AGENDA

Town Council Regular Meeting 5:30 / Executive Session 4:30

Wednesday, February 07, 2024

Town Hall / Council Chambers - 302 Pine St Minturn, CO

The agenda is subject to change, including the addition of items 24 hours in advance or the deletion of items at any time. The order of agenda items listed are approximate.
This agenda and meetings can be viewed at www.minturn.org.

MEETING ACCESS INFORMATION AND PUBLIC PARTICIPATION:

This will be an in-person meeting with access for the public to attend in person or via the Zoom link included. Zoom Link: https://us02web.zoom.us/j/85462137003

Zoom Call-In Information: 1 651 372 8299 or 1 301 715 8592 **Webinar ID:** 854 6213 7003

Please note: All virtual participants are muted. In order to be called upon an unmuted, you will need to use the "raise hand" feature in the Zoom platform. When it's your turn to speak, the moderator will unmute your line and you will have five (5) minutes for public comment.

Public Comments: If you are unable to attend, public comments regarding any items on the agenda can be submitted to Jay Brunvand, Town Clerk, prior to the meeting and will be included as part of the record.

1. CALL TO ORDER

2. EXECUTIVE SESSION (4:30 PM)

An Executive Session for the purposes of receiving legal advice on specific legal questions pursuant to C.R.S. 24-6-402(4)(b) – discussion of Town water rights and potential Water Court applications related to Town water infrastructure improvements – Susan Ryan, Esq.

3. ROLL CALL AND PLEDGE OF ALLEGIANCE

4. APPROVAL OF CONSENT AGENDA

Consent agenda items are routine Town business, items that have received clear direction previously from the council, final land-use file documents after the public hearing has been closed, or which do not require council deliberation.

A. Approval of 01-17-2024 Minutes

5. APPROVAL OF REGULAR AGENDA

Opportunity for amendment or deletions to the agenda.

6. DECLARATION OF CONFLICTS OF INTEREST

7. PUBLIC COMMENT

Citizens are invited to comment on any item on the Consent Agenda, or not on the regular Agenda subject to a public hearing. Please limit your comments to five (5) minutes per person unless arrangements have been made for a presentation with the Town Clerk. Those who are speaking are requested to state their name and address for the record.

8. COUNCIL COMMENTS & COMMITTEE REPORTS

9. STAFF REPORTS

A. Manager's Report

10. SPECIAL PRESENTATIONS

Presentations are limited to 5 minutes. Invited presentations are limited to 10 minutes if prior arrangements are made with the Town Clerk.

11. BUSINESS ITEMS

Items and/or Public Hearings listed under Business Items may be old or new and may require review or action by the Council.

A. Resolution 05 - Series 2024 Approving Minturn's Water Nexus Report and Action Plan

B. Ordinance TBD - Series 2024 Amending Provisions Contained in Chapter 13 (Utilities Code), Chapter 16 (Zoning Code), Chapter 17 (Subdivision Code), and Chapter 18 (Building Code) of the Minturn Municipal Code - Request for Continuance

12. DISCUSSION / DIRECTION ITEMS

A. Minturn Water Treatment

B. Water Tank #2 Rehabilitation

13. FUTURE AGENDA ITEMS

A. Future Agenda Items

14. ADJOURN

INFORMATIONAL ONLY ITEMS

Upcoming Council Meetings:

-- February 21, 2024

-- March 6, 2024

OFFICIAL MINUTES
Town Council Regular Meeting | 5:30 PM

Wednesday, January 17, 2024

Town Hall / Council Chambers - 302 Pine St Minturn, CO

The agenda is subject to change, including the addition of items 24 hours in advance or the deletion of items at any time. The order of agenda items listed are approximate.
This agenda and meetings can be viewed at www.minturn.org.

MEETING ACCESS INFORMATION AND PUBLIC PARTICIPATION:

This will be an in-person meeting with access for the public to attend in person or via the Zoom link included. Zoom Link: https://us02web.zoom.us/j/83696184135

Zoom Call-In Information: 1 651 372 8299 or 1 301 715 8592 **Webinar ID:** 836 9618 4135

Please note: All virtual participants are muted. In order to be called upon an unmuted, you will need to use the "raise hand" feature in the Zoom platform. When it's your turn to speak, the moderator will unmute your line and you will have five (5) minutes for public comment.

Public Comments: If you are unable to attend, public comments regarding any items on the agenda can be submitted to Jay Brunvand, Town Clerk, prior to the meeting and will be included as part of the record.

1. CALL TO ORDER

Mayor Earle B. called the meeting to order at 5:32pm.

2. ROLL CALL AND PLEDGE OF ALLEGIANCE

Those present included: Mayor Earle Bidez, Mayor Pro Tem Terry Armistead, Town Council members, Lynn Feiger, Gusty Kanakis, Brian Rodine, and Kate Schifani. Note: Tom Sullivan has resigned from the Council and his seat is vacant.

3. APPROVAL OF CONSENT AGENDA

Consent agenda items are routine Town business, items that have received clear direction previously from the council, final land-use file documents after the public hearing has been closed, or which do not require council deliberation.

- **A.** Approval of 12-20-2023 Minutes
- **B.** Liquor License Renewal - 542 Main St LLC, DBA Sunrise annual renewal of a Hotel & Restaurant (City) Liquor License; 132 Main St, Douglas McAvity Owner/Manager
- **C.** Liquor License Renewal - Rocky Mountain Taco annual renewal of a Fermented Malt Beverage (City) Liquor license; 291 Main St, Chris McGinnis Owner/Manager
- **D.** Resolution 01 - Series 2024 A Resolution Approving the Posting Sites

Motion by Gusty K., second by Terry A., to approve the Consent Agenda of January 17, 2024 as presented. Motion passed 6-0.

4. APPROVAL OF REGULAR AGENDA

Opportunity for amendment or deletions to the agenda.

Motion by Kate S., second by Terry A., to approve the Agenda of January 17, 2024 as presented. Motion passed 6-0.

5. DECLARATION OF CONFLICTS OF INTEREST

6. PUBLIC COMMENT

Citizens are invited to comment on any item on the Consent Agenda, or not on the regular Agenda subject to a public hearing. Please limit your comments to five (5) minutes per person unless arrangements have been made for a presentation with the Town Clerk. Those who are speaking are requested to state their name and address for the record.

Mr. Michael Boyd, 502 1/2 Eagle St, spoke regarding the HPC meeting last night and changes in Chapter 19 of the municipal code which they are reviewing. He feels these changes bypass the Planning Commission. He asked this be brought before the Planning Commission prior to approval.

Ms. Sarah Smith Hymes, candidate for District 2 Eagle County Commissioner. She outlined how a candidate gets on the ballot, petition or caucus.

7. COUNCIL COMMENTS & COMMITTEE REPORTS

Terry A. commended Public Works for the snow work.

Earle B. echoed Terry A. and noted if you remove snow from your sidewalk in to the street it must be done between 4am and 7am.

8. STAFF REPORTS

- **A.** Manager's Report

Water Treatment Facility Security Fence

A security fence will be installed at the Minturn water treatment facility this spring summer. The fence will border the eastern property line of the town and travel up the slopeside on the east side of the property only. CPW and CDPE required this design for wildlife movement to/from Cross Creek while still keeping out any vehicular traffic and pedestrians coming from the east.

Downtown Development Authority

With Jim Mann, municipal financial advisor, back on board, Minturn is moving forward again with our analysis of the Downtown Development Authority. One new factor for property valuations will be the recently adopted Historic Preservation Ordinance and how that seems to be affecting property values. This will impact the amount of funds a DDA could potentially secure, so Jim Mann will be adding this to his analysis. We hope to have a report in the coming months.

Minturn Tank Operations

Update – Jarod Limke, Jeff Spanel, Jim Mann, and I had a productive conversation with Sean Oliver, State Revolving Fund representative. Sean indicated Minturn CAN use the remaining funds from the concrete tank loan to install a PRV vault which would allow Minturn to efficiently operate both the steel bolted tank and the new concrete tank at maximum capacity. Minturn is now looking into the viability and costs associated for the rehabilitation of the steel-bolted tank. This route may also prove more cost-effective than installing a service line to the Medina property for a separate project. More to come.

12/20/2023 update - Tank #3 is now online and operational. I will be discussing tank loan options with the State Revolving Loan Fund representative to determine if leftover loan funds can be used to facilitate the functioning of the two tanks interchangeably. If funds can be used to improve the functioning of the system, Minturn may want to install a valve box on HWY 24. I will have more information after discussing this option with the SRF representative.

USGS Gauge on Cross Creek

Update – I had a productive discussion with Steve Anders, USGS program manager. Steve provided a little more history regarding the stream gauge and has supplied the contact information for the CWCB representative I can reach out to for discussing cost share options. I expect the CWCB may be interested in supporting this gauge financially.

12/20/2023 update - Minturn currently pays for the USGS gauge on Cross Creek. This comes at an annual cost of around $16,000. This is a federal program and I have reached out to USGS to understand why Minturn incurs this cost. Unless there is a specific reason in one of Minturn's water rights decrees, I expect Minturn to drop this expense. The CWCB and Division 5 Engineer use this gauge to make the instream flow call on Cross Creek. I expect if they wish to continue making the instream flow call on Cross Creek, they will support the federal government in maintaining the costs of the gauge.

Michelle M. updated on the upcoming community survey. Earle B. and Lynn F. volunteered to help develop the survey. She noted that we will continue with our current Town Prosecutor. She is updating the Employee Handbook with Employers Council. Michelle M. noted that we will start looking at Congressional funding options for future needs. She is working on the Council Retreat,

Michelle M. is looking at late April or early May after the election on April 2. Michelle M. note only 67 residents have access to the Smart Water that would allow citizens to view their accounts online. She continues to look for the $43k needed to join the full use of the software. She spoke of a conversation had regarding how we are looking at water conservation and how we can achieve our goals without having underwatering of landscaping issues.

Discussion ensued how the security fence will not be a full enclosure and thus will allow wildlife movement.

9. SPECIAL PRESENTATIONS

Presentations are limited to 5 minutes. Invited presentations are limited to 10 minutes if prior arrangements are made with the Town Clerk.

10. BUSINESS ITEMS

Items and/or Public Hearings listed under Business Items may be old or new and may require review or action by the Council.

A. Resolution 02 - Series 2024 A Resolution Appointing an Interim Council Member
Section 4.6 of the Town Charter requires "the remaining Council Members shall choose by majority vote, within thirty (30) days after such a vacancy occurs, a duly qualified person to fill the unexpired term so vacant."

On December 12, 2023 the Town received a resignation from Council Member Tom Sullivan effective immediately. On direction given at the 12/20/23 Council Meeting, Staff has proceeded in the advertisement opening and solicitation of applicants.

1) The position and qualifications were posted in the Public Posting boxes.
2) This same posting was added to the Town Website.
3) An advertisement was placed in the Vail Daily for the position. The ad refers interested citizens to the website or the Town Clerk for further information.
4) The notice was email blasted several times too.
5) The deadline for Letters of Interest are due in the Clerk's Office by end of business on January 11, 2024.
6) Council would then appoint based on the received Letters of Interest on January 17.
7) The appointment would be effective through the April 2024 election and, upon candidacy, could be included in the April election.

At tonight's Council Meeting you will consider appointment of the Council Seat. Currently the Council stands at six members in order to appoint a candidate to the vacant seat you will need four votes minimum. Through the process, the town received one Letter of Interest and will consider only that individual. Since there is only one there will not be any balloting, the motion to appoint will be the determinant.

Motion by Gusty K., second by Kate S., to appoint Eric Gotthelf as interim Council Member. Motion passed 6-0.

Note: The Mayor swore in Eric G. and Eric G. assumed his seat at the dais.

B. Resolution 03 - Series 2024 A Resolution Approving An Intergovernmental Agreement Between the Town of Minturn and Eagle River Fire Protection District to Support Wildland Fire Mitigation

Michelle M. introduced Fire Chief Bauer and Hugh Fairfield-Smith who outlined the agreement Minturn has participated in the regional wildland fire mitigation efforts for the last several years. This is an ongoing effort requiring the support of all regional jurisdictions. With area fuels continuing to dry and climate fluctuating, the risks associated with wildland fires remain prevalent. Minturn relies on our local organizations like Eagle River Fire Protection District to lead the effort in addressing these issues and Minturn's supporting role through financial contributions, community education, and other means, plays a significant part toward the necessary preliminary emergency preparedness steps we can take.

"Eagle River Fire Protection District, by and through Eagle Valley Wildland shall use the Minturn Contribution only for the direct costs to support wildfire mitigation efforts in the Minturn Area, including salary costs for Eagle Valley Wildland staff. Eagle Valley Wildland will take on all contractual needs, management, and oversight of the projects performed in the Minturn Area during calendar year 2024." – 2024 IGA

Discussion ensued how we can avoid fires and mitigate the concerns and how transmission lines can cause fires.

Michael S. asked if the Fire Chief recommended undergrounding powerlines in new developments and existing as able; yes, that is recommended but there are associated costs that must be considered that make it often unattainable.

Gusty K. asked about community chipping, Mr. Fairfield-Smith outlined how the program would work.

Discussion ensued on the costs involved in the mitigation needs as well as a wish list of priorities for fire mitigation.

Motion by Eric G., second by Gusty K., to approve Resolution 03 – Series 2024 approving an Intergovernmental Agreement with the Eagle River Fire Protection District to support Wildland Fire Mitigation as presented. Motion passed 7-0.

C. Resolution 04 - Series 2024 A Resolution Adopting the Eagle County Community Wildfire Protection Plan

The Community Wildfire Protection Plan serves "as a robust and comprehensive blueprint, thoroughly designed to safeguard our community against the escalating threat of wildfires. Formulated through a collective effort, this plan not only outlines strategic processes but also highlights the unwavering commitment we hold for the well-being of our community. At the heart of the CWPP is a deeply ingrained belief that within our community we possess the capacity to influence the outcomes of future wildfires. This plan, with its overarching theme, underscores the

collective strength and resilience of our community. It is not just a response to challenges, but a proactive initiative in shaping our shared future." – CWPP 2023

Earle B. asked about some of the descriptions and noted a point that needed to be better defined, this will be done prior to signatures.

Motion by Gusty K., second by Kate S., to approve the adoption of the Eagle County Community Wildfire Protection Plan as presented. Motion passed 7-0.

11. DISCUSSION / DIRECTION ITEMS

A. Cross Creek Well Exploration Update

Michelle M. introduced Bill Berg, Martin and Wood who detailed the work done, findings, next steps and recommendations. Michelle M. noted we will have a discussion with the full water team where decisions will be asked. This meeting is presentation only.

This memorandum summarizes the Minturn Well Nos. 3 and 4 testing activities that were performed by Cascade Environmental (Cascade) from October 31, 2023 through November 16, 2023. The purpose of the Minturn Wells 3 and 4 testing program was to assess whether Minturn Well Nos. 3 and 4 could each reliably produce approximately 225 gallons per minute (gpm) and to gather some preliminary information regarding whether the wells would be classified as groundwater under the direct influence of surface water (GWUDI). Both Minturn Well Nos. 3 and 4 have two screened intervals: one shallow and one deep. Due to the concern over the wells being classified as GWUDI, the upper screened interval in each well was to be sealed off during the aquifer testing so that only the lower screened interval was producing groundwater. This was achieved by using an inflatable packer to isolate the lower screened interval. The remainder of this memorandum describes the aquifer testing activities that took place during the testing program.

Well No. 3 appears to be capable of a maximum pumping yield of approximately 100 gpm with groundwater contributions from both screens. The drawdown in Well No. 3 during testing suggests that the well yield limitation for Well No. 3 is a combination of both geology and well diameter. The combination of geology and well diameter limit the rate of groundwater production from a well. The largest pump that can be installed can only produce about 100 gpm, due to well diameter limitations on what size pump can fit down the well. Because of both the well drawdown, which suggests aquifer conductivity limitations, and well casing size, Well No. 3 will be limited to approximately 100 gpm. Well No. 4 may be capable of a maximum pumping yield of approximately 250 gpm with the groundwater contributions from both screens. However, this pumping rate was not tested due to GWUDI concerns. When the well is limited to only the lower screen, the estimated pumping yield was limited to approximately 100 gpm (during testing with the packer installed) because of the drawdown within the well approaching the pump intake. The packer limited water production to only the groundwater entering the well from the lower screen, which is the most likely non-GWUDI interval. The 100 gpm lower screen well yield limitation suggests that a significant portion of the Well No. 4 yield is from the upper screen. Because of concerns of surface water impacts from the upper screen, we conclude that Well No. 4's water production from the lower interval is limited to a well yield of approximately 100 gpm.

Additionally, the lower screen in Well No. 4 is compromised and will have to be replaced at some point in the future due to well cleaning limitations. 128 Section 11, ItemA. Michelle Metteer Well No. 3 and Well No. 4 Testing December 29, 2023 Page 6 Martin and Wood Water Consultants, Inc. If the Town continues to be interested in utilizing wells for its water supply. it is estimated that at least two new wells would be required to meet the demand of up to 450 gpm. We inquired with Cascade about the estimated cost for a new alluvial well in the area near the existing wells. The estimated well construction cost was approximately $75,000 to $85,000, depending on the well casing size. Pumping and power considerations would be separate, but at this cost, multiple additional wells may still be an attractive option to Minturn. Further testing is needed to evaluate the GWUDI status of the groundwater.

Gusty K. clarified the well costs is per well; correct.

Lynn F. asked about the damaged screen. Mr. Berg noted due to the way you build a well, the existing well would need to be rebuilt, not repaired. It was clarified that there is concern of surface water contamination on both wells, especially at the upper screen of each well.

Terry A. discussed the maintenance of Well 4. Mr. Berg explained to determine if the wells would pass the surface water infiltration takes much more study time. Further discussion ensued as to the use of upper and lower screens and the potential yields.

Mr. Berg felt the safer path would be to use the lower screens and multiple more wells. It was noted that, based on the two current wells, we would be looking at a potential of 4-5 total wells. He stated the cost should be evaluated with a filtration plant. Michelle M. stated the rest of the team will be at the 2/7 meeting where a fully vetted discussion can be had. Michelle M. noted that the replacement of Well 4 should be accomplished sooner than later as we would not want to be without the water flow.

Gusty K. asked if you could go deeper in the wells; no, the wells are down to bedrock so are as deep as they can go. Mr. Berg state am alluvial well will produce much more water than a bedrock well at a far less expense.

B. Gilman Disconnection

The former town of Gilman was originally annexed into the town of Minturn in 2008 for the purposes of total environmental remediation and turning the site into employee housing as part of the greater Ginn Development Project. Since 2008, the project has gone through several iterations and no longer includes remediation of the Gilman, Rex Flats or Roster Pile 5 areas. Gilman, Roster Pile 5 and Rex Flats areas are all contaminated superfund site areas requiring enclosure by the property owner and no public access. It is common to receive trespassing calls for both Gilman and the Rex Flats areas. Currently, those calls are at the cost of the town. If disconnected, those calls would be the cost of the county. Additionally, any further environmental remediation of those areas will come with extensive costs associated and unable to be borne by the municipality.

Michael S. presented that because of the location of these areas and the point that the County is better equipped to deal with the Superfund overlays that disconnection of these parcels is recommended by Staff.

Michelle M. introduced Tim McGuire, Battle Mtn representative, responded that the disconnection is cleaner and makes sense to do such. It was noted that the Rex Flats contamination is very high and was never cleaned completely but the EPA feels it is sufficient due to the future "use" of the land. It was noted that digging into the contaminated areas would/could exacerbate the contaminations.

