in fire flow through the full system to a minimum of 800 gpm at all residences. If AMR decides that the system is acceptable with lower fire flows, the addition of the 5400’ of 8” waterline can be removed, but this decreases the available fire flow to 525 gpm in the southern portions of AMR.

Section 8: Recommended Timeline of Improvements

Source Water

Sunrise has not significantly reviewed the source water aspect of the AMR water system (per AMR request). However, Sunrise would recommend making improvements as needed (like adding well #5) to be able to provide the treatment plant with an adequate supply of raw water, depending on the desired rate of treatment flow (150 gpm if assumed reduction of PC water usage is realized, or 200 gpm if reduction of water usage for PC is *not* realized).

Treatment

Depending on future water usage of the Priest Creek subdivision, Sunrise recommends either improving the rated flow of treatment to 150gpm (if assumed PC water reduction at 75% buildout is realized), or 200gpm (if assumed PC water reduction at 75% buildout is not realized). In addition, Sunrise recommends improvements to the backwash pond, and adding cartridge filtration after the existing pressure filters.

Sunrise recommends the backwash pond improvement happen relatively quickly as it is more likely to incur regulatory backlash from CDPHE. For increasing the rated flow of the treatment plant, it depends on the usage of water that is seen from Priest Creek. We recommend improving the facility to its original 150 soon (by 40% buildout), to maintain CDPHE requirements. This is hopefully done through CDC obtaining appropriate filter media and bringing filter 2 back online, otherwise additional improvements will be needed. If it is determined that 200gpm will be needed to satisfy all water needs, we recommend that happen around or before 85% buildout. For the addition of the cartiridge filters, Sunrise recommends these be added once final flow (150gpm vs 200gpm) is determined. Knowing the flow rate will help make sure that the appropriate filters and setup are implemented. However, if steps could be taken to know which flow rate is needed, the sooner the cartridge filters can be added, the more efficiently the treatment plant can be run. Regardless of when the cartridge filters might be installed, they should be installed after the existing pressure filters.

Storage

The improvements to the storage aspect of the water system are to add fire-suppression sprinklers to the lodge and ranch manager's house, to add additional storage to the Priest Creek tank, and to add storage to the Alpine Mountain tank.

The first storage improvement recommended is to add capacity to the Priest Creek zone. The system is currently nearing the limit of the capacity of the tanks. To justify the size of the tanks for fire flow and full build-out, the sprinklers will already need to be installed – otherwise, the required fire flow will be significantly increased. It's also generally good practice to have fire sprinklers, but Sunrise recommends this improvement after the CDC improvements, after the backwash pond, and after the PC additional storage. Once those are installed, the AMR additional storage can be installed immediately after (if desired). If it is desired to push the tank storage improvements back, we recommend no later than approximately 75-80% of full build-out of AMR. That is when it becomes difficult to provide the required storage for all residences.

Distribution

Being directly tied with the fire flow/full build-out requirements, the distribution updates should occur at nearly the same time as the AMR tank site storage improvements. Both components (Storage/distribution) are required to meet full buildout requirements, so it only makes sense to separate them if there's a funding or timeline concern.

Arguably, the booster station could be saved for later improvement after the storage and pipe improvements are made – but this would leave the storage tanks (specifically the Alpine Mountain Tank) to fill very slowly. This may lead to not enough storage if design usage is realized, so Sunrise recommends improving this prior to the AMR tank improvements.

Combined

Below is an example timeline of improvements. While we were tasked with looking 5 years ahead, some of these improvements are more based on the percent buildout of the AMR ranch and have been labeled as such.

If CDC gets media approved for increased flow by CDPHE:

Table 8.1 – Potential Timeline if CDC Media Proposal is Accepted

Improvement	Recommended Finished Construction Date	
Backwash Pond Improvements	2025-2026 or ASAP	
Fire Suppression Sprinklers for Buildings	2025-2027 or before storage improvements	
PC Storage improvement	2026-2028 or 40% buildout	
Installation of Cartridge Filtration	2027-2029 or as soon as convenient or water quality requires	
Increased AMR storage and Distribution Upgrades, Booster Pump-improvement	2028-2030 (or 75% buildout)	
200gpm treatment flow (if required)	2028-2030 (or 85% buildout)	

If CDC is unable to get media approved for increased flow by CDPHE:

Table 8.2 – Potential Timeline if CDC Media Proposal is Not Accepted

Improvement	Recommended Finished Construction Date
Backwash Pond Improvements	2025-2026 or ASAP
150 gpm treatment flow improvement (building footprint increase)	2025-2027 or 40% buildout
PC Storage improvements	2026-2028 or 40% buildout
Fire Suppression Sprinklers for Buildings	2026-2027 or before storage improvements
add cartridge filters (footprint increase)	2027-2029 or as soon as convenient or water quality requires
Increased AMR storage and Distribution Upgrades, Booster Pump-improvement	2028-2030 (or 75% buildout)
200gpm treatment flow (if required)	2028-2030 (or 85% buildout)

Table 8.3 – Alternate Potential Timeline if CDC Media Proposal is Not Accepted

Improvement	Recommended Finished Construction Date
Backwash Pond Improvements	2025-2026 or ASAP
150-200 gpm treatment flow improvement (building footprint increase), add cartridge filters.	2025-2027 or 40% buildout
PC Storage Improvements	2026-2027 or 40% buildout
Fire Suppression Sprinklers for buildings, Booster Pump improvement	2026-2028 or before AMR Storage improvements
Increased AMR Storage and distribution upgrades	2028-2030 (or 75% buildout)

Section 9: Cost Analysis

Itemized construction estimates for the proposed recommendations are included in Appendix B, Table B.1-B.7. Engineering and Construction Administration costs were assumed to each be 10% of the final construction cost. A 50% contingency was added to each construction cost, due to the full design not being completed. A summary of these construction and engineering costs are summarized below:

1. Treatment Plant Backwash Pond Improvements - $310,525
    a. Engineering - ≈$30,000
    b. Construction and CMCA - $280,525
    c. These numbers are based on the sunrise recommendation for a new underground tank with recirculation capability. It is expected that the option to improve the existing tank will be less expensive, but difficult to know by how much until further design is done.