Mr. McGuire noted the recent Battle/Town agreement includes a disconnection of specified lands. These areas would be added to that list and would be approved by ordinance.

Direction was given to proceed with including the discussed Roaster Pile 5 and Rex Flats in the disconnection procedure.

12. FUTURE AGENDA ITEMS

A. Future Meeting Agenda Items

13. EXECUTIVE SESSION

An Executive Session for the purposes of receiving legal advice on specific legal questions pursuant to C.R.S. 24-6-402(4)(b) to discuss the Town's water rights on Cross Creek, recent administrative decisions, and the status of water court case no. 2000CW3030.

Motion by Terry A., second by Gusty K., to convene in An Executive Session for the purposes of receiving legal advice on specific legal questions pursuant to C.R.S. 24-6-402(4)(b) to discuss the Town's water rights on Cross Creek, recent administrative decisions, and the status of water court case no. 2000CW3030. Motion passed 7-0.

14. ADJOURN

Motion by Kate S., second by Eric G., to adjourn the meeting at 8:08pm.

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Earle Bidez, Mayor

ATTEST:

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Jay Brunvand, Town Clerk

INFORMATIONAL ONLY ITEMS

Upcoming Council Meetings:
--February 7, 2023
--February 21, 2023

To: Minturn Town Council
From: Michelle Metteer
Date: February 7, 2024
RE: Town Manager Update

Unita Basin Railway
The USFS withdrew its permission for the Uinta Basin Railway to build 12-miles of rail through the Ashley national Forest which would connect two segments of rail and thereby getting the project one step closer to transporting crude oil from Utah, through Colorado, to the oil refineries in Texas. The Town of Minturn has been supporting Eagle County in opposition of this project. Here is a link to the entire article.

Minturn Elections
Minturn elections take place April 2nd. Voting will be in person or residents can apply in advance for an absentee ballot. See Jay Brunvand, clerk, at town hall with questions or email treasurer@minturn.org.

Bolts Ditch Act
I participated in efforts to support the Bolts Ditch Act which is making its way through the House of Representatives and would allow Eagle River Water & Sanitation District and the Upper Eagle Regional Water Authority direct access to the Bolts Ditch and headgate within the Holy Cross Wilderness Area. The trip included meetings with staff from Senator Bennet's and Hickenlooper's office as well as a tour by Congressman's Neguse's office. Siri Roman provided witness testimony and the sub committee on Natural Resources where Congressman Neguse is the ranking chair.

Regional Housing Plan Kickoff Meeting
I participated in the Regional Housing Plan kickoff meeting which will work toward better understanding the housing demand, housing supply and the needs, gaps and targets. Phase II will include the evaluation of the land use once and housing regulations, evaluate sites for housing, funding sources, potential policies and strategies, policy evaluation and an action plan. There will be extensive community outreach as part of this regional housing scope of work. Outreach will include focus groups, direct interviews, household survey, and a transit and partnerships survey.

Safe Streets 4 All Grant Kickoff
Minturn participated in the SS4A grant kickoff meeting which will allow us to begin the process on creating a safety action plan for our streets and mobility needs. This work is the baseline that will help Minturn's grant applications in showing the value and need for additional safety improvements not only along HWY 24 but also along Minturn's side streets.

CLIMATE ACTION COLLABORATIVE

Water Energy Nexus Report for Town of Minturn

I. Summary

Water and wastewater treatment and distribution processes rely on energy intensive systems, commonly powered by climate change-causing fossil fuels. While there has been a considerable amount of dialogue regarding climate change impacts on water supply and predictability, there have been fewer discussions around the energy intensity of water and wastewater treatment and distribution processes and their impact on our environment. Aerobic water treatment processes are used in all water treatment facilities across Eagle County and are particularly energy intensive compared to anaerobic processes[1]. Below we will detail connecting linkages between water and greenhouse gas emissions for the Town of Minturn and provide tailored recommendations for water provider operations and customer water conservation strategies.

II. Background

The Climate Action Collaborative for Eagle County Communities is tasked with implementing the Climate Action Plan for Eagle County Communities and subsequent goals and strategies. Our greenhouse gas reduction goals are: 50% by 2030 and 80% by 2050 from our 2014 baseline. This momentous task requires our communities and organizations to work in partnership on energy efficiency, electrification, and eradication of human-caused greenhouse gas emissions.

One such industry that has been less of a focal point for emissions reduction in our community is water and wastewater treatment and distribution centers. Community organizations and water providers have done a wonderful job advocating for water conservation, particularly for outdoor water use, however this messaging has not been contextualized with greenhouse gas emissions from treating and providing water to residents. Our aim is to incorporate accurate emissions data per gallons of water treated and distributed to paint a more precise picture of the climate impact of water consumption. This additional data and messaging will help our overall efforts to conserve water in the Eagle River Valley, and help our water utilities make informed decisions regarding increasing

[1] *Energy consumption in anaerobic and aerobic based wastewater treatment plants in Italy* by Ezio Ranieri, Silvia Giuliano, & Ada Cristina Ranieri

efficiencies in their operations. Due to the complex nature of treating and distributing water, energy intensity varies significantly[2] by landscape, source, and distributor. It is for this reason that we have created separate reports for participating water utilities/municipalities, rather than one report for the entire County.

Looking at national data in recent decades, more research has been published on the energy intensity of water treatment and distribution. Notably, River Network produced a report[3] in 2009 that estimated U.S. water-related energy use was at least 521 million MWh per year, equivalent to 13% of U.S. energy consumption at that time. This represented 5% of the nation's CO2 emissions, and was equivalent to the emissions from over 62 coal-fired power plants. Additionally, the U.S. Environmental Protection Agency (EPA) shares that water and waste-water facilities are commonly one of the largest energy consumers in a community, sometimes accounting for 35% of typical municipal energy budgets[4]. Even further, a peer reviewed national study[5] found that one four-person household's monthly drinking water and wastewater demand is equivalent to driving nearly 93 miles in a standard gasoline car each month. The same study found that the average energy demand of water utilities is equivalent to 9.3 million gasoline cars on the road each year.

Energy emissions from water and wastewater treatment plants are significant, and communicating this significance will be an important advancement for our greenhouse gas reduction efforts. We are fortunate to live in a community that is serviced by progressive electricity utilities, Holy Cross Energy and Xcel Energy. Holy Cross Energy's goal is to be 100% renewable energy by 2030, and Xcel Energy's goal is to be 80% renewable energy by 2030. However, it is important to stress that energy efficiency becomes even more important with an increasingly renewable energy grid system, due to the additional importance of reducing energy demand when relying on intermittent renewable energy sources like wind and solar. In other words, renewable energy on our grid should not be understood as a means to liberally use electricity.

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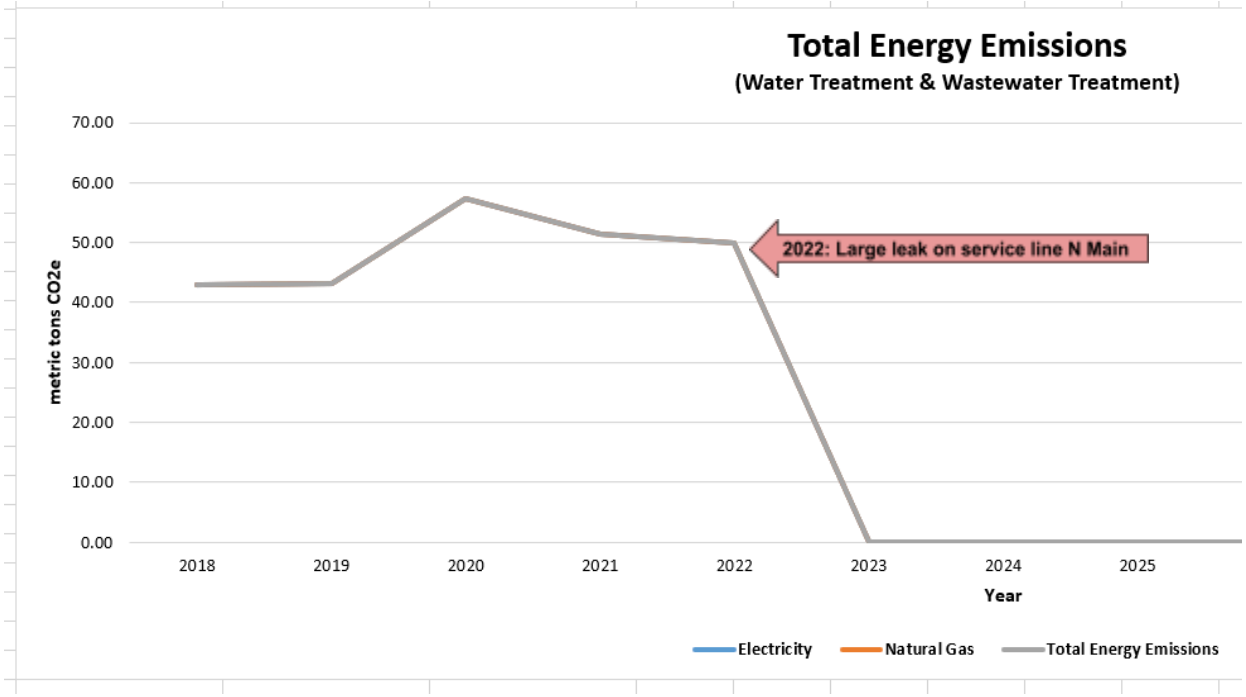
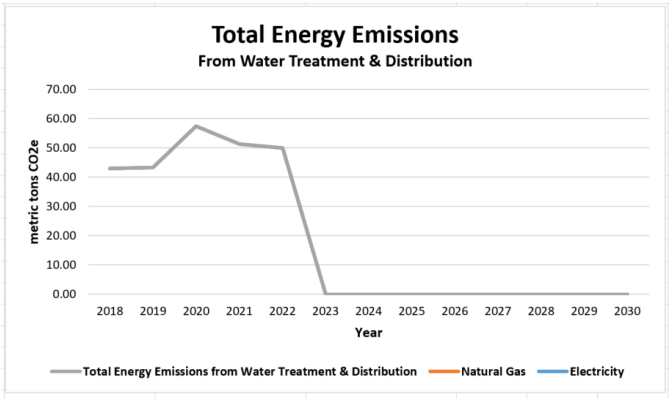
[2] *The estimated impact of California's urban water conservation mandate on electricity consumption and greenhouse gas emissions* by Edward Spang, Andrew Holguin, and Frank Loge
[3] *The Carbon Footprint of Water* by Bevan Griffiths-Sattenspiel and Wendy Wilson
[4] *Energy Efficiency in Water and Wastewater Facilities* by U.S. EPA
[5] *Operational Carbon Footprint of the U.S. Water and Wastewater Sector's Energy Consumption* by Zib III et al. 2021

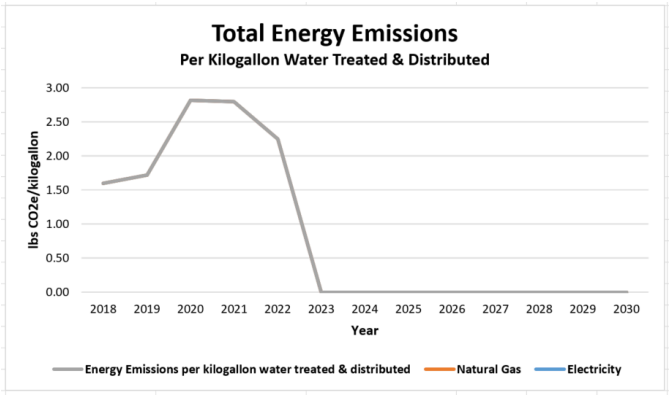
CLIMATE ACTION COLLABORATIVE

III. Data and Analysis for the Town of Minturn:

Annual Data														
		2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Total Energy Emissions														
(metric tons CO2e)	*Electricity*	*42.90*	*43.22*	*57.37*	*51.34*	*49.91*								
	Natural Gas	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*								
Total Energy Emissions from Water Treatment & Distribution														
(metric tons CO2e)	*Electricity*	*42.90*	*43.22*	*57.37*	*51.34*	*49.91*								
	Natural Gas	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*								
Total Energy Emissions from Wastewater Treatment														
(metric tons CO2e)	*Electricity*	*n/a*	*n/a*	*n/a*	*n/a*	*n/a*								
	Natural Gas	*n/a*	*n/a*	*n/a*	*n/a*	*n/a*								
Energy Emissions per kilogallon water treated & distributed														
(lbs CO2e/kilogallon)	*Electricity*	*1.60*	*1.72*	*2.82*	*2.80*	*2.25*								
	Natural Gas	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*								
Energy Emissions per kilogallon wastewater treated														
(lbs CO2e/kilogallon)	*Electricity*	*n/a*	*n/a*	*n/a*	*n/a*	*n/a*								
	Natural Gas	*n/a*	*n/a*	*n/a*	*n/a*	*n/a*								







Greenhouse gas emissions per gallon from the Town of Minturn's water treatment and distribution process are aligned with similar calculations of emissions from water treatment and distribution. Spang et al. (2018) found that in California, greenhouse gas emissions per kilogallon of water treated ranges between .617 and 2.5 lbs CO_2e, depending on location throughout the State[6]. In 2018 through 2022, emissions per kilogallon in Minturn ranged between 1.6 and 2.25 lbs CO_2e. Most likely, this is due to Minturn's relatively low-energy intensive slow-sand filter system, a process that uses little energy to treat water. If Minturn were to replace the slow-sand filter system with a process packaged water treatment plant or a membrane filtration water treatment plant, as has been proposed[7], it is likely that energy consumption, and therefore emissions, will increase.

Interestingly, the data shows that while the amount of water treated in 2020 decreased by nearly 11,000 kilogallons as compared to 2019, monthly electricity consumption between February and May 2020 was nearly double that of previous years. The Town of Minturn may want to investigate this further to understand the reasoning.

IV. Site-Specific Information for the Town of Minturn

Town of Minturn's wastewater is treated by Eagle River Water and Sanitation District. The numbers within this report do not include Eagle River Water and Sanitation District's impact.

V. Recommendations for the Town of Minturn

A. Customer-Facing

1. **Update Rate Structure**
    a) Change the water rate structure to incentivize water conservation. Consider introducing a tiered system where customers are charged more based on the amount of water consumed as it relates to the property's square foot equivalent (SFE). In addition, fixed costs can be tied to the

[6] *The estimated impact of California's urban water conservation mandate on electricity consumption and greenhouse gas emissions* by Edward Spang, Andrew Holguin, and Frank Loge
[7] *Can Minturn find a water solution that no longer requires a treatment plant?* by John LeConte

home's number of SFEs: the higher the square footage, the higher the fixed costs.

(1) **Local context:** The Town of Minturn has updated its outdoor water rate structure to mirror Eagle River Water and Sanitation District's tiered rates for sprinkler and outdoor irrigation use. We recommend that the town also update the residential account rate structure to incorporate a fixed charge per single family equivalent (SFE), and a tiered use rate per kilogallons of water, as Eagle River Water and Sanitation District has.

(2) Case: ERWSD 2023 Tiered Rate Structure

2. **Implement Smart Metering:**
   a) Smart meter technology is an advanced metering infrastructure that measures and records water usage accurately and in real-time. Unlike traditional water meters, which require manual reading and are prone to human error, smart meters provide automated readings that are transmitted to utility companies for billing and analysis.
      (1) Local context: The Town of Minturn is almost complete with updating all water meters to smart meters. The Town should utilize the available data to identify anomalies and high water users towards the goal of reducing water consumption.
      (2) Case Study: What if saving water became a game? (*Suez Smart Solutions*)
3. **Offer Rebate and Incentive Programs for Water Efficiency**
   a) Consider funding match rebates that build off the rebates the Beyond Lawn program provides. Water efficiency rebates are available to landowners across Eagle County and are provided by the Beyond Lawn Program in areas not served by Eagle River Water and Sanitation District. The Beyond Lawn program is collecting benchmarked information about the landscapes they work with. This information will be accessible to each town.
      (1) Local context: Town of Minturn staff are in communication with Beyond Lawn program representatives. We recommend providing match

rebates for landscape assessments, irrigation controllers, turf removal, and more.
(2) Beyond Lawn Program turf replacement rebates
(3) Beyond Lawn Program irrigation system rebates

4. **Host Consumer Education Events**
    a) The more water conservation knowledge consumers have, the more likely they are to implement water-saving measures in their homes and businesses. Engaging educational events are a great way to develop customer's knowledge and build relationships in the community.
        (1) Local context: Beyond Lawn program representatives, including Colorado State University Extension, should be invited to table and provide educational opportunities at the Minturn Market. Minturn could also host a waterwise demonstration or rain barrel event with partners.
        (2) Article: Communication and Education (*Alliance for Water Efficiency*)
5. **Distribute Outdoor Water-Efficient Quick Fixes**
    a) Water-efficient quick fixes are inexpensive tools to encourage customers to reduce their outdoor water consumption. Typically given out for free or during an irrigation assessment, quick fixes include watering gauges, high efficiency hose nozzles, and soil moisture meters.
        (1) Local context: Free outdoor water irrigation quick fixes should be purchased and distributed at Town events or at the Minturn Market. Quick fixes are inexpensive to purchase and an easy way to get people to make small changes in their behavior.
        (2) List of water-efficient quick fixes (*The Water Scrooge*)
6. **Promote Irrigation Assessments**
    a) Irrigation assessments are an effective and low-cost tool for customers to understand their outdoor water consumption and strategies for reduction. The Beyond Lawn program offers discounted irrigation assessments and irrigation upgrade rebates for customers outside Eagle River Water and Sanitation District's territory. After receiving an irrigation assessment, it is recommended to have the findings inform

potential upgrades to an irrigation system. Consider incentivizing homeowners to work with Qualified Water Efficient Landscaper (QWEL) certified contractors.

(1) Local context: The Town of Minturn should promote Beyond Lawn irrigation assessments for residents on its website and at the Minturn Market in coordination with Beyond Lawn representatives. The Town should also do an irrigation assessment of town properties, and direct public outreach about irrigation assessments to properties with large irrigated landscapes and high outdoor water consumption.

(2) Beyond Lawn Irrigation Assessment Rebates (Minturn, Red Cliff, Eagle, Gypsum)

(3) Hire a QWEL Pro

B. Operational

1. **Require Outdoor Water Consumption Submeter**
    a) Require all new construction to install a separate irrigation account submeter or create a separate account for outdoor water consumption. Alternatively, you can compare summer versus winter water consumption to estimate the additional water used for outdoor irrigation across all meters. Eagle River Water and Sanitation District requires all new commercial construction to have a separate outdoor water account.

(1) Local context: The Town of Minturn could amend building code to require a separate, outdoor water account for new commercial and multifamily construction. This would enable the Town to gather better data on outdoor water consumption of large properties.

(2) ERWSD requires a landscape sprinkler account for new commercial construction (ERWSD Rules & Regulations p.49)

2. **Efficiency, Electrification, & Renewable Energy Enrollment**
    a) Make your facility more energy efficient by installing efficient technologies such as LED light bulbs, weatherizing the facility, and purchasing energy efficient all-electric

equipment. These upgrades, especially switching your operations to all-electric, will reduce emissions and save money. Then, enroll in renewable energy programs offered by your utility that will power your water treatment with emission-free energy for a small increase in cost.

(1) Local context: The Town of Minturn is exploring upgrading its water treatment plant soon. For that reason, we do not recommend any investments in the current system. However, when the Town upgrades to a new system, the infrastructure should be built all electric and highly energy efficient.

(2) Public Building Electrification Grant from the CEO

(3) Holy Cross Energy's PuRE Program (Vail, Avon, Eagle, Gypsum)

(4) Xcel Energy's Renewable*Connect (Minturn, Red Cliff)

3. **Onsite offsets**
   a) Investing in onsite renewable power generation at your water and wastewater treatment operation can offset some of the power used and save you money over time. Onsite solar arrays are one such example of an onsite offset, and there are significant federal funding opportunities available right now. Pairing an onsite system with battery storage will increase your operation's resiliency, allowing you to deploy that battery storage in times of need or utilize it during peak hours to reduce utility costs.

(1) Local context: The Town of Minturn is investigating a solar array at the current Consolidated Tailings Pile site. This is a fantastic use of land that is otherwise undevelopable. The Town of Minturn should consider utilizing energy generation from the future solar array to offset the energy consumption of water treatment operations.

(2) Local example: Eagle to undertake two major energy-saving projects as it pursues goal of net-zero carbon emissions by 2030

4. **Water benchmarking key accounts**

a) Water benchmarking allows users to track their water usage across a property and compare water usage over time and against other properties. Requiring key accounts to benchmark their water usage can help reduce water consumption and waste and improve water efficiency. Reduced water consumption saves the user money and translates into reduced greenhouse gas emissions, as detailed in this report. Energy Star Portfolio Manager is a free benchmarking tool which can be utilized, or many for-purchase benchmarking tools exist with additional sophistication.
    (1) Local context: The Town of Minturn is already water benchmarking its own buildings. Additionally, while billing is handled by Eagle River Water and Sanitation District, the Town has access to resident's water data, making benchmarking a much easier process. The Town should require structures above a certain square footage to submit their water data and make reductions to their water consumption. There are different administrative approaches to water benchmarking that the Town would have to consider, and CAC staff would be happy to provide detailed information if desired.
    (2) Case: Austin, Texas Water Benchmarking

VI. Limitations

This report provides an initial snapshot of the greenhouse gas emissions associated with treating and distributing water and wastewater at the Town of Minturn. However, this report only focuses on scope 2 emissions, or those that are indirectly emitted through energy consumption of the operation. There are other emissions from operations, such as from fleet or methane from the wastewater treatment process, that have not been captured. This is important to understand as we communicate these numbers, and we recommend that the Town of Minturn works to understand the emissions impact from these other sources.

Additionally, our analysis is not able to isolate emissions from general building operations, such as lighting or heating and cooling systems, versus the process emissions for treatment and distribution of water. Therefore, even if the marginal emissions become zero, there will still be fixed emissions due to general building operations.

Furthermore, we acknowledge that due to regulatory compliance, not all recommendations that we've offered will be feasible to implement. Our recommendations take environmental sustainability into account.

TOWN OF MINTURN, COLORADO
RESOLUTION NO. 02 – SERIES 2023

A RESOLUTION TO APPROVE THE TOWN OF MINTURN WATER NEXUS REPORT AND ACTION PLAN

WHEREAS, The Minturn Town Council has approved waterwise guidelines supporting water conservation; and,

WHEREAS, The Town Council adopted the Eagle County Climate Action Plan with a goal of reducing greenhouse gases 50% by 2030 and 80% by 2050 from the 2014 baseline; and,

WHEREAS, The Town Council has sought additional outdoor watering conservation measures by utilizing a tiered rate system for all sprinkler and irrigation accounts,

WHEREAS, The Minturn Strategic Plan supports the decisions that support the "Long term stewardship of the natural beauty and health of Minturn's environment,"

NOW THEREFORE, BE IT RESOLVED BY THE TOWN COUNCIL OF THE TOWN OF MINTURN, COLORADO:

1. The Minturn Town Council hereby approves and adopts the Town of Minturn Water Energy Nexus Report and Action Plan as documented in Attachment A of this Resolution.

INTRODUCED, READ, APPROVED, ADOPTED AND RESOLVED this 7th day of February 2024

TOWN OF MINTURN

By:_____
Earle Bidez, Mayor

ATTEST:

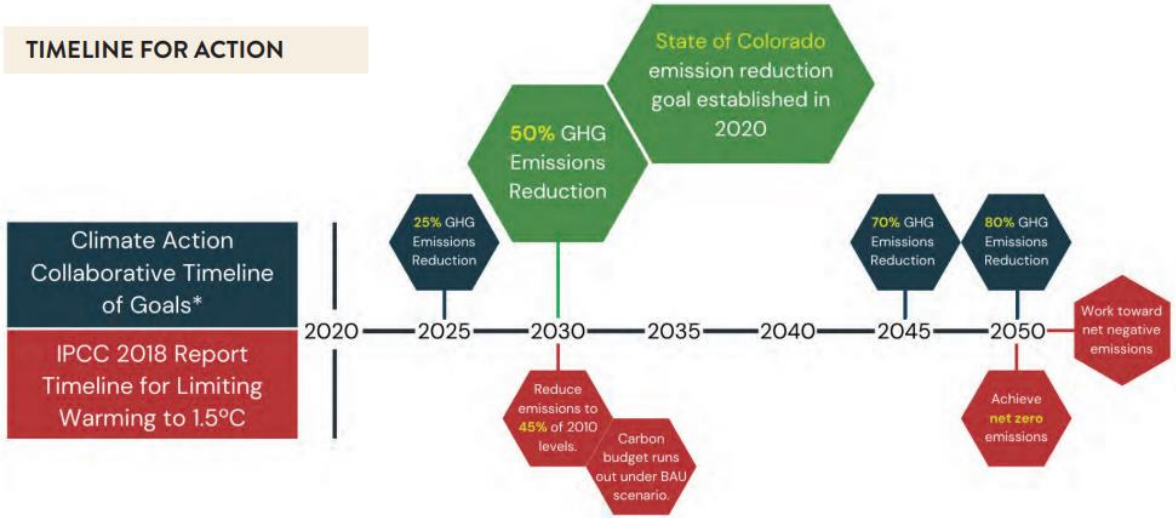
_____
Jay Brunvand, Town Clerk

Climate Action Collaborative for Eagle County Communities

Minturn Water-Energy Nexus Report & Recommendations

Background:

County-wide greenhouse gas (GHG) goals: **50% reduction by 2030; 80% by 2050**



Background:

- Water and wastewater treatment and distribution processes are extremely energy intensive, i.e., using treated water has greenhouse gas (GHG) emissions associated with it!
- Desire to better associate excessive water use and inefficient systems with GHG emissions
- CAC created a calculator to analyze the electricity and natural gas emissions associated with water and wastewater treatment and distribution
- Offering customer-facing and infrastructure recommendations that reduce water consumption and increase infrastructure efficiencies, thus reducing emissions

CLIMATE COLLABORATIVE

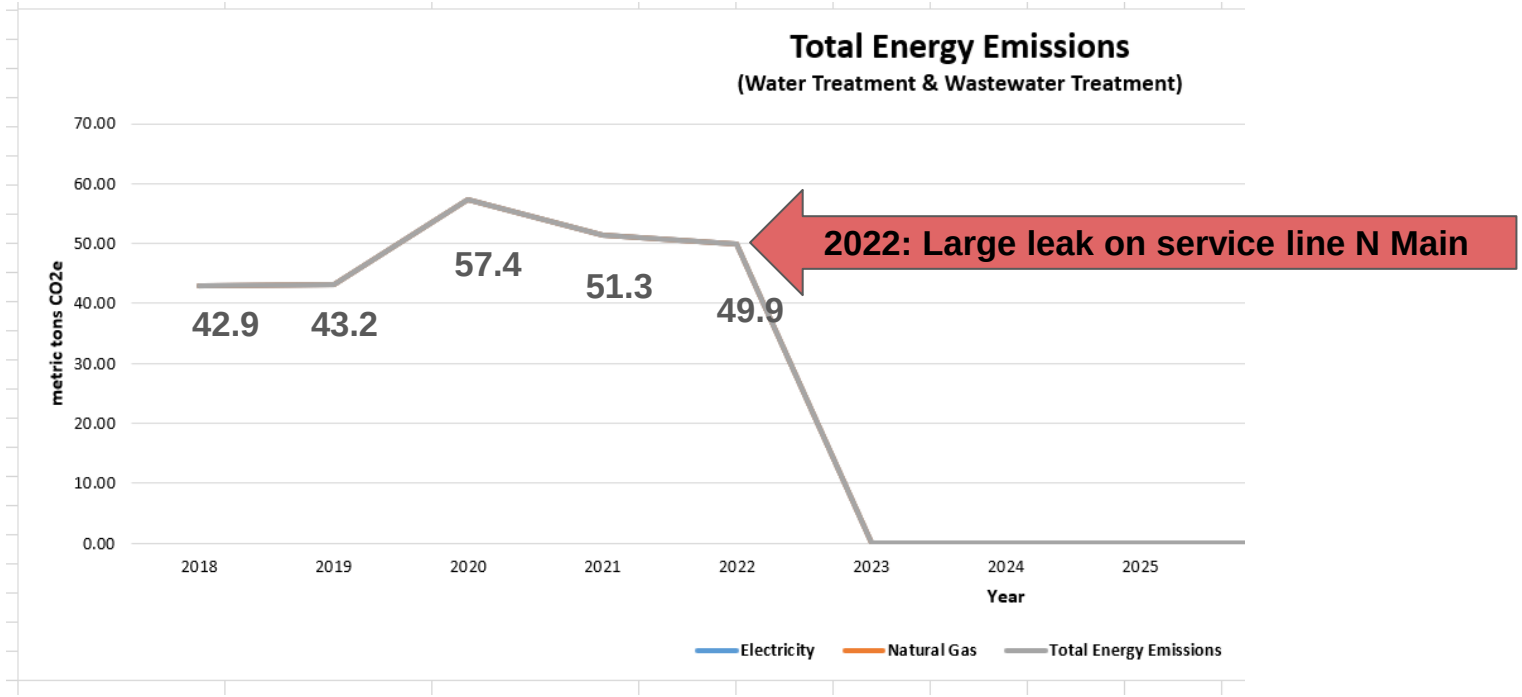
Data Analysis

		Annual Data				
		2018	2019	2020	2021	2022
Total Energy Emissions						
(metric tons CO2e)	*Electricity*	*42.90*	*43.22*	*57.37*	*51.34*	*49.91*
	Natural Gas	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*
Total Energy Emissions from Water Treatment & Distribution						
(metric tons CO2e)	*Electricity*	*42.90*	*43.22*	*57.37*	*51.34*	*49.91*
	Natural Gas	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*
Total Energy Emissions from Wastewater Treatment						
(metric tons CO2e)	*Electricity*	*n/a*	*n/a*	*n/a*	*n/a*	*n/a*
	Natural Gas	*n/a*	*n/a*	*n/a*	*n/a*	*n/a*
Energy Emissions per kilogallon water treated & distributed						
(lbs CO2e/kilogallon)	*Electricity*	*1.60*	*1.72*	*2.82*	*2.80*	*2.25*
	Natural Gas	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*
Energy Emissions per kilogallon wastewater treated						
(lbs CO2e/kilogallon)	*Electricity*	*n/a*	*n/a*	*n/a*	*n/a*	*n/a*
	Natural Gas	*n/a*	*n/a*	*n/a*	*n/a*	*n/a*

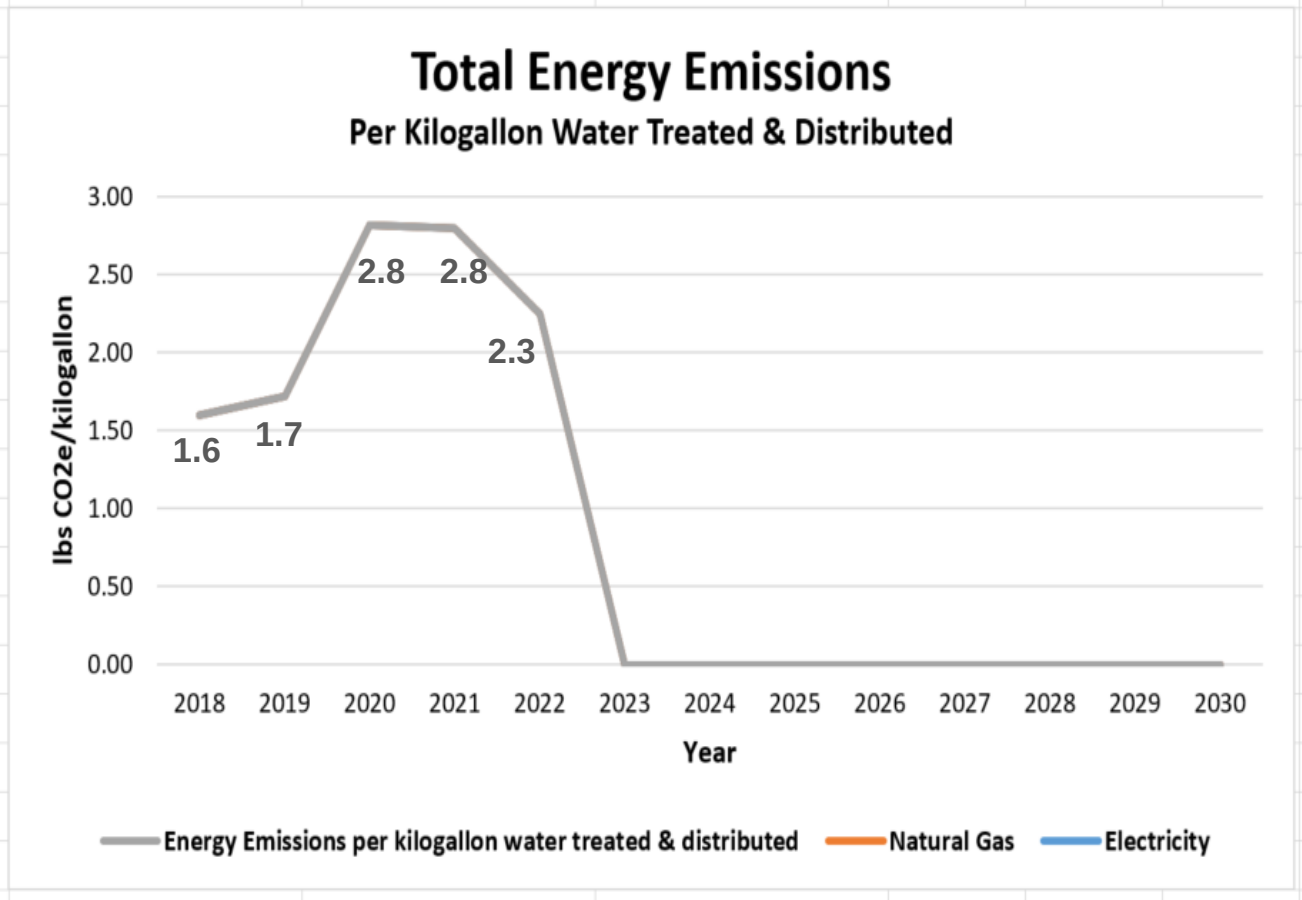
Some Perspective:

- **The average vehicle in the US emits 4.6 mT CO2e/year**
- **1 gallon of gasoline = 19.6 lbs CO2e**
- **1 kilogallon = 1,000 gallons**

Data Analysis



Data Analysis



Data Analysis - Anomaly

Year	Water Treated (kilo-gallons)	Total Energy Consumption (kWh)	*Jan. (kWh)*	*Feb. (kWh)*	*Mar. (kWh)*	*April (kWh)*	*May (kWh)*	*June (kWh)*	*July (kWh)*	*Aug. (kWh)*	*Sept. (kWh)*	*Oct. (kWh)*	*Nov. (kWh)*	*Dec. (kWh)*
2018	59,119.4	77,720	11,120	**9,480**	**10,040**	**9,080**	**10,640**	600	2,240	3,000	3,800	3,000	5,800	8,920
2019	**55,372.3**	84,080	9,360	**10,200**	**12,280**	**9,280**	**6,800**	4,880	3,920	3,400	3,560	4,960	5,480	9,960
2020	**44,843.4**	121,040	10,280	**22,520**	**19,720**	**20,160**	**16,720**	6,320	4,000	2,960	2,760	3,360	3,280	8,960
2021	40,379.2	107,640	13,640	**12,160**	**12,800**	**12,400**	**10,760**	9,320	5,440	4,960	4,200	4,640	5,800	11,520
2022	48,904.5	111,160	13,760	**13,560**	**14,120**	**12,560**	**12,520**	5,400	4,520	3,680	3,960	4,680	7,680	14,720

- The amount of water treated in 2020 decreased by nearly 11,000 kilogallons compared to 2019
- However, monthly electricity consumption between February and May 2020 was nearly double that of previous years
- The Town of Minturn could investigate this further to understand the reasoning

Data Analysis - Conclusions

- Minturn's emissions/gallon are similar to other calculations from across the Country
  - Spang et al. (2018) in California
- Minturn's slow-sand filter system uses relatively little energy and therefore produces relatively little emissions
- If Minturn constructs a process packaged water treatment plant or a membrane filtration water treatment plant, as has been proposed, it is likely that energy consumption, and therefore emissions, will increase
- Recommended to compare energy consumption and water treatment often to observe any anomalies or discrepancies in the data

Recommendations for the Town of Minturn

Customer-Facing

Update Rate Structure to a Tiered System

What is it?

A way to equitably incentivize water conservation by charging each single family equivalent (SFE) the same fixed fee; water users pay more per kilogallon on a tiered system, which disincentivizes excessive use.

How it applies to Minturn

- Minturn utilizes a tiered structure for outdoor irrigation accounts- *great!*
- Minturn should incorporate a SFE fixed cost for all residential accounts, and charge per kilogallon of use on a tiered system. We recommend mirroring Eagle River Water and Sanitation District's tiered costs for water use.

Update Rate Structure to a Tiered System

Example:

WASTEWATER SERVICE CHARGE / SFE / MONTH	
Wastewater Service Charge	$36.72
Additional Charge Average Winter Use Greater than 5 Kgals (per kgal)	$7.34
Capital Replacement Charge	$5.47
Debt Service Charge	$19.85
Wastewater Service Charge per SFE	**$62.04**

INDIVIDUALLY METERED RESIDENTIAL / Kgal / MONTH	
TIER 1 (0 - 6 kgals)	$3.70
TIER 2 (6 - 12 kgals)	$6.72
TIER 3 (12 - 18 kgals)	$13.28
TIER 4 (18 - 30 kgals)	$20.15
TIER 5 (Greater than 30 kgals)	$28.21

Cost: low ⇩
Benefit: high ⇧

Implement Smart Metering

What is it?

Advanced metering infrastructure that measures and records water usage accurately and in real-time. Smart meters provide automated readings that are transmitted to utility companies for billing and analysis.

How it applies to Minturn

- Minturn is almost complete with updating all water meters to smart meters. Data analysis from meters is critical to achieving benefits from meters.

Cost: high ⇧

Benefit: medium ⇨

Offer Rebates and Incentives for Water Efficiency

What is it?

The Beyond Lawn Program offers rebates and incentives for irrigation assessments and grass lawn replacement. These incentives apply to those outside of Eagle River Water and Sanitation District boundaries.

How it applies to Minturn

- Minturn should provide matching rebate funds to residents to further incentivize outdoor water conservation.

Cost: medium

Benefit: medium

Promote Irrigation Assessments

What is it?

- Effective strategy for customers to understand their outdoor water consumption and strategies for reduction.
- The Beyond Lawn program offers discounted irrigation assessments and rebates for upgrades.

How it applies to Minturn

- Minturn should promote irrigation assessments on its website & at events, do an irrigation assessment of Town properties, and directly promote irrigation assessments to high outdoor water users.