2. Booster Pump Station - $281,000
    a. Engineering - ≈$25,000
    b. Construction and CMCA - $256,000

3. Treatment Plant 150gpm Flow Upgrades if CDC media rejected - $387,000
    a. Engineering - ≈$35,000
    b. Construction and CMCA - $352,000
    c. Add ≈15% if 200gpm is needed

4. Add Cartridge Filtration - $290,00
    a. Engineering - ≈$25,000
    b. Construction and CMCA - $265,000

5. Storage Improvements
    a. Required Storage For 75% PC Buildout – $836,000
        i. Engineering - ≈$70,000
        ii. Construction and CMCA - $766,000
    b. Required Storage For AMR full buildout) – $939,000
        i. Engineering - ≈$80,000
        ii. Construction and CMCA - $859,000

6. Distribution Improvements
    a. Distribution Upgrades to Achieve 525 gpm Minimum Fire Flow – $977,000
        i. Engineering - ≈$85,000
        ii. Construction and CMCA - $892,000
    b. Distribution Upgrades to Achieve 800 gpm Minimum Fire Flow – $2,136,000
        i. Engineering - ≈$180,000
        ii. Construction and CMCA - $1,956,000

It is important to know that there are multiple ways that project improvements can be approached. While we have listed the estimated costs for our recommended improvements, there are additional potentials like adding a little cost on an earlier project to prepare (and thus not spend as much on) later projects. For example, if going to 150gpm treated requires additional facility space, you could buildout the facility to be able to house cartridge filters, but not implement the actual cartridge filters until later. This might frontload the cost, but would likely be cheaper overall than having two distinct building additions. Please keep this concept in mind when looking through the costs.

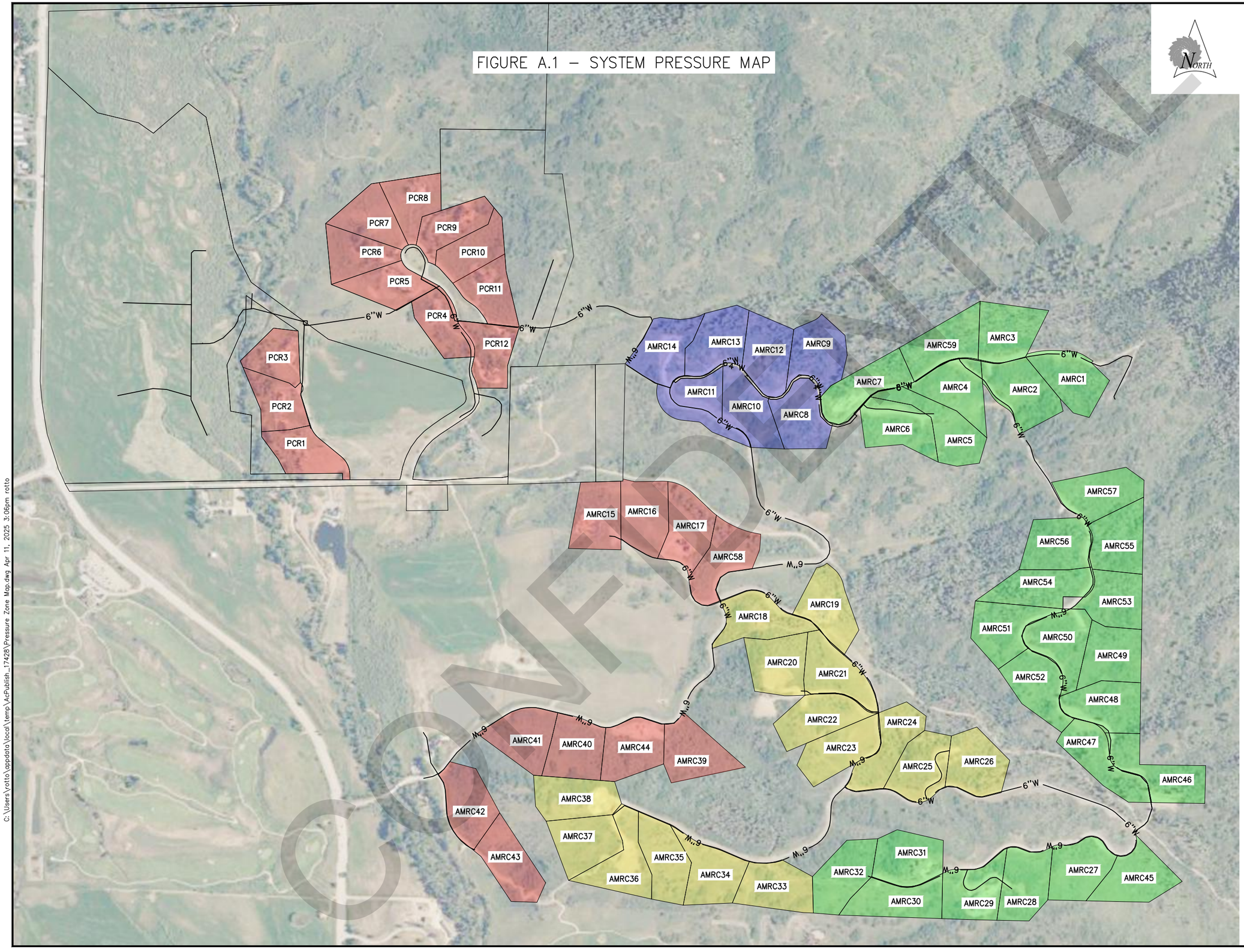
Section 10: Summary and Recommendations

The most important aspect of a potable water system is to provide adequate, clean water to every connection in the district. This is why we would prioritize these aspects of the system. However, due to the water quality being adequate currently, and the facility providing enough water for existing residents currently, our focus goes on the next most important aspect: compliance. This is why making sure the backwash pond does not flag the AMR system from a future CDPHE survey is a high priority. After that, and ensuring the treatment plant can produce the (at least initial) rate of 150gpm, the storage needs to be addressed next. The exiting total storage between the two tank sites is enough to cover current needs, but not by too much (≈10k gallons). Increasing the storage will relatively quickly become an issue. Since the PC zone uses far more water than they have storage in that zone, we recommend the initial storage improvements be focused in the PC zone. The next most important we believe is adding the sprinkler systems to existing buildings that don't currently have them. This is to ensure that the water system can provide fire flow requirements to the growing system. Adding the cartridge filters provides future water quality as well as greater efficiency for the treatment plant. While *this* can be done with other treatment improvements, these aren't as needed as the prior improvements mentioned. Once AMR starts approaching 75% building, Sunrise recommends adding capacity to the booster station, as well as adding storage in the AMR tank site. AMR should be monitoring the usage trend of the PC zone to see if additional storage and treatment flow are needed.

We believe this list to be a good 5-year (potentially a little longer) look into the future of the AMR potable water system. These improvements include our preliminary design recommendations, but during the final design, there may be aspects that come out or obstacles to overcome that would be better served by going a different route. This PER is to serve as a guide, not a step-by-step requirement for how to maintain and keep a well-operating potable water system for the Alpine Mountain Ranch and Priest Creek districts.

Appendix A: Existing Infrastructure

FIGURE A.1 – SYSTEM PRESSURE MAP



PRIEST CREEK TANK ZONE

ALPINE HIGH TANK ZONE

ALPINE MID TANK ZONE 1

ALPINE MID TANK ZONE 2

PRESSURE ZONE CONTROLS

PRIEST CREEK TANK ZONE:
- TREATMENT PLANT PUMPS (X2)
  - 150 GPM @ 347 TDH
- TREATMENT PLANT
  - CLEARWELL NWL = 6808.00
- PRIEST CREEK STORAGE TANK
  - 30,000 GALLONS
  - TANK NWL = 7130.00

ALPINE HIGH TANK ZONE:
- BOOSTER STATION PUMPS (X3)
  - 52 GPM @ 459 TDH
- AMRC STORAGE TANK
  - 75,000 GALLONS
  - TANK HWL = 7584.67

ALPINE MID TANK ZONE:
- PRV SETTINGS
  - PRV 3
    - ELEVATION = 7045.00
    - UPSTREAM = 132 PSI
    - DOWNSTREAM = 40 PSI
  - PRV 4
    - ELEVATION = 7245.00
    - UPSTREAM = 146 PSI
    - DOWNSTREAM = 45 PSI

ALPINE LOW TANK ZONE:
- PRV SETTINGS
  - PRV 1
    - ELEVATION = 7095.00
    - UPSTREAM = 119 PSI
    - DOWNSTREAM = 13 PSI
  - PRV 2
    - ELEVATION = 7265.00
    - UPSTREAM = 138 PSI
    - DOWNSTREAM = 45 PSI

SCALE
0 375' 750'
HORIZ: 1" = 750'

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Appendix B: Engineer's Opinion of Probable Cost

Table B.1 – Treatment Plant Backwash Pond EOPC

Engineer's Opinion of Probable Cost - Backwash Pond Improvements

Item No.	Item Description	Quantity	Unit	Unit Cost	Cost
1	MOBILIZATION	1.00	LS	$ 16,000.00	$ 16,000.00
2	SETTLING TANK AND RECIRCULATION	1.00	LS	$ 138,000.00	$ 138,000.00
3	ELECTRONICS	1.00	LS	$ 13,000.00	$ 13,000.00
				Subtotal =	$ 167,000.00
			50%	Contingency =	$ 84,000.00
				Engineering	$ 30,000.00
				Construction Management	$ 30,000.00
				Total =	$ 311,000.00

Table B.2 – Booster Station EOPC

Engineer's Opinion of Probable Cost - Booster Station

Item No.	Item Description	Quantity	Unit	Unit Cost	Cost
1	MOBILIZATION	1.00	LS	$ 14,000.00	$ 14,000.00
2	BOOSTER STATION PUMPS AND MISC PIPING	1.00	LS	$ 140,000.00	$ 140,000.00
				Subtotal =	$ 154,000.00
			50%	Contingency =	$ 77,000.00
				Engineering	$ 25,000.00
				Construction Management	$ 25,000.00
				Total =	$ 281,000.00

Table B.3 – Treatment Plant Flow EOPC

Engineer's Opinion of Probable Cost - Treatment Plant Expansion for 150 gpm (CDC media not accepted)

Item No.	Item Description	Quantity	Unit	Unit Cost	Cost
1	MOBILIZATION	1.00	LS	$ 20,000.00	$ 20,000.00
2	BUILDING EXPANSION	1.00	LS	$ 120,000.00	$ 120,000.00
3	ADDITIONAL TREATMENT	1.00	LS	$ 49,000.00	$ 49,000.00
4	REPIPING/CONNECTIONS	1.00	LS	$ 22,000.00	$ 22,000.00
				Subtotal =	$ 211,000.00
			50%	Contingency =	$ 106,000.00
				Engineering	$ 35,000.00
				Construction Management	$ 35,000.00
				Total =	$ 387,000.00

Table B.4 – Treatment Plant Cartridge Filtration EOPC

Engineer's Opinion of Probable Cost - Adding Cartridge Filters					
Item No.	Item Description	Quantity	Unit	Unit Cost	Cost
1	MOBILIZATION	1.00	LS	$ 15,000.00	$ 15,000.00
2	BUILDING EXPANSION	1.00	LS	$ 95,000.00	$ 95,000.00
3	CARTRIDGE FILTERS	1.00	LS	$ 33,000.00	$ 33,000.00
4	CONNECTIONS	1.00	LS	$ 17,000.00	$ 17,000.00
				Subtotal =	$ 160,000.00
			50%	Contingency =	$ 80,000.00
				Engineering	$ 25,000.00
				Construction Management	$ 25,000.00
				Total =	$ 290,000.00

Table B.5 – Water Storage for 75% Priest Creek EOPC

Engineer's Opinion of Probable Cost - Tanks Option 1					
Item No.	Item Description	Quantity	Unit	Unit Cost	Cost
1	MOBILIZATION	1.00	LS	$ 43,000.00	$ 43,000.00
2	FINISHED WATER STORAGE TANK (PC LOCATION) (55,500 GALLONS)	1.00	LS	$ 350,000.00	$ 350,000.00
3	MISC PIPING IMPROVEMENTS	1.00	LS	$ 71,000.00	$ 71,000.00
					$ -
				Subtotal =	$ 464,000.00
			50%	Contingency =	$ 232,000.00
				Engineering	$ 70,000.00
				Construction Management	$ 70,000.00
				Total =	$ 836,000.00