Cost: low ⇩
Benefit: high ⇧

Recommendations for the Town of Minturn

Operational

Energy Efficiency, Electrification, and RE Enrollment

What is it?

Water treatment facilities and distribution infrastructure should be electrified, as energy efficient as possible, and, when applicable, enrolled in energy utility renewable energy programs.

How it applies to Minturn

- We do not recommend Minturn update current water treatment facilities as the Town will be investing in a new system.
- Minturn should ensure the new system is all-electric and highly energy efficient.

Cost: high ⇧
Benefit: high ⇧

Onsite Offsets

What is it?

Investing in onsite renewable power generation can offset some of the power used and save you money over time. Pairing a system with battery storage will increase your operation's resiliency, allowing you to deploy storage in times of need or utilize it during peak hours to reduce utility costs.

How it applies to Minturn

- Minturn is exploring a solar installation at the CTP; some or all of the energy generated should be used to offset the energy consumption of the new water treatment system.

Cost: high ⇧
Benefit: high ⇧

Final Thoughts

- The full list of recommendations for the Town of Minturn can be found in your Water-Energy Nexus Report
- Outdoor water conservation is critical for our drought-inundated climate, and has a GHG reduction impact
- Water and wastewater treatment and distribution are energy intensive, expensive processes! Let's do what we can to mitigate energy and cost burdens.

Thank you!
Questions?

ginam@walkingmountains.org
Climateactioncollaborative.org

Minturn Planning Department
Minturn Town Center
302 Pine Street
Minturn, Colorado 81645

To: Planning Commission

From: Scot Hunn, Planning Director

Date: January 31, 2024

Re: Bolts Lake Code Changes Ordinance - Request for Tabling

Staff has been working with Battle North to review a draft ordinance inclusive of amendments to the Town of Minturn Municipal Code (Chapters 13, 16, 17, and 18) that will affect the Bolts Lake properties that are subject to and required as part of the settlement agreement by and between the Town of Minturn and Battle North.

Staff anticipated that an ordinance with the code changes would be presented at the January 24, 2024, regular meeting of the Town of Minturn Planning Commission. While staff and Battle North representatives continued to work together to finalize code amendment language and to finalize a draft ordinance prior to that hearing, the ordinance was not ready for presentation and review by the Commission at that time. At their regular meeting of January 24, 2024, the Commission opened the public hearing to consider the ordinance, and then moved to table the review of the ordinance to February 14, 2024, to allow staff and Battle North representatives to continue work on the ordinance.

Staff provided public notice for the January 24th Commission meeting and the February 7th Town Council meeting within the same public notice. To avoid renotification, and at the recommendation of staff, the Commission tabled the hearing on the ordinance to a date certain (February 14th).

Therefore, staff recommend that the Town Council also open the public hearing on the ordinance, and then entertain a motion to table or continue the public hearing to a date certain.

Staff recommends the ordinance hearing be continued to the Council's regular meeting of February 21, 2024.

To: Mayor and Town Council
From: Michelle Metteer
Date: February 7, 2024
Agenda Item: Water Treatment Discussion

REQUEST:
Council to discuss the merits of the various future water treatment options and provide direction to staff as deemed appropriate.

INTRODUCTION:
In 2019, after extensive analysis including the 2019 Water Capital Improvements Plan which was followed by a variety of public outreach efforts that culminated in multiple public discussions surrounding the topic of Minturn's water, water production and water future, the Council decided to move forward with the design and construction of a secondary water source and membrane water treatment plant. Since that time, the original secondary water source, the decreed well field on the Eagle River, did not prove to be a viable long-term water source solution and in keeping with the Strategic Plan to make decisions that "…maintain the viability for Minturn's future…" the Council decided in 2021? to no longer pursue the Eagle River well field option. Instead, the Council negotiated an alternate option for a secondary water source through an IGA signed in 2022 with the Eagle River Water & Sanitation District and the Upper Eagle Regional Water Authority. This alternate option is referred to as the confluence diversion and is a surface diversion water right at the confluence of the Eagle River and Cross Creek. This water right is now moving through the water court process, led by the ERWSD/UERWA legal team and looking for approval sometime in 2024 or 2025.

Simultaneous to the secondary water source efforts, Council has tirelessly looked for ways to improve Minturn's water treatment system while keeping utility rates as low as possible. This included the Council's request for a Water Treatment Plant Alternatives Analysis when the updated cost estimates for a membrane plant and diversion structure came back higher than anticipated. This analysis included the review of a package plant as well as the rehabilitation of the slow sand filtration system. The package plant came back more expensive than a membrane plant and the slow sand filtration system is dated technology which is unlikely to keep up with ongoing state-level regulations. Therefore, for these reasons, neither the package plant nor the long-term reliance on only the slow sand filtration system was recommended by the engineers or the operations consultant. Lastly, Minturn's Well Nos. 3 & 4, both located on Cross Creek, were analyzed to see if their water production capacities could be increased to allow for the needed water and thus, make the need for a membrane plant moot. Both wells, as shown in the included memo, failed the testing process and cannot produce close to the amount of water required to support Minturn's long-term needs. The Minturn Well Nos. 3 & 4 Memo ends with the option for more wells and more testing along the Cross Creek well field corridor. Testing more wells remains an option, but there are a number of caveats to consider when making this decision.

ANALYSIS:

Water Treatment Options
The **2019 Capital Improvements Plan** recommended Minturn move to membrane filtration technology for the town's water treatment needs. The document is attached to this cover memo for review as

needed. Included with the Plan is Resolution __ – Series 2019 which approved "Option 2" therein. Option 2 supported both the membrane plant and a secondary water source, albeit at much lower cost estimates than what the town is facing today.

The **Water Treatment Plant Alternatives Analysis** likewise recommended Minturn move to membrane filtration technology. This analysis was completed by HDR, Inc., and included the review by Minturn's Water Committee who conducted a matrix analysis of the water treatment options based on the values identified within the document (see matrix included within the Water Treatment Plant Alternatives Analysis). Of note, one of the differences between the 2019 Capital Improvement Plan and the 2023 Water Treatment Plant Alternatives Analysis is the separation of the water treatment infrastructure and the secondary water source. For this analysis, the Water Committee determined financial constraints required a phased approach to the construction of a membrane plant and any potential secondary water source in the future. A key element was that a membrane plant leaves a secondary water source option viable into the future where other water treatment options do not.

Separately, and although this topic hasn't arisen in years, there is merit in addressing the concept of an **interconnect** with the ERWSD/UERWA system. This concept was broached by the Minturn public in 2018 and was met with opposition. Residents identify Minturn as a "strong mountain town" which seems to coincide with having its own water treatment system. Additionally, any interconnect would require extensive costly infrastructure improvements all of which would be borne entirely by Minturn residents, not by the overall ERWSD/UERWA system. I would anticipate if this avenue were pursued for the purposes of costs savings, it would not be as financially beneficial as some might initially assume.

The **Minturn Well Nos. 3 & 4 Analysis** brought the Town further understanding on the limitations of Minturn's current alluvial wells on Cross Creek and their volumetric production. Neither well can currently produce over 100 gpm reliably and maintain confidence of remaining within the GWUDI regulations. For the utilization of wells as Minturn's sole water treatment option, additional exploratory wells are necessary within the Cross Creek wellfield decreed area (see included map). These additional wells would also need to be tested to estimate their yield and determine if the wells are under the influence of surface water (non-GWUDI). Assuming the testing results are favorable, a legal source of water would need to be obtained. There are several options for obtaining a legal source of water, which are detailed in the attached memo from Holland & Hart. Several of the options would require filing a water court action. The water court process may be time consuming and could result in new risks to and limitations on the Town's existing water rights. Exposing the Town's existing water rights to the risks associated with a water court proceeding should be carefully considered when weighing this option. The Town's water attorney, Susan Ryan, is available to discuss this topic in more detail during the executive session.

COMMUNITY INPUT:
Extensive and Ongoing

BUDGET / STAFF IMPACT:
Dependent upon the direction from Council. See attached materials for the most recent cost estimates associated with a membrane water treatment plant option. Jim Mann will be available the evening of February 7th for questions pertaining to rates and debt service and financial aid options for seniors as well as other discount programs/options for those in need.

STRATEGIC PLAN ALIGNMENT:
A water utility is a long-term investment into the viability of a community and decisions affecting the utility must align with the Town's goals and strategic plan for the long-term community objectives to be realized.

Minturn's four Key Strategies to guide the town efforts as identified in the 2023-25 Strategic Plan are:

- Practice fair, transparent and communicative local government
- Long-term stewardship of the natural beauty and health of Minturn's environment
- Sustain and invest in the things that define Minturn as a proud, sturdy mountain town to "keep Minturn Minturn"
- Advance decisions/projects/initiatives that expand future opportunity and viability for Minturn

RECOMMENDED ACTION OR PROPOSED MOTION:
The membrane water treatment plant option is most in alignment with the Council's Strategic Plan Strategies and long-term goals, especially toward "expand(ing) future opportunity and viability for Minturn." Staff and consultants therefore recommend the Council direct the staff to begin the efforts toward securing the funding, design, and engineering for a membrane water treatment plant.

ATTACHMENTS:
- 2019 Water Capital Improvement Plan
- Water Treatment Plant Alternatives Analysis
- Wells 3 & 4 Memorandum
- Cross Creek decreed wellfield
- Water Rate Impact Memo
- Water Rate Study

WATER SYSTEM CAPITAL IMPROVEMENT PLAN

TOWN OF MINTURN

September 30, 2019

Prepared by

SGM

118 West Sixth Street, Suite 200
Glenwood Springs, CO 81601
970.945.1004
970.945.5948 fax

WATER SYSTEM CAPITAL IMPROVEMENT PLAN

TOWN OF MINTURN

PREPARED BY

RYAN GORDON, PE

SGM Project # 2017-258.005

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0.0 Executive Summary

Supply and Demand

The Town's potable water production requirements have been steady over the past 10 years, or so. The Town is at a crossroads and has limited ability to serve additional demand with current water resources and treatment capacity. Additionally, the Town relies solely Cross Creek as their water supply.

Raw Water System

The Town maintains the ability to divert raw water from Cross Creek and groundwater from Wells 3 and 4. This plan identifies a number of projects to address multiple raw water system challenges and develop additional raw water sources.

- Conveyance Pipelines. As a result of the configuration of the Well 4 pipeline, the Town is limited in how Well 4 water is used and is not in compliance with the CDPHE. The reconfiguration of this pipeline will allow the Town to resolve compliance issues and more effectively use their groundwater resources.
- Redundancy. The Town does not have a redundant water source and if Cross Creek was impaired for some reason it would possibly be challenging for the Town to meet the water demand. Furthermore, the amount of water the Town can get from Cross Creek limits the amount of growth the Town can accommodate. By developing the Towns water rights on the Eagle River the Town can secure a secondary water source and additional physical supply.

Water Treatment Plant

The Town's water plant struggles to meet CDPHE regulations during spring runoff and is limited in the quantity of treated water it can produce. While currently able to meet demand, future demand will strain the plant, additionally, the plant may not be able to produce water if the raw water source changes.

- Filtration. The Town utilizes slow sand filtration which is a biological process and is difficult to control and is not adaptable to changing circumstances. Rehabilitation of the filters carries significant risk that the effort will not solve the issues at the plant. SGM recommends that the Town upgrade the filtration process to membrane filters which will allow the Town to utilize and adapt to different raw water sources and increase water production rates while maintaining high quality potable water.

Distribution System

The Town maintains 2 water tanks and approximately 7 miles of distribution piping.

- Water Storage. Evaluation of the Town's water storage indicates that the system is in need of significant attention. The Maloit Park Tank is currently undersized and does not meet the fireflow storage requirements and needs to be expanded to meet fireflow and

future development needs. The Minturn Tank, while currently sized adequately, is nearing the end of its useful life, is leaking and needs to be replaced.

- Water Mains. The Town's system is aging, water leaks have been a persistent problem and a replacement program have not been implemented to keep the system in good shape. To address the situation, the Town needs to implement a main replacement program that will systematically replace mains.

- Redundancy. This report includes recommendations to improve redundancy within the distribution system in order to increase water service reliability. These projects include connecting the Town Service area and the Maloit Service area.

- Water Loss. Beyond the water main replacement program, the Town should invest in a water loss detection system to effectively locate leaks that might be on the service lines or identify leaks that are not visible at the surface.

A prioritized summary of all of the recommended projects with estimated costs is provided in **Chapter 6.**

1.0 Introduction

1.1 Document Scope and Purpose

The Town of Minturn is a historic mining and railroad town incorporated in 1904. The Town owns and operates a potable water system to provide treated water to approximately 1,100 residents.

Previous water system planning studies include:

- 2009 Town of Minturn Water Master Plan

In 2017, the Town of Minturn selected SGM to be its water infrastructure engineer. In 2019, Minturn initiated this Water System Capital Improvement Plan project.

This document is not an evaluation of water availability or the Towns' water rights. This plan identifies and prioritizes critical water system capital improvement projects. The plan is intended to guide decision-making for the next 10 years as well as provide a basis for evaluating the suitability of Minturn's existing rates and fees and identifying many needed changes.

This document captures the results and recommendations compiled through a system-wide analysis. For this reason, design and cost estimates associated with each project are considered planning-level only. SGM advises Minturn to establish annual budgeting values for recommended projects it wishes to implement by initiating design in the year prior.

This document identifies projects based on the following:

- Existing and known upcoming regulatory requirements.
- Industry standards and/or AWWA recommendations.
- Staff-identified challenges.
- Water distribution system hydraulic modeling results.
- Anticipated development and projected demand associated with that development.
- Engineering judgement.

2.0 Water Demand Analysis and Supply Comparison

Chapter 2 presents historical and projected development and water demands and summarizes water sources and recommended improvements. Water demands are compared to existing water production capacity to verify that upcoming demands can be met.

2.1 Historical Connected SFEs

Minturn assigns Single Family Equivalents Equivalent Residential Units (SFEs) to its customers. Eagle River Water and Sanitation District (ERWSD) handles the billing for the Town and we are relying on ERWSD records for SFE counts. For water system planning, trends in the annual average number of SFEs are of most interest. SGM determined the average annual connected SFEs in Minturn's system by examining monthly billing records. Monthly billing records were obtained from Eagle River Water and Sanitation District (ERWSD). **Table 1** provides a summary of the historically connected SFEs for a recent 5-year period. Because the Town's water delivery system splits after the water treatment plant, we have made the distinction throughout this report between the "Maloit Park Service Area" and the "Town Service Area". Currently, there are approximately a total of 730 SFEs served by Minturn; 35.6 SFEs in the Maloit Park Service Area and 693 SFEs in the Town Service Area.

Table 1 Recent Annual Average SFEs

	Average Single-Family Equivalents					
	2014	**2015**	**2016**	**2017**	**2018**	**5-Year Average**
Town Service Area						
Commercial	83.8	84.9	84.9	84.5	87.7	104.8
Mixed Use	95.7	95.7	95.4	95.2	94.9	95.4
Residential	509	509.1	509.8	514.2	510.5	526.5
TOTAL	*688.5*	*689.7*	*690.1*	*694*	*693*	*691*
Maloit Park Service Area						
Commercial	15.5	20.6	20.6	20.6	20.6	19.6
Residential	16	16	16	17	15	16
TOTAL	*31.5*	*36.6*	*36.6*	*37.6*	*35.6*	*35.6*
Total						
Commercial	99.3	105.5	105.5	105.1	108.3	104.7
Mixed Use	95.7	95.7	95.4	95.2	94.9	95.4
Residential	525	525.1	525.8	531.2	525.5	526.5
TOTAL	**720**	**726.3**	**726.7**	**731.5**	**728.7**	**726.6**

2.2 Historical Water Production

Table 2 shows the monthly and total annual produced water volume for a recent five-year period. **Figure 1** graphically depicts the monthly data which has been recorded from the Town's master meters for each service area.

As with many water utilities, water production peaks in summer months when outdoor irrigation occurs. Peak day to average day production ratios for the Town Service Area

range from 2.0 to 3.0 for the period, which is within the range of normal peaking factors for other communities in which potable water is used for irrigation.

Peak day to average day production ratios for the Maloit Park Service Area range from 2.73 to 5.8 which are above the normal range, however, the ratios exceeded the norm in 2017 and 2018 which coincide with batching water due to challenges meeting disinfection requirements.

Figure 1 Historical Monthly WTP Production

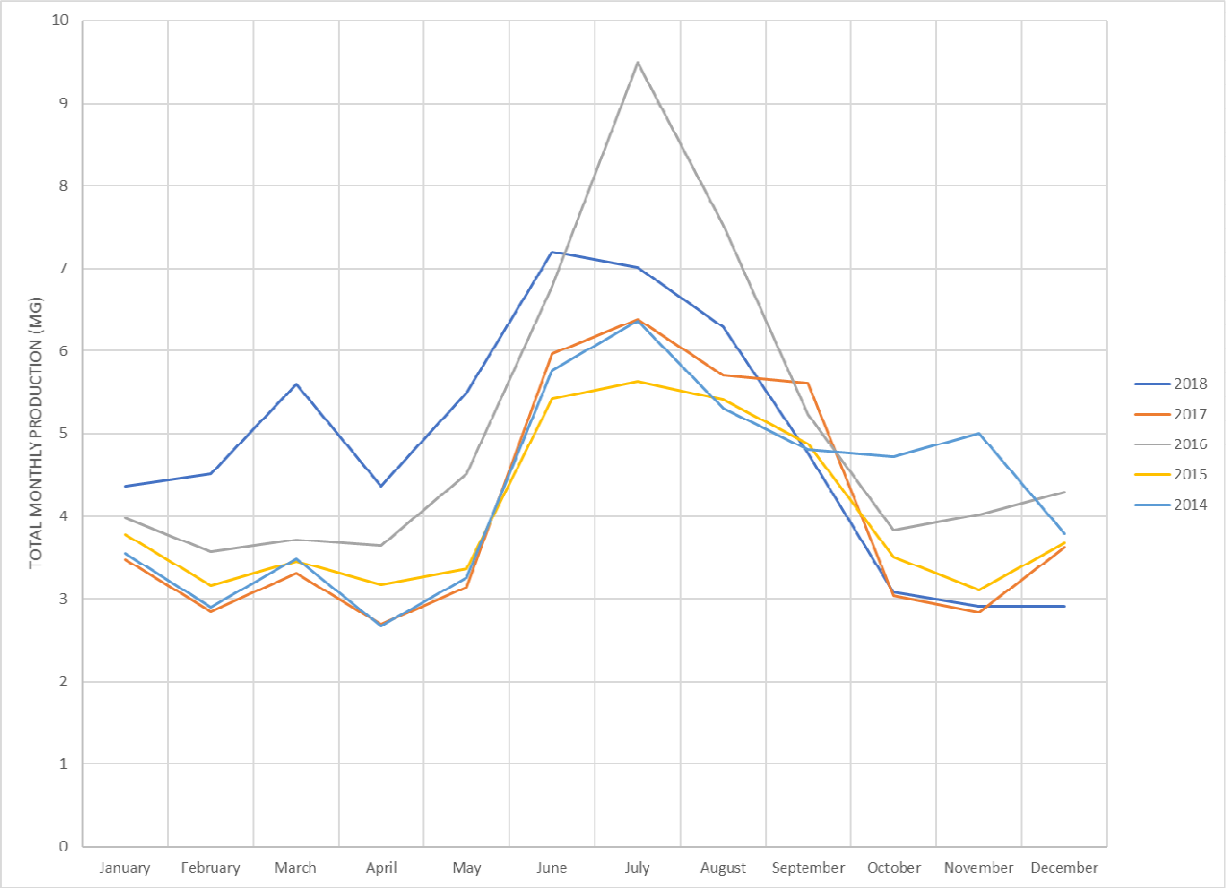


Table 2 Historical Water Produced (2014-2018)