Table B.6 – Water Storage for 100% AMR EOPC

Engineer's Opinion of Probable Cost - Tanks Option 2					
Item No.	Item Description	Quantity	Unit	Unit Cost	Cost
1	MOBILIZATION	1.00	LS	$ 48,000.00	$ 48,000.00
2	FINISHED WATER STORAGE TANK (AMR LOCATION) (70,000 GALLONS)	1.00	LS	$ 420,000.00	$ 420,000.00
3	MISC PIPING IMPROVEMENTS	1.00	LS	$ 51,000.00	$ 51,000.00
				Subtotal =	$ 519,000.00
			50%	Contingency =	$ 260,000.00
				Engineering	$ 80,000.00
				Construction Management	$ 80,000.00
				Total =	$ 939,000.00

Table B.7 – Water Distribution System Option 1 EOPC

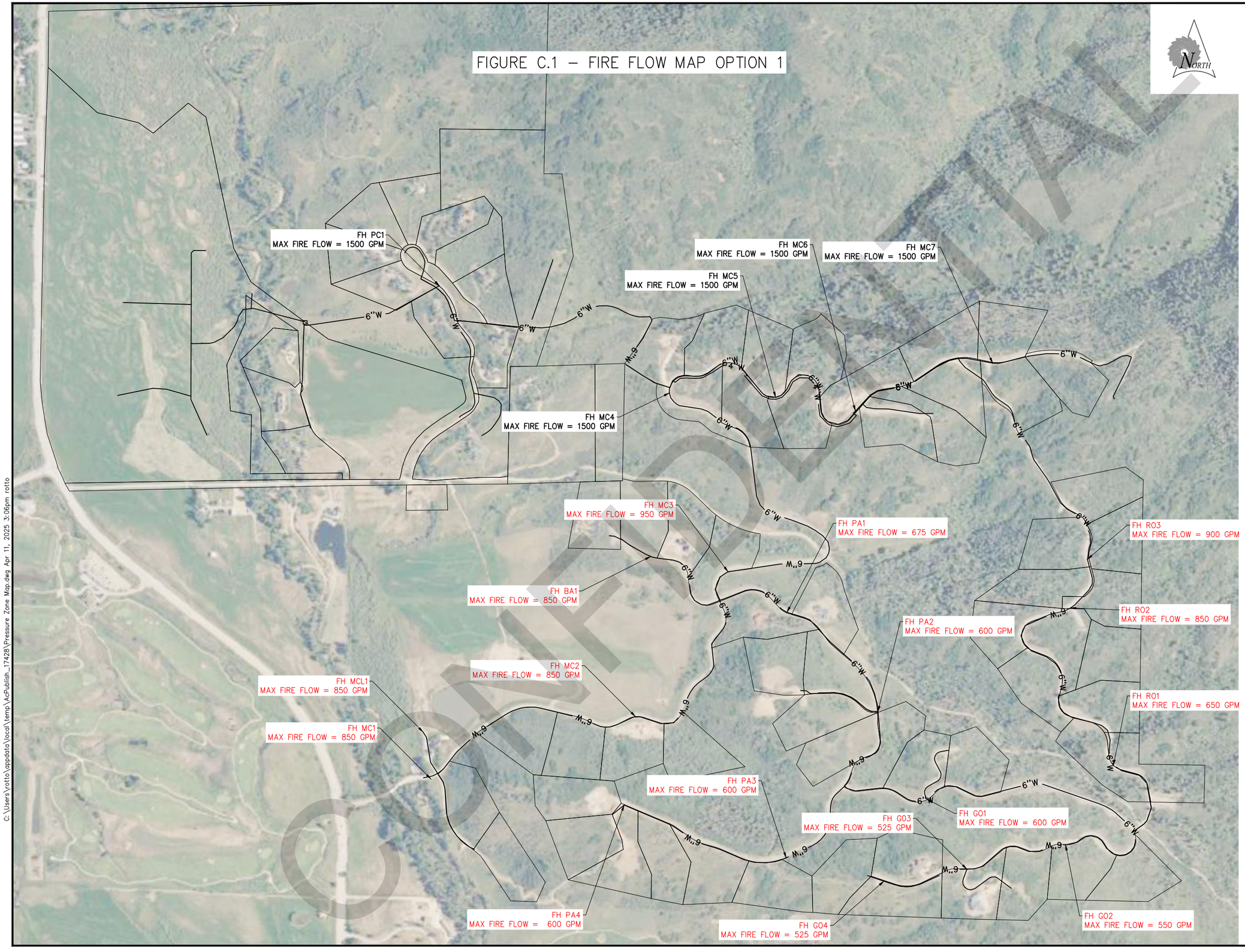
Engineer's Opinion of Probable Cost - Distribution Upgrades Option 1					
Item No.	Item Description	Quantity	Unit	Unit Cost	Cost
1	MOBILIZATION	1.00	LS	$ 49,000.00	$ 49,000.00
2	PVC WATERLINE (8")	2,900.00	LF	$ 140.00	$ 406,000.00
3	WATER VALVE (8")	6.00	EA	$ 8,000.00	$ 48,000.00
4	MISCELLANEOUS FITTINGS AND CONNECTIONS	1.00	LS	$ 20,000.00	$ 20,000.00
5	ADJUST WATER SERVICE	6.00	EA	$ 2,500.00	$ 15,000.00
				Subtotal =	$ 538,000.00
			50%	Contingency =	$ 269,000.00
				Engineering	$ 85,000.00
				Construction Management	$ 85,000.00
				Total =	$ 977,000.00

Table B.8 – Water Distribution System Option 2 EOPC

Engineer's Opinion of Probable Cost - Distribution Upgrades Option 2					
Item No.	Item Description	Quantity	Unit	Unit Cost	Cost
1	MOBILIZATION	1.00	LS	$ 110,000.00	$ 110,000.00
2	PVC WATERLINE (8")	6,300.00	LF	$ 140.00	$ 882,000.00
3	WATER VALVE (8")	13.00	EA	$ 8,000.00	$ 104,000.00
4	MISCELLANEOUS FITTINGS AND CONNECTIONS	1.00	LS	$ 40,000.00	$ 40,000.00
5	ADJUST WATER SERVICE	18.00	EA	$ 2,500.00	$ 45,000.00
				Subtotal =	$ 1,181,000.00
			50%	Contingency =	$ 595,000.00
				Engineering	$ 180,000.00
				Construction Management	$ 180,000.00
				Total =	$ 2,136,000.00

Appendix C: Fire Flow

FIGURE C.1 – FIRE FLOW MAP OPTION 1



FIRE FLOW ANALYSIS

FIRE FLOW ANALYSIS PERFORMED WITH MAX DAY AVERAGE HOURLY FLOWS. FLOW MUST MAINTAIN 20 PSI AT THE HYDRANT.

THIS FIRE FLOW SCENARIO IS RUN WITH A DEDICATED TRANSMISSION MAIN FROM THE BOOSTER PUMP TO THE ALPINE MOUNTAIN RANCH TANK, AND 8–IN DISTRIBUTION LINE FROM THE ALPINE MOUNTAIN RANCH TANK TO THE 6–IN WATERLINE AT ROCKLEDGE ROAD. THE BOOSTER PUMP IS SIMULATED WITH AN UPGRADED 100 GPM FLOWRATE

IFC REQUIREMENTS FOR SYSTEMS WITH FIRE SPRINKLERS IN HOUSES

FLOW = 1500 GPM
DURATION = 1 HR

SCALE
0 375' 750'
HORIZ: 1" = 750'

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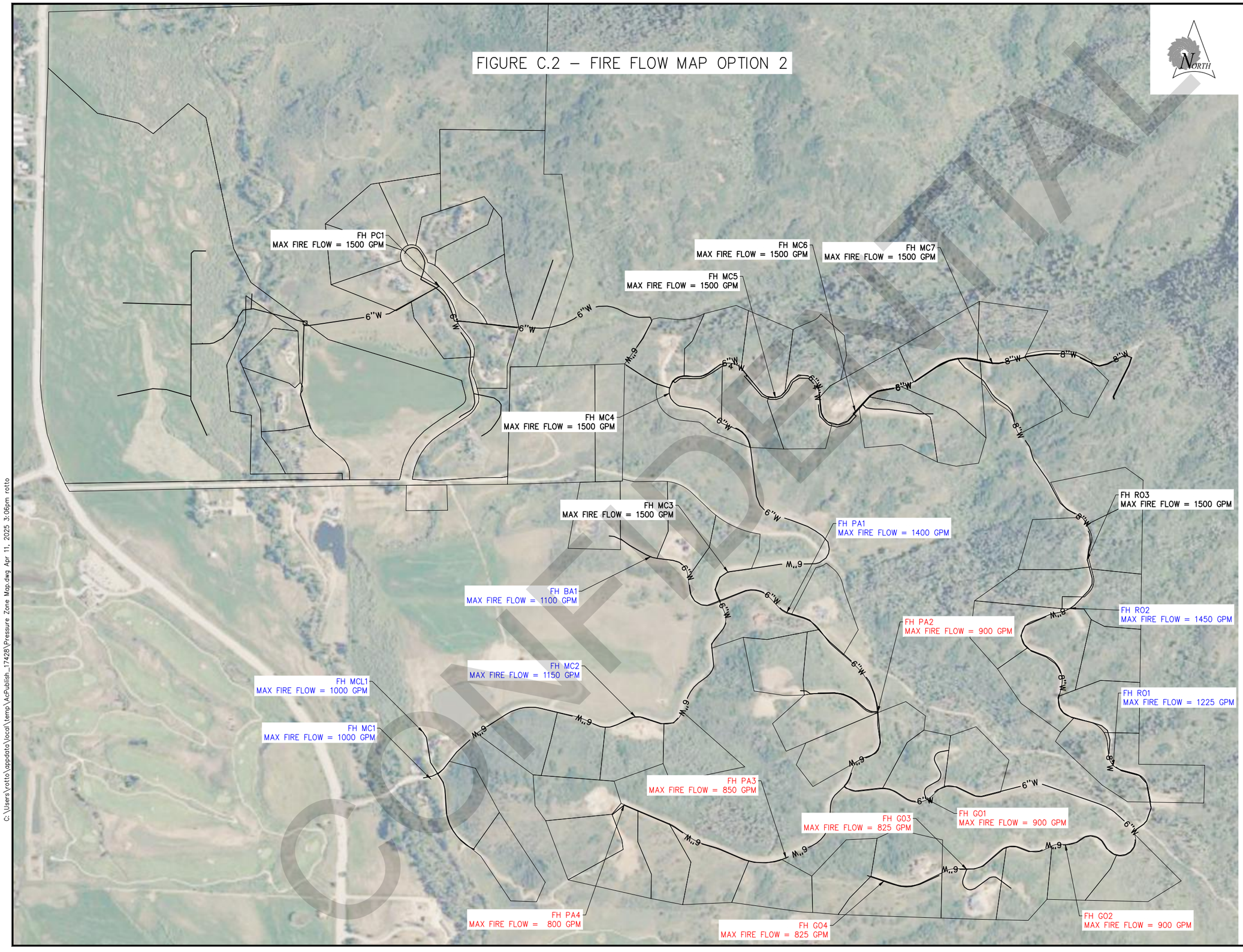
FIGURE C.2 – FIRE FLOW MAP OPTION 2



FIRE FLOW ANALYSIS

FIRE FLOW ANALYSIS PERFORMED WITH MAX DAY AVERAGE HOURLY FLOWS. FLOW MUST MAINTAIN 20 PSI AT THE HYDRANT.

THIS FIRE FLOW SCENARIO IS RUN WITH A DEDICATED TRANSMISSION MAIN FROM THE BOOSTER PUMP TO THE ALPINE MOUNTAIN RANCH TANK, AND 8–IN DISTRIBUTION LINE FROM THE ALPINE MOUNTAIN RANCH TANK TO THE 6–IN WATERLINE AT ROCKLEDGE ROAD AND DOWN ROCKLEDGE ROAD TO GOLDEN EAGLE DRIVE. THE BOOSTER PUMP IS SIMULATED WITH AN UPGRADED 100 GPM FLOWRATE

IFC REQUIREMENTS FOR SYSTEMS WITH FIRE SPRINKLERS IN HOUSES

FLOW = 1500 GPM
DURATION = 1 HR

SCALE
0 375' 750'
HORIZ: 1" = 750'