Month	Total Produced Water (MG)									
	2014		2015		2016		2017		2018	
	Town Service Area	Maloit Service Area	Town Service Area	Maloit Service Area	Town Service Area	Maloit Service Area	Town Service Area	Maloit Service Area	Town Service Area	Maloit Service Area
January	4.63	0.12	3.63	0.14	3.87	0.11	3.38	0.09	4.27	0.09
February	2.78	0.13	3.05	0.12	3.47	0.09	2.77	0.08	4.42	0.09
March	3.34	0.14	3.28	0.17	3.60	0.12	3.22	0.09	5.50	0.10
April	2.54	0.12	3.02	0.16	3.55	0.09	2.62	0.08	4.26	0.10
May	3.10	0.16	3.12	0.24	4.38	0.14	3.00	0.14	5.36	0.14
June	5.57	0.20	5.12	0.31	6.60	0.18	5.77	0.19	6.98	0.22
July	6.14	0.23	5.20	0.42	9.31	0.18	6.22	0.17	6.81	0.21
August	5.09	0.21	4.91	0.50	7.37	0.16	5.56	0.14	6.14	0.16
September	4.60	0.21	4.36	0.52	5.10	0.13	5.47	0.13	4.59	0.16
October	4.56	0.16	3.31	0.20	3.71	0.11	2.93	0.11	2.92	0.16
November	4.86	0.14	2.99	0.12	3.93	0.09	2.74	0.10	2.72	0.19
December	3.66	0.13	3.52	0.16	4.19	0.11	3.51	0.12	2.77	0.21
Subtotal	50.87	1.95	45.51	3.05	59.08	1.52	47.19	1.44	56.75	1.83
Total	52.83		48.57		60.61		48.63		58.58	
Daily Production Statistics										
Peak Day (MGD)	0.278	0.019	0.285	0.023	0.367	0.014	0.395	0.023	0.368	0.022
Average Day (MGD)	0.139	0.005	0.125	0.008	0.161	0.004	0.129	0.004	0.156	0.005
Ratio	2.00	3.55	2.29	2.73	2.28	3.38	3.05	5.80	2.36	4.33

2.3 Unit Water Production Requirements

Unit water production requirements are defined as the daily volume of water the Town's treatment plant and wells need to produce to meet the demand of one (1) SFE of new development. SGM established the following recommended planning values based on current unit consumption rates in Minturn and other high-mountain communities as well as consideration of how water use in new development might compare to that within the existing Town, the potential impacts of a warming climate, trends in non-revenue water percentage with new development, system water loss etc. The recommended unit production values for planning are:

- Winter: 180 gpd/SFE
- Average Annual: 259 gpd/SFE
- Max. Month: 427 gpd/SFE
- Max. Day: 570 gpd/SFE

2.4 Development Projections

The Town provided SGM with information regarding two growth scenarios identified in **Table 3** as "Option 1: Cross Creek Only" and "Option 2: Cross Creek plus Eagle River

Wells." The growth scenarios are largely tied to the availability of water to support the growth. These are described below.

- *Option 1: Cross Creek Only* – Under this option the Town would continue to rely solely on Cross Creek for its water supply.
- *Option 2: Cross Creek plus Eagle River Wells* – Under this option the Town would continue to utilize Cross Creek water and also develop additional water resources on the Eagle River through a well field. This option includes moderate growth.

SGM has not evaluated if the levels of growth described below in Table 3 can be supported by the Town's water rights portfolio and augmentation supplies.

Table 3 Development Summary

		Option 1 Cross Creek Only	Option 2 Cross Creek plus Eagle River Wells
PROPERTY	**Service Area**		
Infill (Comm/Res/Ind)	Town	70	330
School District	Maloit Park	120	120
	Total	***190***	***450***

2.5 Current and Projected Future Water Production Needs

Tables 4, 5, and **6** showing projected additional, existing, and total future water production needs under the growth scenarios for the Town and Maloit Park service areas and the overall water system. Future water production figures are based on planning numbers and existing water production figures are based on actual data.

Table 4 – Overall Water Demands

	Additional Required Water Production (GPD)			
	SFEs	**Average Daily**	**Max. Month**	**Max. Day**
Option 1	190	49,210	81,100	108,300
Option 2	450	116,580	192,300	256,400
	Existing Water Production Requirements (GPD)			
	SFEs	**Average Daily**	**Max. Month**	**Max. Day**
Existing	728	147,700	233,500	333,000
	Total Future Water Production Requirements (GPD)			
	SFEs	**Average Daily**	**Max. Month**	**Max. Day**
Option 1	918	196,900	314,800	441,300
Option 2	1,178	264,300	425,900	589,400

Table 5 - Town Service Area Water Demands

	Additional Required Water Production (GPD)			
	SFEs	**Average Daily**	**Max. Month**	**Max. Day**
Option 1	70	18,130	29,890	39,900
Option 2	330	85,500	141,000	188,000

	Existing Water Production Requirements (GPD)			
	SFEs	**Average Daily**	**Max. Month**	**Max. Day**
Existing	691	141,700	224,500	314,400
	Total Future Water Production Requirements (GPD)			
	SFEs	**Average Daily**	**Max. Month**	**Max. Day**
Option 1	761	159, 800	254,500	354,400
Option 2	1,021	227,200	365,600	502,500

Table 6 - Maloit Park Service Area Demands

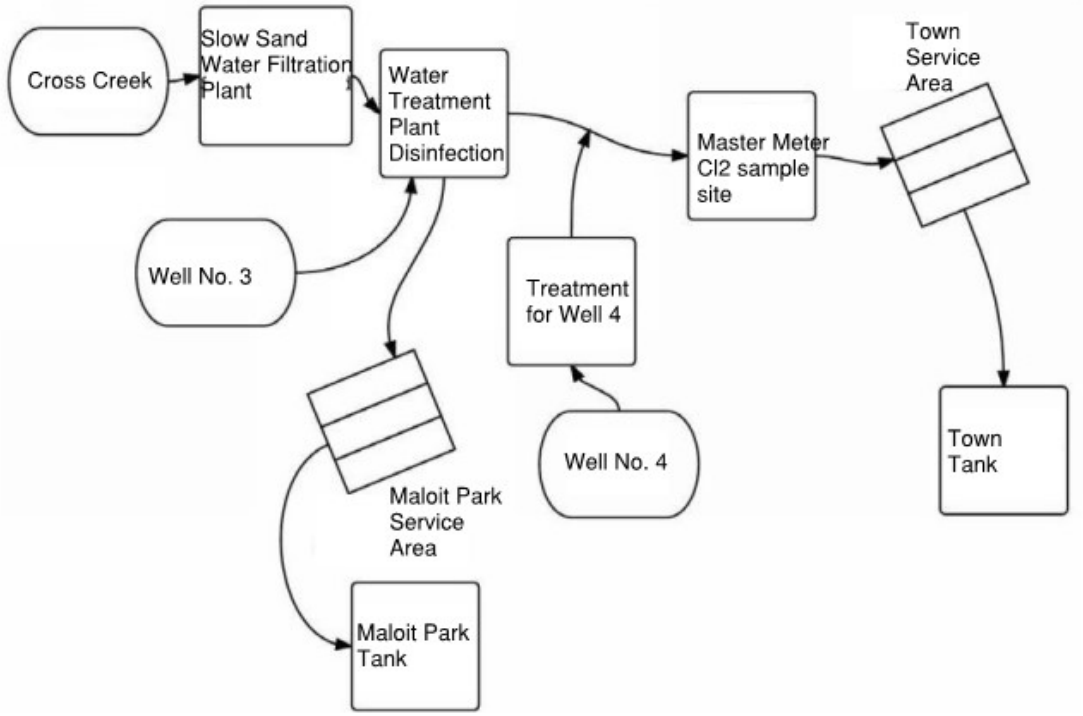
	SFEs	**Average Daily**	**Max. Month**	**Max. Day**
	Additional Required Water Production (GPD)			
	SFEs	**Average Daily**	**Max. Month**	**Max. Day**
Option 1	120	31,080	51,300	68,400
Option 2	120	31,080	51,300	68,400
	Existing Water Production Requirements (GPD)			
	SFEs	**Average Daily**	**Max. Month**	**Max. Day**
Existing	37	6,000	9,000	18,600
	Total Future Water Production Requirements (GPD)			
	SFEs	**Average Daily**	**Max. Month**	**Max. Day**
Option 1	157	37,100	60,300	87,000
Option 2	157	37,100	60,300	87,000

2.6 Sources of Water

The Town of Minturn's water supplies include surface water diverted and gravity fed from Cross Creek at a concrete diversion structure located approximately 1,600 feet upstream of the treatment plant in a 12-inch cast iron raw water pipeline.

The Town also has two groundwater wells (Well 3 and Well 4). Well 3 pumps water directly to the plant clearwell through a 4-inch pipeline. Well 4 waterline is connected to the existing transmission line from the plant to the town. This configuration does not meet CDPHE disinfection requirements and Well 4 has been classified as an emergency water supply until the Town can resolve and satisfy CDPHE disinfection requirements. **Figure 2** shows a schematic of the Town's current water system.

Figure 2 Minturn Raw Water System Schematic



2.6.1 Water Reliability and Redundancy

Currently the Town relies solely on Cross Creek and the groundwater wells for its water. Relying on a single water source carries risks to the Town in the event that Cross Creek water is limited either through low flow/drought conditions or the water quality is degraded through an event such as a forest fire or contaminated by a pollutant. It is advisable that the Town secure a secondary/redundant water source to be able to provide water to the Town if the primary water source is not available.

There are two options for a redundant water source as identified by the Town and their consultants and as presented to Council in September 2018; either develop the Town's existing Eagle River water rights or construct an interconnection to the ERWSD system. Developing the Eagle River water rights is presented in the next section. The infrastructure for interconnect with ERWSD is not analyzed in this document because future infrastructure is presumably to be provided by the future development.

3.0 Raw Water Improvement Projects

This plan includes three recommended projects to improve the raw water system. **Table 7** provides a cost estimate and proposed timing. A summary of the project is as follows.

3.1 Raw Water Screening Improvements

The existing inlet structure has a ½”x½” coarse screen to keep out large debris. The current screening openings is adequate for the slow sand filtration process, however if alternative treatment is used, better screening will assist to remove debris and protect treatment equipment.

3.2 Well 4 Pipeline Improvements

Well 4 connects to the main distribution pipeline to the Town service area. As previously discussed, CDPHE has determined this configuration is not acceptable. Additionally, this configuration does not allow Well 4 water to be delivered to the Maloit Park service area.

Constructing a new pipeline from Well 4 pump head to the existing clearwell will resolve the configuration issues and allow the Town to manage its water resources more effectively, see **Figure 3**.

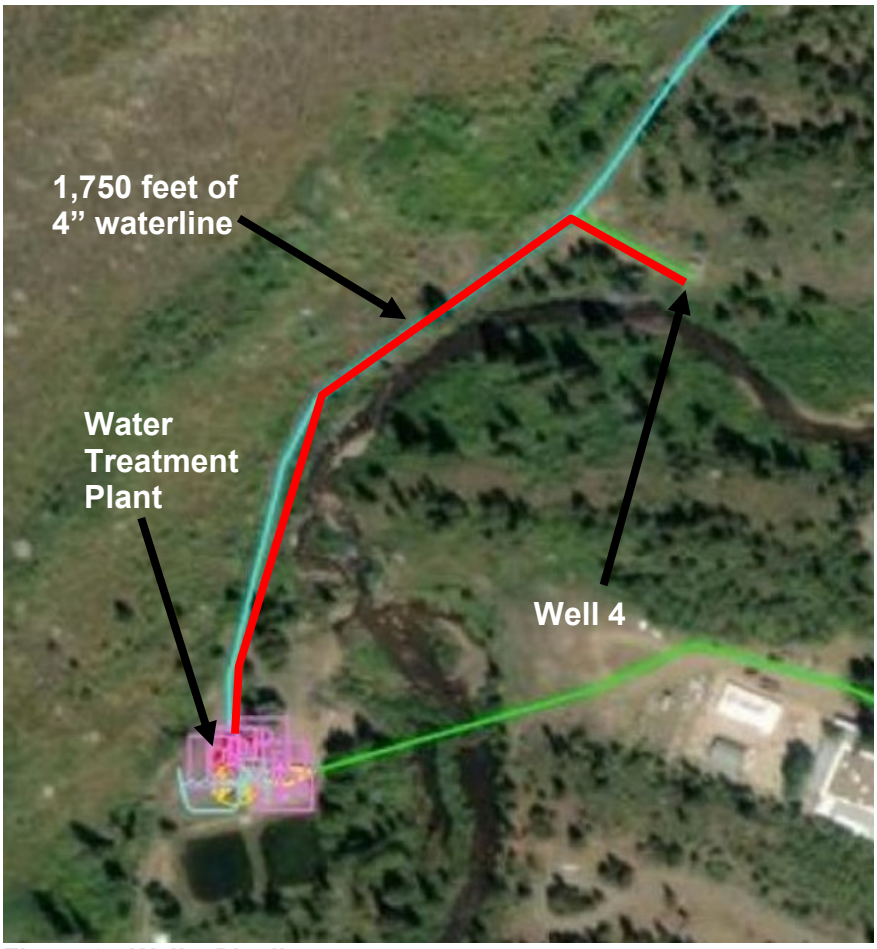


Figure 3 - Well 4 Pipeline

3.3 Eagle River Wells

Currently there is not a secondary or redundant water source available to the Town. Development of the Towns water rights on the Eagle River would provide this redundant

water supply through the development of a well field as well as provide additional water resources for future growth.

Wells would be drilled on banks of the Eagle River. Based on conversations with drilling companies, the wells would likely be drilled using a combination of air rotary and cable tool rigs. For the purpose of this CIP it is assumed that water would be pumped to the existing water treatment plant site for treatment and distribution. It is assumed that the wells would be drilled on the western bank of the Eagle River, see **Figure 4**.

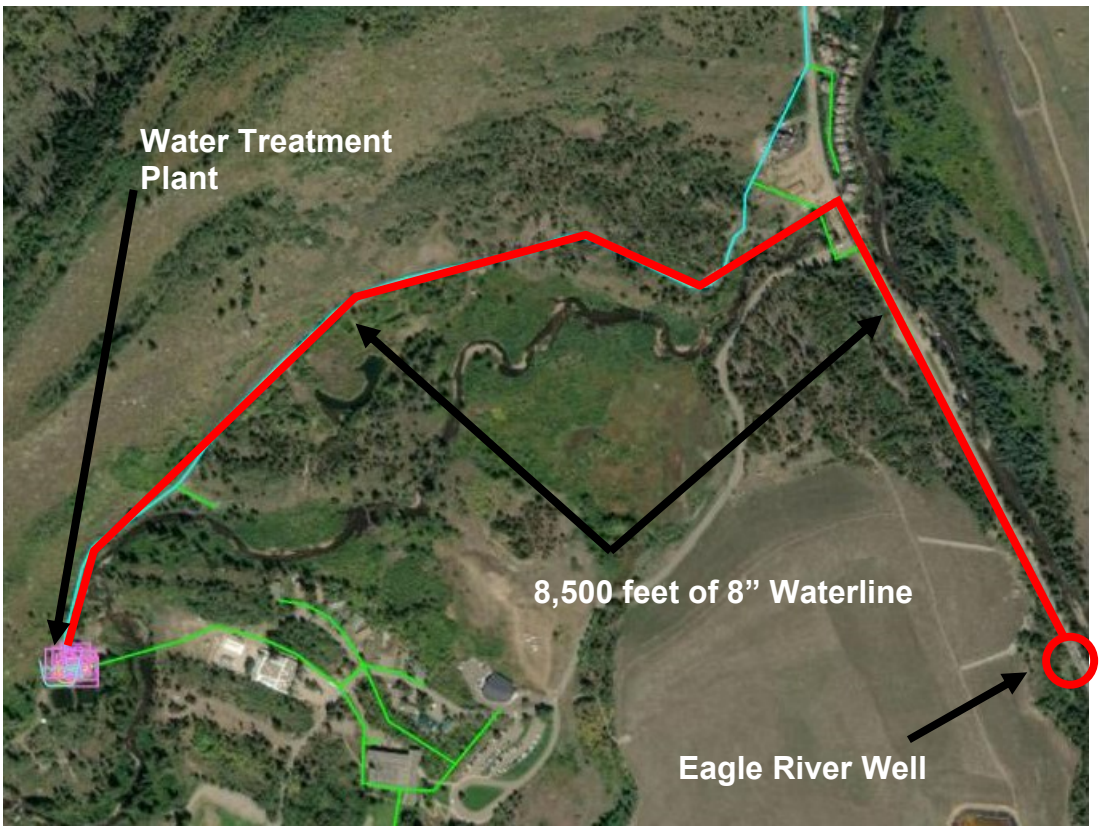


Figure 4 - Eagle River Wells and Pipeline

Table 7 Raw Water System Improvements Summary

Project	Purpose	Cost Est.
Raw Water Intake Improvements	Reduce O&M requirements and minimize sediment	$25K
Well 4 Pipeline Improvements	Come into compliance with CDPHE regulations and to fully utilize groundwater resources.	$230K
Eagle River Well Field and Pipeline	Provide additional water supply to support future growth and provide the Town with a redundant water supply	$5.2M

4.0 Water Treatment Plant Analysis

This chapter summarizes background, challenges and recommended projects associated with the Town's Water Treatment Plant (WTP).

4.1 WTP Background Information

4.1.1 Existing Water Facilities

The existing WTP consists of and intake structure off of Cross Creek, two groundwater wells (Well 3 and 4), three slow sand filters (filters 1 and 2 are located outdoors and filter 3 is indoors), a 25,000 gallon clearwell, sodium hypochlorite disinfection system and distribution pumps that deliver treated water to the Town and Maloit Park. All three filters discharge to a common clearwell through separate pipes. Sodium hypocholorite is dosed into the clearwell for disinfection.

Well 3 discharges directly to the clearwell. Well 4 feeds directly into the distribution line between the WTP and the Town. Well 4 is disinfected by sodium hypochlorite at the well pump, however, CDPHE has determined the piping configuration does not meet current regulations with regard to disinfection credits and has been categorized as an emergency supply. Well 4 cannot discharge into distribution system as currently operated unless under emergency conditions.

There are two separate distribution systems, Town Service Area and Maloit Park Service Area, that are fed from the clearwell. These systems have separate pumps, tanks and distribution pipelines.

4.1.2 Existing WTP Unit Processes

Filtration

Based on existing drawings titled "Water Treatment Plant Filter Addition," dated 1991, and discussions with Minturn staff, the filters consist of the following (note that the filters have not been deconstructed, rebuilt or rehabilitated since 1991 to allow for field verification):

- All filters have perforated PVC underdrain laterals supported in a 1 foot gravel layer.
  - Filters 1 and 2 laterals are 6"-diameter and spaced every 6 feet. The size and spacing of the perforations is unknown.
  - Filter 3 laterals are 4"-diameter and spaced every 5.5 ft. The size and spacing of the perforations is unknown.
- A geotextile fabric is provided above the gravel/laterals.
  - Filters 1 and 2 have a single layer of fabric.
  - Filter 3 has two layers of fabric with 2-inch of coarse sand between the fabrics.
- Approximately 3 to 3.5 feet of sand is provided above the collection laterals.
  - Filter 3 has a geotextile fabric between the sand layers at approximately 2 feet above the laterals.
- All filters have an overflow which sets the depth of water above the top of sand.
  - Water depth in Filters 1 and 2 is approximately 5.0 feet.
  - Water depth in Filter 3 is approximately 5.6 feet.