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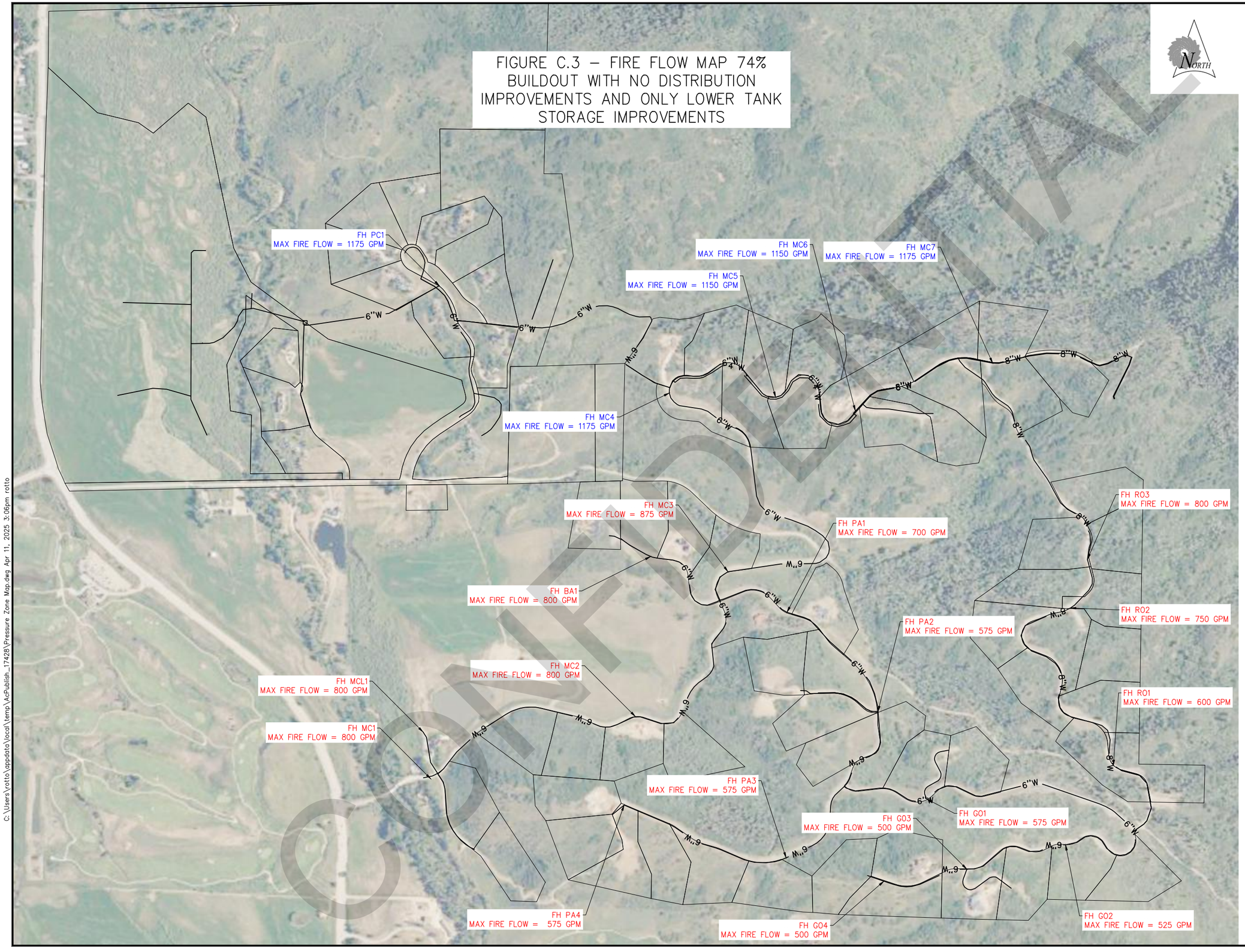
FIGURE C.3 – FIRE FLOW MAP 74% BUILDOUT WITH NO DISTRIBUTION IMPROVEMENTS AND ONLY LOWER TANK STORAGE IMPROVEMENTS



FIRE FLOW ANALYSIS

FIRE FLOW ANALYSIS PERFORMED WITH MAX DAY AVERAGE HOURLY FLOWS. FLOW MUST MAINTAIN 20 PSI AT THE HYDRANT.

THIS FIRE FLOW SCENARIO IS RUN WITH NO DISTRIBUTION AND TRANSMISSION IMPROVEMENTS. THE PRIEST CREEK TANK HAS BEEN UPSIZED TO 85500 GALLONS
IFC REQUIREMENTS FOR SYSTEMS WITH FIRE SPRINKLERS IN HOUSES

FLOW = 1500 GPM
DURATION = 1 HR

SCALE
0 375' 750'
HORIZ: 1" = 750'

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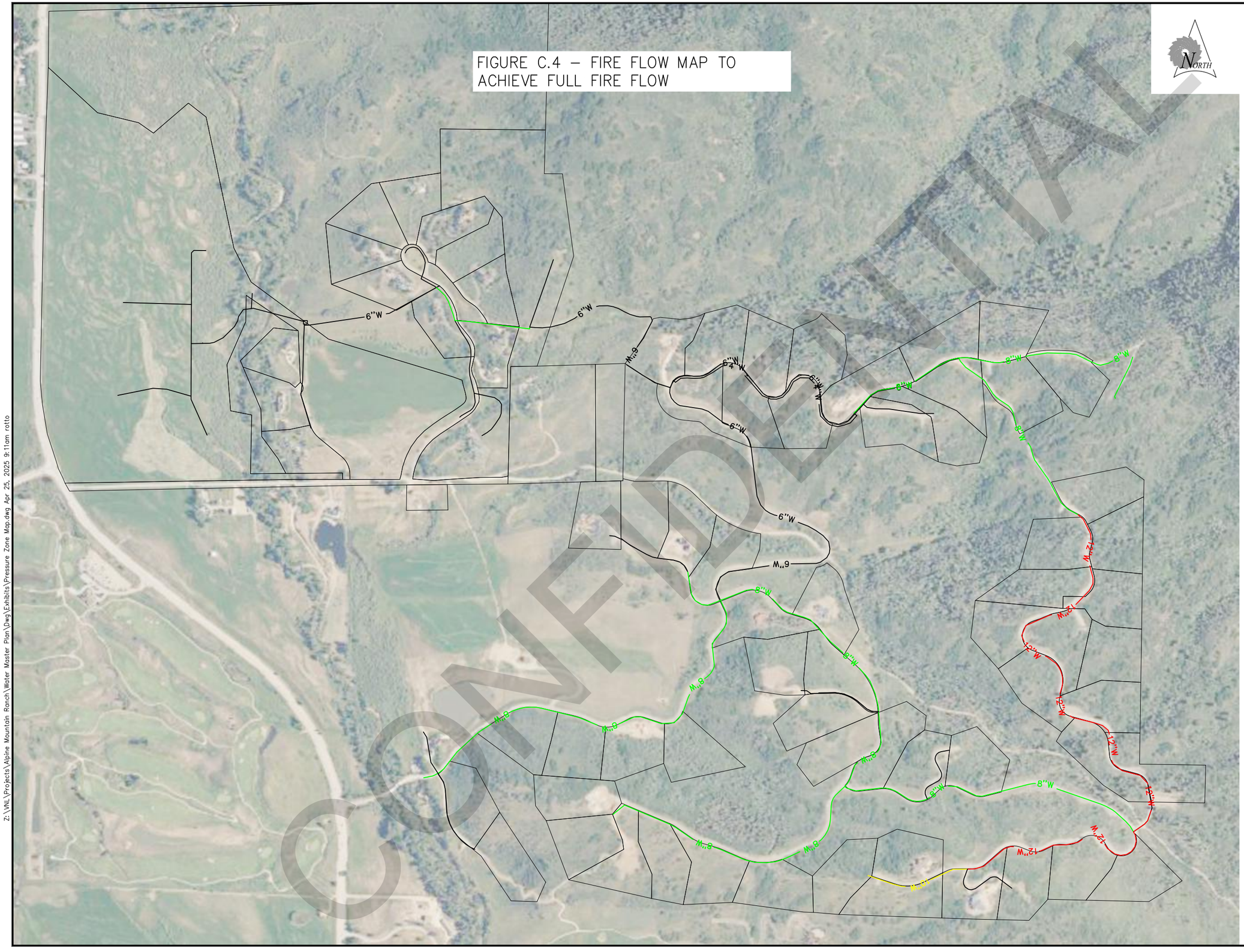
FIGURE C.4 – FIRE FLOW MAP TO ACHIEVE FULL FIRE FLOW



FIRE FLOW ANALYSIS

FIRE FLOW ANALYSIS PERFORMED WITH MAX DAY AVERAGE HOURLY FLOWS. FLOW MUST MAINTAIN 20 PSI AT THE HYDRANT.

THIS FIRE FLOW SCENARIO IS RUN WITH ALL TANK SIZE IMPROVEMENTS, THE BOOSTER STATION UPSIZED, AND A DEDICATED TRANSMISSION MAIN.

IFC REQUIREMENTS FOR SYSTEMS WITH FIRE SPRINKLERS IN HOUSES

FLOW = 1500 GPM
DURATION = 1 HR

LEGEND:

8" WATERLINE IMPROVEMENT — 8"W

10" WATERLINE IMPROVEMENT — 10"W

12" WATERLINE IMPROVEMENT — 12"W

SCALE
0 375' 750'
HORIZ: 1" = 750'

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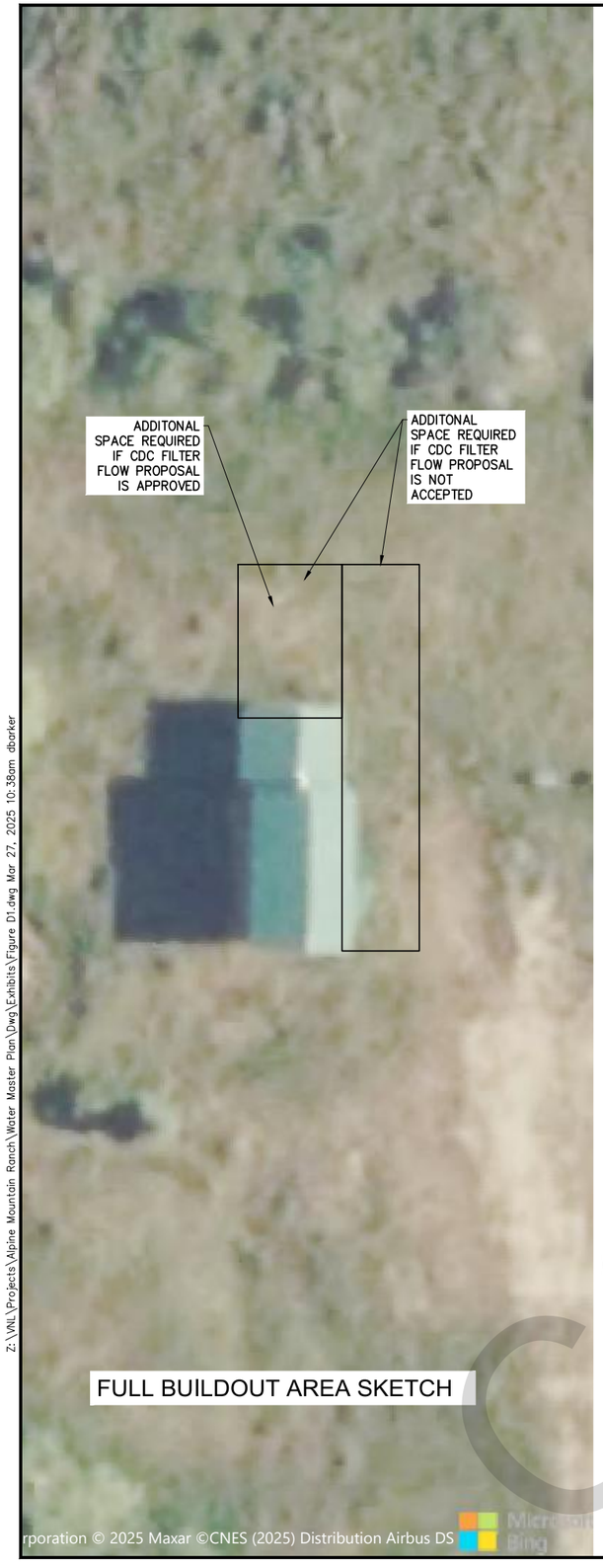
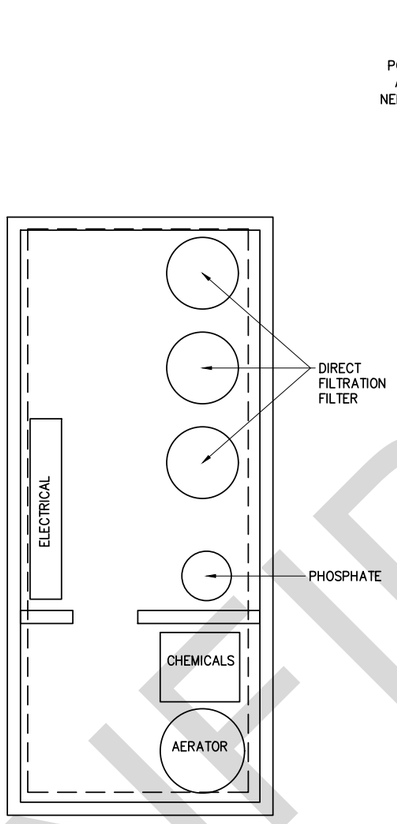
Appendix D: Proposed Treatment Improvements