- Existing drawings and documentation do not provide the specifications for the gravel or filter sand. However, staff replaces sand that is removed during cleaning operations and this sand has an effective size (ES) of 0.15 to 0.3 mm and a uniformity coefficient (UC) of 3.0. These specifications meet the CDPHE criteria for sand.

The configuration of Minturn's slow sand filters generally follows accepted design practices in published design guides and literature. This includes the depth of the sand and height of water above the sand, both of which are critical components.

Filters 1 and 2 are located outdoors and are excavated into the existing ground. The filters are trapezoidal in cross section with 3:1 side slopes (horizontal:vertical). The various layers in the filters have different plan areas:

- Bottom of sand layer is 42 ft x 42 ft (1,764 sf)
- Top of the sand layer is 60 ft x 60 ft (3,600 sf)

Filter 3 is indoors and within a concrete basin. The concrete basin is 80 feet long and 40 feet wide (3,200 sf); all layers in the filter have the same area.

CDPHE design guidelines limit the maximum allowable filtration rate to 0.1 gpm/sf. **Table 5** shows that current hydraulic loadings for the existing filters are well below this maximum. Note that the CDPHE maximum loading rate does not imply that all slow sand filters can be operated successfully at that rate. It is an upper bound above which CDPHE believes the technology's application would create an unacceptably high risk to public health based on its inherent limitations.

Table 8 Slow Sand Filter Hydraulic Loading Rates

Filt. No.	Filter Area (ft^2)[1]	Filter Area (ft)[2]	Current Loading Rate (GPM/sf)[1]	Current Loading Rate (GPM/sf)[2]	Max. Loading Rate (GPM/sf)[3]	Current Flow-rate (GPM)[1]	Max. Allowed Flowrate (GPM)[3]
1	3,600	1,764	0.0167	0.034	0.1	60	360
2	3,600	1,764	0.0167	0.034	0.1	60	360
3	3,200	3,200	0.018	0.018	0.1	60	320
		Total Slow Sand Filter Capacity				180	1,040

1. Area based on top of sand layer
2. Area based on the bottom of sand layer
3. CDPHE Design Criteria for Potable Water. Water Quality Control Division. 2013.

Disinfection

Disinfection is achieved using hypochlorite to maintain a residual at the point of entry. Water from the filters and Well 3 discharged to the clearwell where chlorine is added. The clearwell is 25,000 gallons and does not have any baffling and therefore has a baffle factor of 0.1. The configuration and the size of the clearwell is not sufficient to achieve the required 1-log Giardia inactivation and 2-log virus inactivation. To achieve the required inactivation, the transmission pipelines and batching has been employed, further discussed below.

Town Service Area
The Town Service Area achieves the required disinfection requirements through the clearwell and the transmission pipeline. However, as described above, Well 4 is not able to operate due to lack of disinfection compliance.

Maloit Service Area
The Maloit Service Area cannot meet inactivation requirements using the clearwell and transmission pipeline due to contact time. In order to meet disinfection, water is "batched" in the clearwell. The clearwell is filled with filtered water and dosed with hypochlorite and held for the requirement time to achieve the required inactivation.

4.2 WTP Improvements

The slow sand filtration has served the Town well for many years, however, there are several factors and indicators that suggest this technology is not sustainable to reliably produce high quality drinking water to meet CDPHE regulations and future growth. However, it is clear that the following contributing factors warrant that the Town make significant improvements to the WTP to ensure efficient, manageable operations and reliable regulatory compliance.

- Water Quality Challenges are present during spring runoff with elevated turbidity levels in Cross Creek. The existing slow sand plant struggles to meet the permit turbidity limits during high turbidity events seen in spring runoff and the Town has had to shut down the slow sand filter plant and utilize the wells during runoff. This has been workable for the current demand but severely limits the ability of the Town to serve additional demand.
- Seasonal Operating conditions can have a significant impact on the operations, required maintenance and performance of slow sand filters. These impacts are generally more acute than for more highly engineered filtration systems and must be considered when evaluating the future use of these filters to serve the Town.
  - Winter- The outdoor filters can potentially freeze, potentially prohibiting their use for water production during the winter months. Ideally, outdoor filters should be drained and taken offline during winter to prevent ice from damaging the underdrain piping and/or disturbing the sand bed. CDPHE recommends that outdoor sand filters be enclosed.
  - The biological action of the filters, which is the key to their filtration performance, is reduced with low water temperatures. Operating at a slower filtration rate can help to counteract the effects of lower water temperature.
  - Spring - Spring runoff conditions often generate higher turbidity raw water, which typically yields shorter filter run times. Historically, Minturn has not seen turbidities greater than 5 NTU, or so, in water from Cross Creek. That said, spring runoff conditions are still the most challenging and they are concurrent with the start of the high water demand season in Minturn. Additionally, if water sources to the WTP are changed, or if there are disruptions to the Cross Creek watershed, such as a forest fire, spring runoff conditions may become more challenging in the future.
  - The filtration plant will need to be operating at peak flows during peak demand season, which occurs during the summer months. Plant operations will need to be carefully planned to ensure that the filters are cleaned and fully operational

prior to peak demand. When one of the Town's slow sand filters reaches the end of its filter run, drying, cleaning, and ripening, can require that the filter be off-line for 4+ weeks. This leaves the Town without a critical production source.

- As described in Section 3.1.2, the amount of water that the filters can produce is less than observed in other slow sand filter plants and the maximum permitted limit. The reasons for the low production is not known but could be due to blockage or clogging within the filter and it is possible the production rate may continue to fall without significant rehabilitation.
- Meeting regulatory requirements will continue to be challenging and will likely become more stringent in the future. Multiple tests are being conducted in 2019 to determine the ability and extent of the slow sand filters to produce water. While preliminary results suggest the filters are performing well, future performance will need to be validated and it is likely additional water quality testing will be necessary.

4.2.1 WTP Process Upgrade Alternatives Summary

In order to address changes to influent water quality at the WTP, a planning-level analysis was conducted to evaluate potential alternatives. The alternatives are summarized as follows:

Alternative 1. Filter Rehabilitation and Upgrades

Filter rehabilitation would entail completely removing and replacing all media, filter underdrain piping and the liner. Rehabilitation would attempt to address the low production rate and address regulatory and water quality challenges. However, rehabilitation does not guarantee that the filter issues are resolved. Slow sand filters are not mechanical, rather they are biological and there are significant risks that rehabilitation will not solve the issues and may lead to the filters not performing as designed which has been observed with other slow sand filter rehabilitations in Colorado.

CDPHE design criteria states the filters are to be indoors and while CDPHE has stated that they won't require them to be enclosed, there is a possibility that they will be required in the future. The large footprint associated with slow sand filters limit the ability to expand production in the future.

Alternative 2. Filter Replacement (Membrane Filters)

Membranes represent state-of-the-art filtration technology, are highly automated, and offer robust treatment and can handle a wide range of influent water quality conditions. Membranes have a small footprint which would fit within the existing plant site. Membranes are skid mounted and are module based therefore the capacity can be expanded easily. The systems are generally automated which simplify operation compared to conventional water filtration treatment plant.

It is assumed that existing clearwell would be repaired and kept in service as well as the Town and Maloit Park service pumps. The existing outdoor filters would be abandoned, and a new engineered metal building would be constructed in the footprint of one of the outdoor filters. The other filter would be repurposed to serve as the backwash holding pond for the membrane waste.

This analysis evaluated MEMCOR CPII low-pressure membrane ultrafiltration System. Two membrane trains, 1 duty and one standby, would be installed. Each train would house a 24 L40N membrane module capable of treating approximately 450 GPM.

Based on this information, SGM recommends that the Town pursue Alternative 2 – membrane filters. Given the costs and the risks of filter rehabilitation, the ability of membranes to manage a wide range of variable raw water parameters and the ability to easily expand plant capacity membranes are the most reliable technology to produce water for current and future conditions.

4.2.2 Clearwell Repairs

Existing clearwell has settled and groundwater is seeping in at pipe penetrations and at cracks in the concrete walls. Repairs to the existing clearwell are necessary to repair spalling concrete in the basin and repairs to ensure the clearwell is water tight. The interior of the clearwell should be repaired and recoated.

4.2.3 Water Treatment Plant Improvements Summary

Table 9 presents a summary of the water treatment plant improvement recommendations identified in this chapter.

Table 9 Water Treatment Plant Improvements Summary

Project	Purpose	Cost Est.
Construct new membrane filter plant	Improve the reliability of the water plant to deliver the quality and quantity of water needed for current and future growth	$3.8M
Construct new water plant building	New building to house membrane filtration equipment	$475K
Repairs and Modifications to the clearwell	Clearwell is cracked and needs repairs to extend the service life of the structure. The piping and controls need to be upgraded to improve the operations	$250K

5.0 Water Distribution System Analysis

Minturn maintains over 7 miles of potable water distribution piping, 2 water storage tanks, and 1 PRV station.

This chapter documents the capital improvements related to the water distribution system. Included in each improvement category is a description of the analysis criteria, assumptions and methodology used to develop recommendations.

5.1 Water Storage

Minturn maintains 2 water storage tanks (Minturn and Maloit Park tanks) and 708,000 gallons of combined stored water. The following summarizes the analysis and recommendations associated with water storage.

5.1.1 Minturn Water Tank Inspection and Evaluation

A dive inspection by Marine Diving Solutions was performed on October 3, 2015 and SGM performed an in-service floating inspection on May 7, 2019. The result of the inspection was that the existing Minturn Tank is near the end of its useful like and either significant rehabilitation or replacement is necessary. It is our recommendation to plan for a replacement of the tank as rehabilitation is a short term fix and deterioration will continue. Replacement analysis and options are presented in Section 5.1.2.

5.1.2 Evaluation of Tank Replacement Options

SGM evaluated three types of tanks: bolted steel tanks, welded steel tanks and concrete tanks.

Bolted Steel Tank

A factory-coated bolted carbon steel tank for water storage meeting the requirements of American Water Works Association (AWWA) D103.

A bolted steel water storage tank is composed of rolled steel tank panels connected at the lap joint by a bolted connection. A row of bolts, along with gasket material and sealant are used to seal each horizontal and vertical lap joint. The capacity of a bolted steel tank can be as large as 8 million gallons and typically includes an aluminum geodesic dome roof and a concrete foundation. Bolted tanks are typically factory coated for an ideal coating and curing environment, then transported and erected in the field.

Welded Steel Tank

A welded steel tank for water storage meeting the requirements of AWWA D100.

Similar to a bolted steel tank, a welded steel tank is composed of rolled carbon steel sheets or panels connected together by lap or butt-jointed welds. Due to the high strength of a welded connection, welded steel tanks are constructed to capacities up to 25 million gallons. Larger capacity welded steel tanks require roof framing members to support lateral and vertical loads. Typical foundation types include a concrete ringwall or deep foundation.

Concrete Tank

There are three design and construction methods for concrete tanks which include conventionally reinforced meeting the requirements of American Concrete Institute (ACI) 350, Wire- and Strand-Wound, Circular, Prestressed Concrete Water Tanks meeting the requirements of AWWA D110, and Tendon-Prestressed Concrete Water Tanks meeting the requirements of AWWA D115. Conventionally reinforced concrete tanks are typically designed for capacities less than 250,000-gallon capacities.

AWWA D110, Type III Strand-Wound, Prestressed Concrete Tank

D110 Type III tanks are constructed with a continuous steel diaphragm which is permanently embedded in the finished tank wall. The diaphragm acts as a water barrier within the tank wall, providing assurance of water tightness. The tanks are constructed with bonded wire prestressing applied to the exterior wall, providing multiple layers of continuous prestressing. These tanks are typically constructed with a free-standing concrete spherical dome roof eliminating the needs for internal columns and roof framing. Wall and roof sections are cast-in-place in “casting beds” and erected similar to tilt-up construction prior to installation of the bonded wire prestressing. Shotcrete is applied to the bonded wire for protection and an aesthetic finish.

AWWA D115 Tendon- Prestressed Concrete Tank

D115 tanks do not utilize a steel diaphragm within the wall, instead waterstop materials are installed at all joints to provide a water-tight tank. Tendons are placed internal to the tank wall, which is threaded through a plastic duct and hydraulically jacked. Corrosion protection is applied by injecting grout into the plastic duct. D115 tanks are typically constructed with a column-supported, moderately sloped roof.

Advantages and Disadvantages

There are advantages and disadvantages applicable to all tank construction methods. A few of each are summarized in the table below. It is SGM’s opinion the greatest disadvantage with bolted and steel tanks are the continual maintenance required throughout the life-span of the tank. Concrete tanks require very little maintenance in comparison. All construction methods have challenges related to weather. Welding and coating operations are highly affected by low temperatures and moisture. Similarly, there are challenges with on-site pre-casting of concrete panels in inclement weather.

Table 10 Tank Advantages and Disadvantages

Tank Type	Advantages	Disadvantages
Bolted Steel (AWWA D103)	Lowest capital cost	Anticipated 30- to 45-year life-span
	Reduced construction duration from factory applied coatings and quick field erection	Gaskets and sealants at bolted connections deteriorate over time; very difficult to replace and maintain
	Aluminum dome roof as a design option allows for elimination of roof framing	Very difficult to recoat
	Tanks are typically designed by the in-house tank fabrication engineer utilizing modeling software	Poor construction
		Multiple contractors needed for site work, pipeline installation and foundation construction
Welded Steel (AWWA D100)	Full replacement tank designed to current regulations and codes	Steel tariffs have increased the price of steel; steel tanks are no longer as affordable as in previous years
	Numerous qualified steel fabrication and construction companies in the industry which improves competitive pricing	Requires interior and exterior surface preparation and recoating every 15 years for life of the tank
	Full penetration welding for water-tightness	Anticipated 75-year life span; requires maintenance beyond typical sandblasting and recoating, i.e., floor plate scanning and repairs, pitting repairs and roof framing repairs and replacement
	Exterior color selection available to camouflage with surroundings	Susceptible to corrosion for life of the tank
		Dome roof is not likely an option of the size of the tank; significant roof framing required to support vertical and horizontal loads which become cumbersome for maintenance and cleaning
		Additional expense associated with internal, external and below floor plate cathodic protection
		Longer construction duration for fabrication, erection, and field coating
		Inclement weather can affect welding and coating processes
Concrete Tank AWWA D110 Wire-Wound Tank	100-year life-span; minimal maintenance required	Specialized design and construction; Preload and DN Tanks are industry leaders which reduces competitiveness in the market, i.e., limited contractors in the industry compared to steel tanks
	Improved insulation; can be buried	Longer construction duration needed for casting of wall and roof panels and cure time
	Dome roof eliminates roof framing and internal columns; improves ease of cleaning	Some spall and crack repair may be needed during life of the tank
	Watertight steel diaphragm within the wall	
	Streamlined construction	

	process, i.e., simultaneous construction of the tank walls and floor	
	Concrete can be colored, and/or architectural finishes can be used for aesthetics	
Concrete Tank AWWA D115 Tendon Prestressed Tank	100-year life-span; minimal maintenance required	Specialized design and construction; D115 tanks are typically designed by a structural engineer, constructed by a general contractor and post-tensioned by a specialty contractor
	Watertight joints provided by internal waterstop material and joint sealant	Joints may require rehabilitation during life-span
	Improved insulation; can be buried	
	Concrete can be colored, and/or architectural finishes can be used for aesthetics	

New Construction Costs

The table below summarizes anticipated tank construction costs for a 0.60 MG tank, which are applicable to the tank construction only and exclude all items typical to the site which include access, foundation, site piping, site security. All appurtenances associated with the tank such as vents, access hatches, handrail, and ladders are included in the tank construction cost.

Table 11 Tank Unit Costs

Bolted Steel Tank	Welded Steel Tank	Prestressed Concrete Tank
~$1.05/gallon	~$1.20/gallon	~$1.45/gallon

Life Cycle Analysis

While bolted steel tanks may be the most cost effective for initial capital costs, the life-span of a bolted tank is not comparable to a welded steel or concrete tank primarily due to the need to replace the tank based on the useful life of the tank.

Bolted Steel Tank Maintenance

As seen in the existing bolted steel tank, the gasket and sealant materials have deteriorated at the bolted connections causing a number of leaks. Numerous repairs have been performed on the tank by underwater dive teams. To properly rehabilitate a bolted steel tank, the gasket and sealant materials should be replaced during recoating operations which can be a significant undertaking.

Maintenance costs for a bolted steel tank are extremely difficult to estimate as it is challenging to estimate the rate of corrosion at joints and bolts, required relining/coating for corrosion protection and replacement of gaskets. It is also extremely difficult to estimate the extent of the rehabilitation as each tank tends to be somewhat unique. For this analysis, it is assumed that the tank will need to be replaced every 45 years and that the gaskets and the interior liner needs to be replaced once before the lifespan of the tank expires. We have assumed that this effort is approximately $200,000 per repair event.

Welded Steel Tank Maintenance

A welded steel tank will need to be taken offline approximately every 15 years throughout the life of the tank to replace the internal and external coating system and perform steel pitting repairs and potentially roof framing repairs and/or replacement. Anticipating a 75-year life of a welded steel tank and maintenance scheduled every 15 years, the table below summarizes the anticipated costs associated with steel tank maintenance and are listed for the 0.60 MG tank. Traditionally construction costs would be escalated when projecting; however, for simplicity, recoating costs are recorded the same for each maintenance cycle. Applicable to both steel and concrete tanks, the Town is required to inspect and clean their tanks every 5 years per the requirements of Colorado's Primary Drinking Water Rule. These costs are applicable to either construction method and are therefore excluded from the lifecycle analysis.

Table 12 Welded Tank Maintenance Costs

0.60 MG Steel Tank Maintenance Schedule and Costs			
Year	**Maintenance Scheduled**	**Total Price**	
15	Full abrasive blast and re-application of interior coating	$187,000	Total 1st Maintenance Cycle Cost **$380,100**
15	Full abrasive blast and re-application of exterior coating	$175,000	
15	Engineering / Inspection Cost (estimated as 5%)	$18,100	
Year	**Maintenance Scheduled**	**Total Price**	
30	Full abrasive blast and re-application of interior coating	$187,000	Total 2nd Maintenance Cycle Cost **$401,100**
30	Full abrasive blast and re-application of exterior coating	$175,000	
30	Magnetic Flux Leakage (MFL scan) of floor plate	$15,000	
30	Floor plate repairs	$5,000	
30	Engineering / Inspection Cost (estimated as 5%)	$19,100	
Year	**Maintenance Scheduled**	**Total Price**	
45	Full abrasive blast and re-application of interior coating	$187,000	Total 3rd Maintenance Cycle Cost **$456,750**
45	Full abrasive blast and re-application of exterior coating	$175,000	
45	Magnetic Flux Leakage (MFL scan) of floor plate	$15,000	
45	Floor plate repairs	$8,000	
45	Roof framing repairs	$50,000	
45	Engineering / Inspection Cost (estimated as 5%)	$21,750	
Year	**Maintenance Scheduled**	**Total Price**	Total 4th Maintenance

60	Full abrasive blast and re-application of interior coating	$187,000	Cycle Cost **$401,100**
60	Full abrasive blast and re-application of exterior coating	$175,000	
60	Magnetic Flux Leakage (MFL scan) of floor plate	$15,000	
60	Floor plate repairs	$5,000	
60	Engineering / Inspection Cost (estimated as 5%)	$19,100	
75	Tank Replacement		
		Total Life Cycle Maintenance Cost	**$1,639,050**

Concrete Tank Maintenance

Little to no maintenance is required for AWWA D110/D115 tanks; however, concrete tanks should be inspected routinely following initial construction. Inspections should include examination of the surfaces to locate signs of possible deterioration or corrosion, including rust stains, efflorescence, cracks or leaks. The below table estimates the maintenance costs associated with a pre-stressed concrete tank.