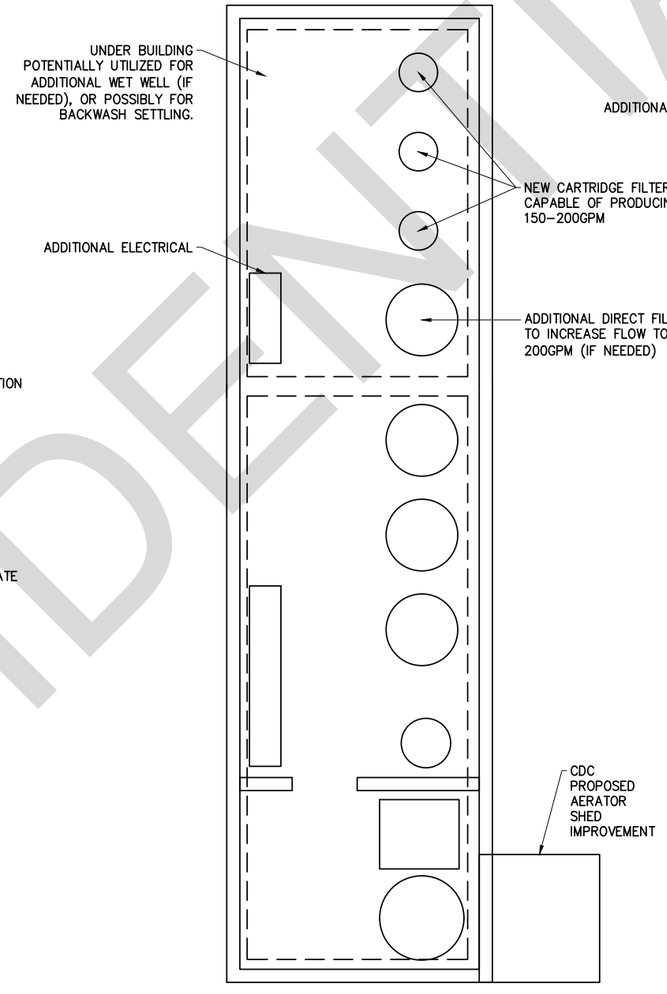
FIGURE D.1 – POTENTIAL TREATMENT IMPROVEMENTS



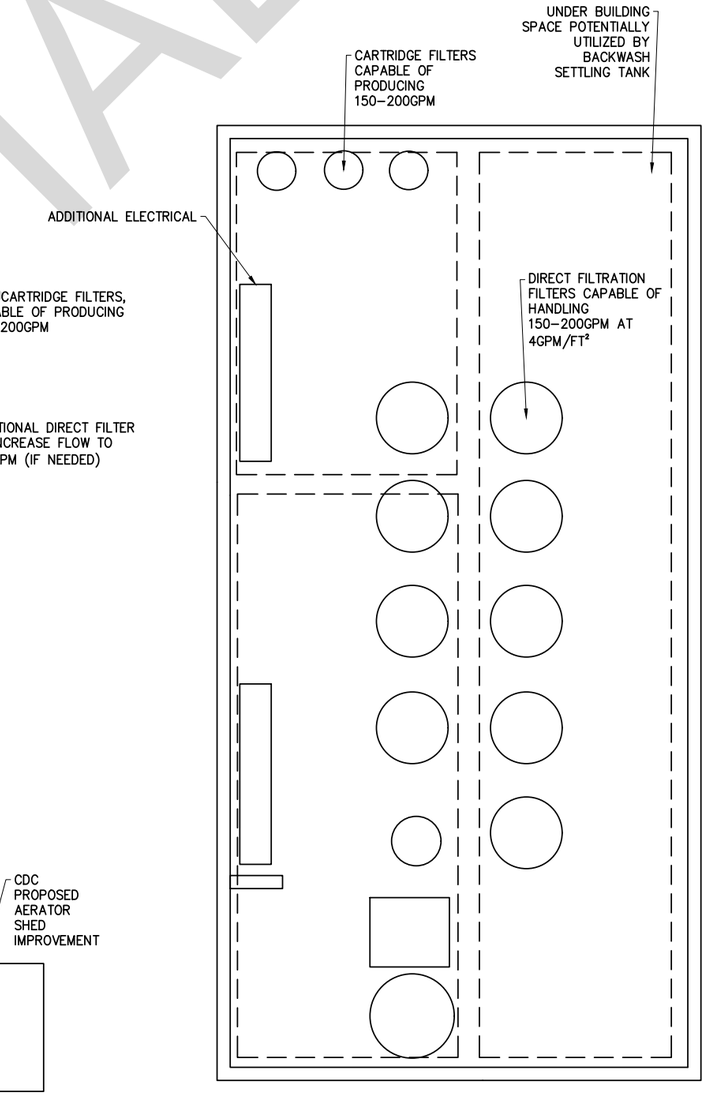
FULL BUILDOUT AREA SKETCH



EXISTING TREATMENT LAYOUT
&
150GPM LAYOUT IF CDC MEDIA APPROVED



POTENTIAL LAYOUT AFTER IMPROVEMENTS, ASSUMING CDC FLOW APPROVED



POTENTIAL LAYOUT AFTER IMPROVEMENTS, ASSUMING CDC FLOW NOT APPROVED

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Appendix E: Water Storage Calcs Diagram

Figure E.1 – Diagragm Showing/Explaining Water Storage Calculations