Table 13 Concrete Tank Maintenance Costs

Concrete Tank Maintenance Schedule and Costs			
Year	**Maintenance Scheduled**	**Total Price**	
30	Minor crack and concrete spall repair	$75,000	Total 1st Maintenance Cycle Cost **$84,000**
30	Replacement gaskets and bolts on shell manways and roof access hatches; replacement vent screening	$5,000	
30	Engineering / Inspection Cost (estimated as 5%)	$4,000	
Year	**Maintenance Scheduled**	**Total Price**	
60	Crack and concrete spall repair	$75,000	Total 2nd Maintenance Cycle Cost **$141,750**
60	Replacement gaskets and bolts on shell manways and roof access hatches; replacement vent screening	$5,000	
60	Replacement anchorage for exterior and interior ladders and roof handrail	$5,000	
60	Exterior shotcrete repairs	$50,000	
60	Engineering / Inspection Cost (estimated as 5%)	$6,750	
Year	**Maintenance Scheduled**	**Total Price**	
90	Crack and concrete spall repair	$75,000	Total 3rd Maintenance Cycle Cost **$186,375**
90	Replacement roof access hatches and	$30,000	

	roof vents		
90	Replacement exterior and interior ladders	$20,000	
90	Replacement shell manway gaskets and bolts	$2,500	
90	Exterior shotcrete repairs	$50,000	
90	Engineering / Inspection Cost (estimated as 5%)	$8,875	
100	Tank Replacement		
Total Life Cycle Maintenance Cost			**$412,125**

The tables above show the costs to maintain a steel tank can far exceed the cost of a prestressed concrete tank.

Cost Summary

It is assumed that a new bolted steel tank will be replaced at year 45, and a new welded steel tank will be replaced at year 75. When the tank is at the end of the design life (every 45 years for a steel bolted tank, 75 years for a welded steel tank), the replacement cost is the present day tank cost with an assumed 1.5% yearly inflation – the replacement costs shown are future costs.

The lifecycle maintenance costs summarized in the tables above are added to the initial capital cost associated with the construction of a bolted steel, welded steel or concrete tank. The following table summarizes the 100-year lifecycle costs for different asset lifespans. It is important to note, the replacement costs listed are for the tank only.

Table 14 Tank Lifecycle Costs

100-Year Lifecycle Cost Summary			
Cost Analysis over 100-Year Lifecycle	**Bolted Steel Tank**	**Welded Steel Tank**	**Prestressed Concrete Tank**
New Construction	$627,000	$720,000	$870,000
Replacement of Bolted Steel at Tank- Age 45	$1,230,000	N/A	N/A
Replacement of Welded Steel Tank - Age 75	N/A	$2,000,000	N/A
Replacement of Bolted Steel at Tank - Age 90	$2,500,000	N/A	N/A
Maintenance Costs	$600,000	$1,639,050	$412,215
Total Cost	**$4,957,000**	**$3,223,450**	**$1,282,215**

SGM recommends the Town consider prestressed concrete tanks for the future replacement of the existing 0.60 MG tank and the Maliot Tank. SGM recommends performing a tank selection study and perform preliminary design to analyze an AWWA D110 vs D115 pre-stressed concrete tank and perform a constructability review to address operational needs based on ability to construct a new tank concurrent with the existing operational tank or removing the existing tank from operation during construction and supporting the system needs with by-pass piping.

5.1.3 Water Storage Analysis – Volume

5.1.3.1 Water Storage Volume Analysis Criteria

SGM evaluated water storage using the concept of "tank service area." A tank's service area is defined as the pressure zone on which the tank floats plus the pressure zones below if those lower zones do not have storage.

Sufficient water storage capacity should be prepared for industry-standard criteria which are determined using the volume components of demand equalization, emergency supply and fire suppression. A description of these components is as follows:

- *Equalization storage* – the volume needed to meet the instantaneous water demands in the area served by a given tank (or tanks) that occur at a rate which is greater than the capacity of available water production and pumping facilities serving that area. The difference in instantaneous water demand and delivery capacity is typically calculated as peak hour demand (PHD) less maximum day demand (MDD) since production and pumping systems are often designed with a firm capacity that meets MDD. In this study, the duration of this event is taken as 6 hours. Since PHD is often calculated as two times MDD, the target *equalization volume was set to 25% of MDD*.

- *Emergency storage* - the volume needed to meet water demands during emergency conditions or a planned maintenance activity, which reduces or eliminates the ability to deliver water to an area served by a given tank (or tanks). Such an event might include:
    - a power outage
    - a mechanical failure of a production/pumping facility
    - a break on a critical water transmission line
    - preventative maintenance activities on a production/pumping facility or critical water transmission line

  Recommendations for emergency storage volume vary. Appropriate emergency storage is site-specific because it involves balancing risk, costs, and water age. The most often cited recommendations for emergency storage volume are to meet either ADD or MDD conditions for a 24-hour period. In order to minimize water age and chlorine residual decay, SGM will target *an emergency storage volume equal to ADD*.

- *Fire storage* – the volume required to meet the controlling firefighting needs in the area served by a given tank (or tanks). For this water system, SGM met with Mick Woodworth of the Eagle River Fire Protection District (ERFPD) on June 5, 2019. Mr. Woodworth indicated that fire flow needs for Minturn would follow the International Fire Code (IFC) - latest edition; Minturn's code matches the IFC. For fire storage requirements, target fire flows are

multiplied by duration, estimated using Appendix B of the 2017 International Fire Code (IFC). Fire storage volumes assume that only one fire event occurs at a time in the service area of a tank (or tanks).

5.1.3.2 Water Storage Volume Analysis Results and Recommendations – System Wide

Table 15 summarizes the current water storage capacities versus calculated storage needs. **Table 16** provides the same information under anticipated future demand conditions. **Table 17** Fire Flow Required by Zone outlines the fire flow requirements for each tank zone.

As shown in **Table 15**, the storage requirements vary depending on which growth option is used. However, as detailed in section 4.1, the Minturn Tank should be replaced due to structural and leakage concerns.

Table 15 Existing Water Storage Analysis

	Storage Required for Current Conditions				
Tank (Capacity, Gal)	**Emergency (Gal)**	**Equalization (Gal)**	**FireFlow (Gal)**	**Total (Gal)**	**Deficit**
Minturn Tank **(600,000)**	150,000	83,000	270,000	503,000	**0**
Maloit Park Tank **(108,000)**	5,000	6,000	270,000	281,000	**173,000**

Table 16 Future Water Storage Analysis

	Tank (Capacity, Gal)	**Emergency (Gal)**	**Equalization (Gal)**	**FireFlow (Gal)**	**Total (Gal)**	**Deficit**
Option 1	Minturn Tank **(600,000)**	198,000	109,000	270,000	577,000	**0**
	Maloit Park Tank **(108,000)**	38,000	22,000	270,000	330,000	**222,000**
Option 2	Minturn Tank **(600,000)**	228,000	126,000	270,000	624,000	**24,000**
	Maloit Park Tank **(108,000)**	89,000	51,000	270,000	410,000	**302,000**

Table 17 Fire Flow Required by Zone

Service Area	**Maximum Fire Flow Location**	**Max. Fire Flow Required (GPM)**	**Duration (Hours)**	**Volume (MG)**
Town	Entire Service Area	2,250	2	0.27
Maloit Park	Entire Service Area	2,250	2	0.27

5.2 Fire Flow Delivery

5.2.1 Fire Flow Analysis Criteria

Fire flow delivery is the ability of the system to transmit target fire flows under conservative operational and demand conditions. For this evaluation these conditions are:

- Demand condition: MDD
- Minimum tank levels: 5 feet

The recently created water distribution system model was used to predict fire flow delivery throughout the system. Adequate fire flow delivery through firefighting equipment depends on maintaining residual pressure at the local fire hydrant. Furthermore, when large fire flow rates are pulled from the system, pressures drop zone-wide. Maintaining a minimum pressure throughout the distribution system is critical to keep positive pressure and eliminate potential contaminant intrusion. These two considerations lead to the following two pressure criteria, which constrain the maximum available fire flow in a given area:

- Minimum residual pressure at flowing hydrants: 20 PSI
- Minimum pressure elsewhere in the system: 20 PSI

5.2.2 Fire Flow Results and Recommendations

Simulation results indicate that 83% of nodes meet the required fireflow target of 2,250 gpm under current maximum day demand conditions. The percentage decreases for Options 2 and 3, decreasing to around 71%. Critical nodes with the lowest available fireflow are located at the end of Taylor Street, near Cross Creek Road, and throughout the lower portions of Maloit Park. Fireflow deficit in these areas can be mitigated by implementing the following improvements:

- *Taylor Street:* Install a new pipeline under 4th Avenue or 4th Street which ties into the proposed 12" line to Dowd Junction (if the interconnect is built) or extend the existing waterline from Taylor St/Minturn Rd to 4th St (See **Figure 5**). This loop would reduce hydraulic resistance between Minturn's primary storage tank and Taylor street, increasing available fire flow.
- *Cross Creek Road:* Install a PRV station near the intersection of Cross Creek Road and Highway 24 which provides water from the Maloit Park pressure zone via the new Maloit Park Tank.
  - Installing a PRV station would only be beneficial if distribution piping in Maloit Park were upsized or looped to facilitate delivery of fireflow.
  - Installing a PRV near Cross Creek Road could provide a redundant pathway for delivering finished water to the Town Zone. It would possibly reduce the Town's storage requirements by allowing emergency storage to be provided from multiple Tanks.

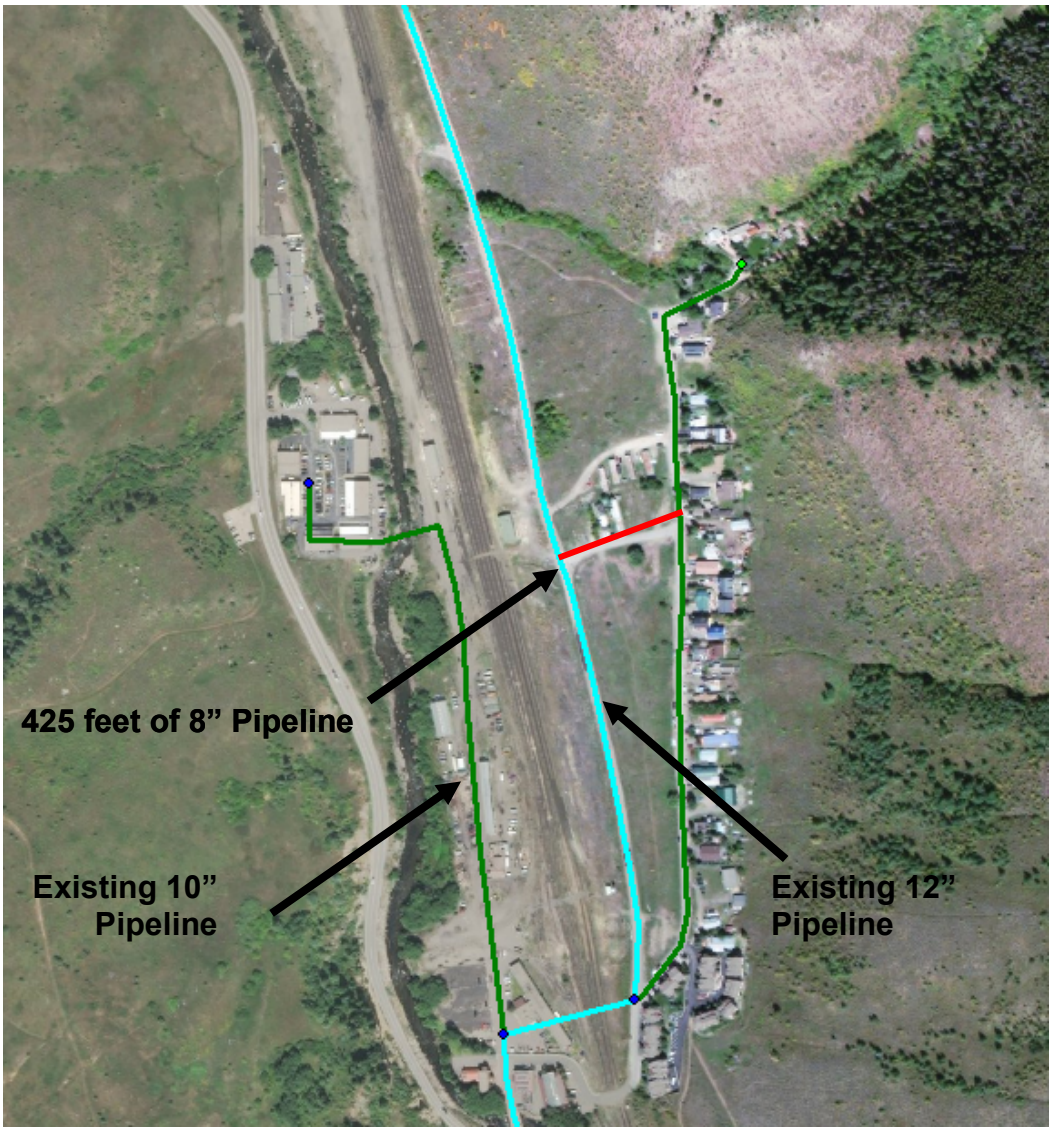


Figure 5 - 4th Avenue Loop Line

5.3 Velocity

5.3.1 Velocity Analysis Criteria

High flow velocity in pipes is undesirable because it (1) increases the potential magnitude of pressure transients, which can increase the risk of contaminant introduction or infrastructure damage (2) increases head loss and required energy consumption and (3) causes stress and wear on fittings and connections, increasing the potential for leaks and main breaks.

Recommended maximum velocity is as follows:

- Maximum day demand conditions: Velocity < 5 FPS (ideal), 7FPS (maximum)
- Peak hour demand conditions: Velocity < 10 FPS

The recently created water distribution system model was used to predict velocity in pipes throughout the system. Velocity analysis was conducted under MDD conditions with pumps running.

5.3.2 Velocity Results and Recommendations

Flow velocities throughout the Town service area and Maloit service area are generally below recommended maximums for MDD and fireflow. The only instance where pipe velcities are outside the maximum reocmmendations are in the Maloit Park service area during fireflow events where they exceed the maximum by approximately 10% which does not impair the ability to delvier the quantity of water necessary druing a fire. Therefore, there are no projects proposed to mitigate velocity concerns.

5.4 Pressure

5.4.1 Pressure Analysis Criteria

Both insufficient and excessively high pressures within the distribution system are undesirable. Low operating pressures provide less protection against backflow, increasing the possibility of system contamination. Low service pressures also can lead to customer complaints, especially regarding domestic service pressure and proper irrigation system function. High pressures increase water use, water loss, energy consumption, buried infrastructure and pump wear, work hazards, and the risk of property damage. The benefits of system design using tight pressure ranges must be balanced against the associated infrastructure costs to create the pressure zone breaks. The appropriate design pressure range for a given system is often site-specific.

Colorado Department of Public Health and Environment (CDPHE)'s 2013 Design Criteria for Potable Water Systems indicate that:

> *"The system must be designed to maintain a minimum pressure of 20 PSI at ground level at all points in the distribution system under all conditions of flow. The normal working pressure in the distribution system must be at least 35 PSI and should be approximately 60 to 80 PSI. Near storage tanks, the water main pressure will be less than the required pressures stated above. The Department expects water systems to mitigate the low pressure around storage tanks and to minimize the amount of distribution main impacted."*

SGM recommends the following normal working pressure range:

Minimum: 20 PSI
Maximum: 120 PSI

5.4.2 Pressure Analysis Results and Recommendations

Modeling results indicate that operating pressures range between **32** and **110** psi under both current and future demand conditions. The only area which fails to meet the minimum recommended pressure criteria of 55 psi is near the intersection of Highway 24 and Cross Creek Road, which is the highest point in the Town service area. Considering that the elevation of this location limits the maximum service pressure to 33 psi, model results do not indicate a supply deficiency. Therefore, the existing distribution system is adequately sized to convey system demands under current and future operating conditions.

5.5 Redundancy

5.5.1 Redundancy Analysis Criteria

A water distribution system design should minimize the likelihood and duration of service interruptions to the extent practicable. The majority of taps should be able to receive water even during planned maintenance activities and unplanned repairs or equipment failures. The Town system was analyzed with consideration given to:

- Piping - Looping and parallel piping networks
- Water storage - Gravity water storage (versus pressure tanks) and ability to take tanks offline for maintenance
- Production - Multiple water production sources

A critical component of system redundancy is having a secondary water source to supply raw water if the primary source – which is Cross Creek is limited. The secondary water source has been identified as the Eagle River Wells as described in Section 3.3 of this report.

5.5.2 Redundancy Analysis Results and Recommendations

Piping –
As with all distribution systems, elimination of all dead-end lines is not feasible. Minimization of dead-end lines, however, should be the goal. The Minturn system generally has a well-looped network outside of the primary transmission mains. However, there are areas that are limited to water delivery by a single main. Those include the following:

- The north end of Town north is fed by a single 12-inch pipe that is exposed and runs across the Eagle River at Bellm Bridge. The pipe is at risk of scour or damage from the Eagle River. It is recommended that the line be replaced – or a parallel line be installed – to mitigate the potential of a failure of this waterline, see **Figure 6**. Waterline can be bored beneath the Eagle River, hung on the existing bridge or installed across the river with an aerial crossing.

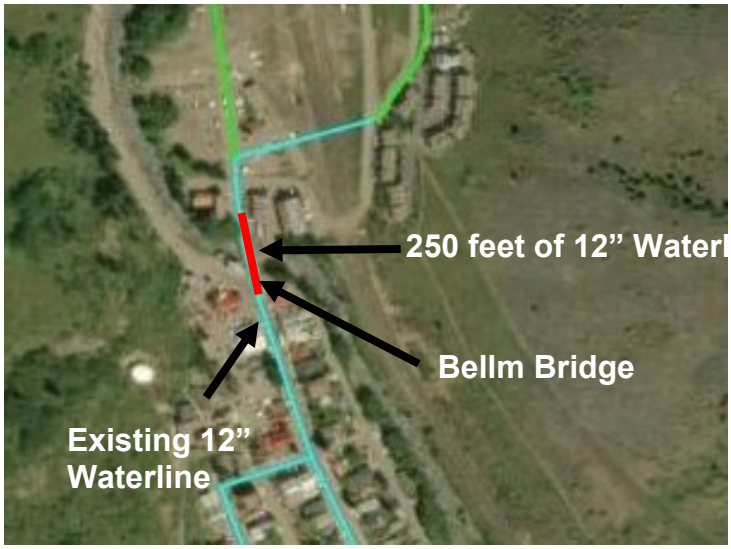


Figure 6 - Bellm Bridge Pipeline

Water Service Redundancy –
The Town and Maloit Park Service Areas are not connected and there needs to be a way to deliver water to either area if the primary feed is compromised. Additionally, water storage tanks should be drained for maintenance occasionally. However, single tank zones that are present in Minturn this can be challenging. SGM recommends:

- Interconnecting the Maloit Service Area and the Town Service area at approximately Cross Creek Drive and Highway 24 at a new PRV/BPS vault and installing a 12-inch line in Cross Creek Road to the Maloit Park service area, see **Figure 7**.
    - Recommend installing a 8-inch PRV with a 2-inch by-pass in parallel.
    - It is recommended that the vault has sufficient space to allow for pump connections to facilitate pumping water between the zones either by installing pumps in the vault or a portable pumping system.

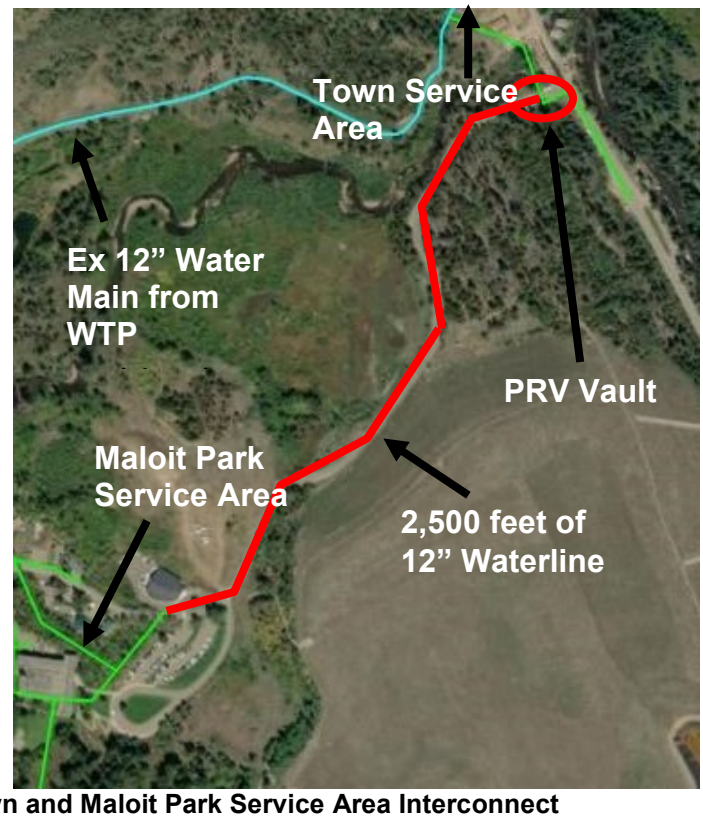


Figure 7 - Town and Maloit Park Service Area Interconnect

5.6 Water Loss Management

Water loss has been a persistent problem for the Town with water loss ranging from 30-60% which is well outside of the typical range of 10-15% for municipalities. While the Town has aggressively tracked and repaired leaks (and recent water loss figures suggests that these efforts have generally been successful), it is likely higher than normal water loss will persist. Generally, leaks have been located and repaired on service lines and not on the water mains. Furthermore, water meters on service lines have not been upgraded or calibrated and might be leaking or recording water used potentially incorrectly leading to a “paper water loss”. The following water loss management projects are recommended:

It is recommended that the Town utilize leak detection equipment to efficiently detect and locate leaks that are not observable from the surface. This will allow Town staff to find and repair leaks that would otherwise go undetected.

It is recommended that the Town initiate a water meter replacement program to upgrade the water meters to current technology.

5.7 Water Main Line Replacement

The majority of the Towns water mains are aging. The Town has not had a pipe replacement plan in place to systematically replace waterlines as they reach the end of their useful life. By delaying the replacement of aging infrastructure, there is risk of line breaks and disruptions to the system.

It is recommended that the Town establish a yearly replacement budget to be used to systematically replace aging pipes. This will help to address water leaks on the mains as new waterlines have very low permissible water loss. Additionally, the corporation stops and service lines to at least the curb stop would be replaced which would address leaks on this section of the system. It is recommended that the Town allocate $250,000 per year to fund the water main replacement plan.

5.8 Water Distribution System Improvements Summary

Table 18 summarizes the distribution system improvements detailed in the previous sections and provides a summary of the water system improvements recommended in this section.

Table 18 Water Distribution System Improvements Summary

Project	Purpose	Cost Est.
Maloit Park Tank	Address storage requirement needs	$1.67M
Minturn Tank	Address leaks and storage requirement needs	$1.55M
Bellm Bridge Waterline Replacement	Provide redundancy to the north part of Town	$570K
Maloit Park and Town Interconnect	Allow water to be moved between service areas	$1.31M
Leak Detection System	Locate leaks	$50K
Water Main Replacement Program	Replace aging watermains	$2.5M
Water Meter Replacement Program	Upgrade aging water meters	$250K

6.0 Recommended Improvements Summary

This chapter summarizes the recommended water system improvements identified in Chapters 2 through 5. The description of the development options are listed below.

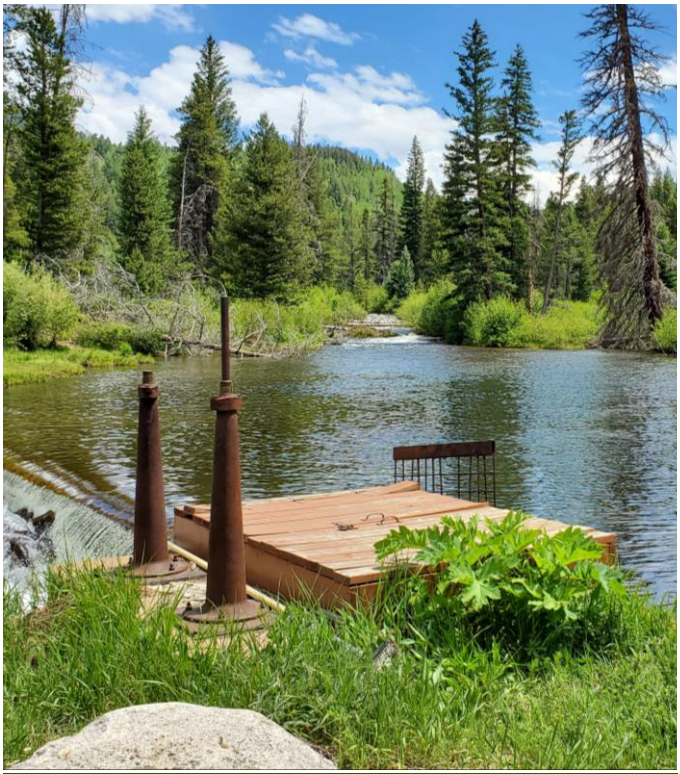
- Option 1: Cross Creek Only – Under this option the Town would continue to rely solely on Cross Creek for its water supply.
- Option 2: Cross Creek plus Eagle River Wells – Under this option the Town would continue to utilize Cross Creek water and also develop additional water resources on the Eagle River through a well field. This option includes moderate growth.

Table 19 Recommended Water System Improvements – Option 1

Projects	Category	Description	Cost
1 TO 3 YEAR TIME HORIZON			
Construct a new Minturn Tank	Tank	Replace existing Minturn Tank with a 600,000 gallon tank	$ 1,600,000
Construct new Maloit Park Tank	Tank	Construct a new 250,000 gallon concrete water tank on the existing tank site. Project would include the demolition of the existing tank.	$ 900,000
Connect Well 4 to existing clearwell	Treatment	Construct approximately 900 feet of 4" pipe from Well 4 to the existing clearwell	$ 230,000
Systematic Waterline Replacement Program	Pipeline	Systematic replacement of the Town's waterlines	$ 2,500,000
Invest/Install leak detection system	O&M	Implement a leak detection system	$ 50,000
Develop a Town GIS system	O&M	Create a comprehensive GIS mapping system of the Town's water and public infrastructure	$ 15,000
Water Meter Replacment Program	O&M	Replace water meters throughout Town	$ 250,000
3 TO 5 YEAR TIME HORIZON			
Construct new membrane plant at existing plant site designed to treat Cross Creek and Eagle River water	Treatment	Install membranes in a new pre-engineered building at the existing WTP site. New components will include pre-treatment system, booster/feed pumps, membranes, clean-in-place chemical system and compressed air system. The existing clearwell and distribution pumps will remain in service.	$ 4,290,000
Repairs and Modifications to the clearwell	Treatment	Make repairs to the existing clearwell and modifications to piping and controls.	$ 100,000
Raw Water Intake Improvements	Treatment	Install finer screening	$ 25,000
5 TO 10 YEAR TIME HORIZON			
Connect Maloit Park Service Area to Town Service Area	Pipeline	Construct approximately 2,500 feet of 12" waterline from the Minturn Community Center to the intersection of Highway 24/Cross Creek Road. Project includes the construction of a pressure reducing/sustaining station in a buried vault to include the ability to install booster pumps or connect an electric or diesel powered pump to supply water to either zone.	$ 1,310,000
Replace waterline in Eagle River at Bellm Bridge	Pipeline	Construct approximately 150 feet of 12" waterline across the Eagle River at Bellm Bridge	$ 570,000
			$ 11,840,000
10 TO 20 YEAR HORIZON			
Loop Taylor Street	Pipeline	Construct approximately 425 feet of 8" pipe from the new 12" Dowd Junction waterline to the existing 8" water line in Taylor St in 4th St.	$ 130,000
			$ 130,000
			$ 11,970,000

Table 20 Recommended Capital Improvements Projects - Option 2

Projects	Category	Description	Cost
1 TO 3 YEAR TIME HORIZON			
Construct a new Minturn Tank	Tank	Replace existing Minturn Tank with a 650,000 gallon tank	$ 1,670,000
Construct new Maloit Park Tank	Tank	Construct a new 250,000 gallon concrete water tank on the existing tank site. Project would include the demolition of the existing tank.	$ 900,000
Connect Well 4 to existing clearwell	Treatment	Construct approximately 900 feet of 4" pipe from Well 4 to the existing clearwell	$ 230,000
Systematic Waterline Replacement Program	Pipeline	Systematic replacement of the Town's waterlines	$ 2,500,000
Invest/Install leak detection system	O&M	Implement a leak detection system	$ 50,000
Develop a Town GIS system	O&M	Create a comprehensive GIS mapping system of the Town's water and public infrastructure	$ 15,000
Water Meter Replacment Program	O&M	Replace water meters throughout Town	$ 250,000
3 TO 5 YEAR TIME HORIZON			
Construct new membrane plant at existing plant site designed to treat Cross Creek and Eagle River water	Treatment	Install membranes in a new pre-engineered building at the existing WTP site. New components will include booster/feed pumps, membranes, clean-in-place chemical system and compressed air system. The existing clearwell and distribution pumps will remain in service.	$ 4,290,000
Construct pretreatment system to pretreat Eagle River water	Treatment	Build concete basins and chemical feed systems to address Eagle River water quality issues.	$ 429,000
Repairs and Modifications to the clearwell	Treatment	Make repairs to the existing clearwell and modifications to piping and controls.	$ 100,000
Raw Water Intake Improvements	Treatment	Install finer screening	$ 25,000
New Well Field and pipeline to connect wells to WTP	Water Supply	Drill 3 new wells at the decreed location of the Eagle River Wells. Includes property acqusition, drilling wells, constructing well building, well pumps and pipeline to the existing WTP site.	$ 5,220,000
5 TO 10 YEAR TIME HORIZON			
Connect Maloit Park Service Area to Town Service Area	Pipeline	Construct approximately 2,500 feet of 12" waterline from the Minturn Community Center to the intersection of Highway 24/Cross Creek Road. Project includes the construction of a pressure reducing/sustaining station in a buried vault to include the ability to install booster pumps or connect an electric or diesel powered pump to supply water to either zone.	$ 1,310,000
Replace waterline in Eagle River at Bellm Bridge	Pipeline	Construct approximately 150 feet of 12" waterline across the Eagle River at Bellm Bridge	$ 570,000
			$ 17,559,000
10 TO 20 YEAR HORIZON			
Loop Taylor Street	Pipeline	Construct approximately 425 feet of 8" pipe from the new 12" Dowd Junction waterline to the existing 8" water line in Taylor St in 4th St.	$ 130,000
			$ 130,000
			$ 17,689,000



Treatment Process Alternatives Analysis

Minturn Water Treatment Plant

FINAL

Minturn, CO

August 1, 2023

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Executive Summary

The Town of Minturn is evaluating the best path forward for improving the reliability of water production as their existing water treatment plant (WTP) is nearing the end of its serviceable life. A new WTP is proposed to replace the existing one which uses slow sand filtration to treat the surface water. Several alternative treatment process technologies are being considered by Minturn for the new WTP. The treatment technology alternatives under consideration are:

- Alternative A: Rehabilitation of existing slow sand direct filtration WTP
- Alternative B: Construction of new WTP using packaged conventional treatment units with dual-media filters
- Alternative C: Construction of a new WTP with membrane filtration with consideration for expansion and future preliminary treatment

The project team first went through a qualitative exercise to determine the top priorities for Minturn in the selection of the new treatment technology. The following criteria and their relative importance were developed jointly by HDR and the Minturn Water Committee during a workshop on January 12th, 2023. The criteria below are listed in the order of importance to Minturn.

1. Resiliency 35%
2. Operations & Maintenance 26%
3. Long Term Reliability 22%
4. Process Modifiability 13%
5. Capacity Flexibility 3%

Each of the three proposed alternatives were evaluated against the established quantitative criteria, independent of the other alternatives, on a scale of Very Low, Low, Moderate, Strong, and Very Strong. The following table presents how the project team ranked each alternative against each of the criteria . These rankings, in combination with the weighting of each criterion, was used to tabulate a “final score” for each alternative, shown in the last row of the same table. The final score provides a qualitative ranking of the alternatives to showcase which treatment technology best meets the priorities of Minturn.

Criteria	Alternative A: Slow Sand Filtration	Alternative B: Packaged WTP	Alternative C: Membrane WTP
Resiliency (35%)	Moderate	Strong	Very Strong
Operations & Maintenance (26%)	Strong	Moderate	Moderate
Long Term Reliability (23%)	Strong	Strong	Strong
Process Modifiability (13%)	Very Low	Strong	Very Strong
Capacity Flexibility (3%)	Low	Moderate	Very Strong
FINAL SCORE	**56**	**64**	**75**

HDR developed cost estimates for each alternative using parametric estimating tools and vendor proposals for this project. HDR prepared Class 4 Opinions of Probably Construction Costs (OPCCs) as described by the American Association of Cost Estimating (AACE), shown in the table below.

Alternative	Low Capital Cost (-15%)	High Capital Cost (+30%)	Annual O&M
A - Rehabilitation of Existing Slow Sand Filters	$5.8M	$8.9M	$120K
B - Packaged Conventional Water Treatment Plant	$10.5M	$16.7M	$200K
C - Membrane Water Treatment Plant	$9.8M	$14.9M	$150K

Based on the results of this alternative analysis, it is recommended that Minturn move forward with construction of a new membrane filtration plant. Membrae filtration provides the highest qualitative score and is thus recognized to best address the priorities Minturn has for a providing a resilient and reliable treatment system. While rehabilitation of the slow sand filters ultimately had the anticipated lowest cost of the alternatives, the drawbacks of continuing to rely on an aging technology and cutting off the option for the addition of Eagle River water in the future far outweigh the cost savings associated with the option. Membrane filtration allows Minturn to address the needs of its existing customers, while leaving open the option for future water rights.

1 Introduction & Background

The Town of Minturn (Minturn) is evaluating the best path forward for improving the reliability of water production as their existing water treatment plant (WTP) is nearing the end of its serviceable life. A new WTP is proposed to replace the existing one which uses slow sand filtration to treat the surface water. Several alternative treatment process technologies are being considered by Minturn for the new WTP. Three WTP process alternatives are proposed for evaluation against subjective criteria developed by the project team. Life cycle cost estimates for each alternative are provided separate from the qualitative evaluations so that Minturn can make a value-based decision on the best path forward. The alternatives being evaluated are:

- Alternative A: Rehabilitation of existing slow sand direct filtration WTP
- Alternative B: Construction of new WTP using packaged conventional treatment units with dual-media filters
- Alternative C: Construction of a new WTP with membrane filtration with consideration for future preliminary treatment

The evaluation will consider each alternatives' ability to meet or exceed established criteria. The project consists of a new 0.6 mgd capacity water treatment plant using water from Cross Creek, Minturn's only existing surface water source. Minturn also operates two groundwater wells which can provide up to 80 gpm each as supplemental water to the existing WTP's clearwell. The proposed infrastructure is depicted diagrammatically in Figure 1.

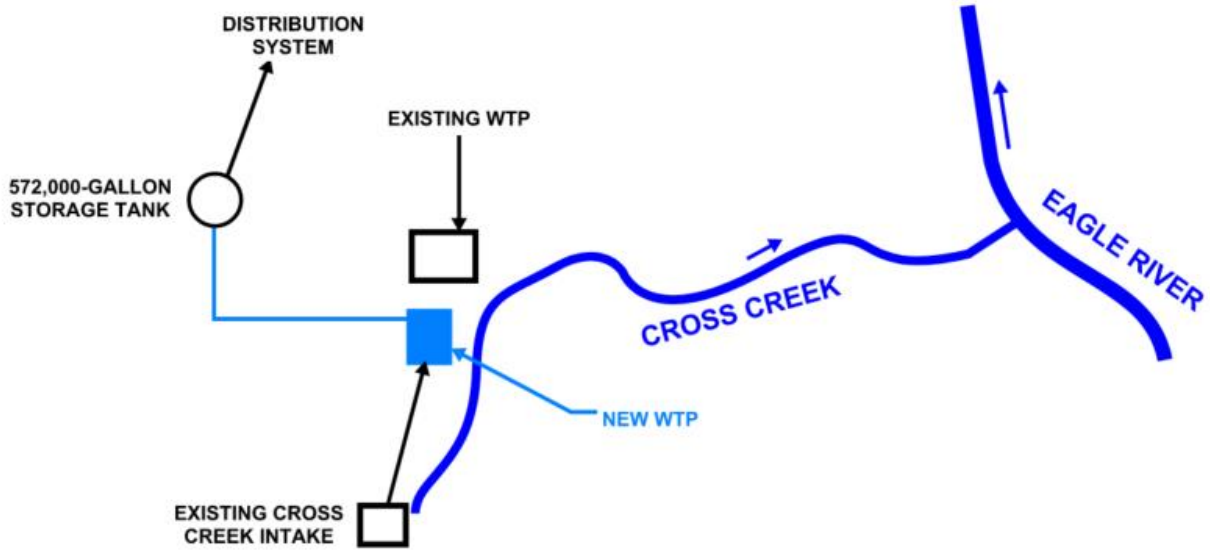

Figure 1. Diagrammatic Overview of Proposed WTP

1.1 Existing Treatment

Minturn presently operates a direct filtration WTP consisting of three slow sand filters. Filter 1 and Filter 2 are earthen pits constructed in 1963. Filter 1 is no longer in service, and Filter 2 feeds a 1.0-micron cartridge filter (Harmsco PPFS-HC-170-1) capable of producing 50 gpm of treated water. Filter 3 is a concrete lined filter constructed in 1991, capable of producing 60 gpm. A process flow diagram of the existing process is presented in Figure 2. Water treated through Filter #3 and the cartridge filter comes from a surface water diversion on Cross Creek. The water is blended together in the WTP clearwell, where chlorine is applied for disinfection, and then pumped to the Minturn distribution system.

During spring runoff, turbidity increases in Cross Creek and Filter 3 struggles to maintain turbidity compliance at the higher solids loading. Filter 3 is subsequently taken offline during spring runoff for filter skimming, where the fouled layer of sand and particles is removed and washed, a process that takes approximately 2-3 months. Filter 3 is brought back online when turbidity has declined, and the filters are clean. While Filter 3 is skimmed, groundwater is used to as the source of supply to Minturn. Groundwater wells #3 and #4 can produce up to 80 gpm each (approx. 0.25 mgd in total) to the existing clearwell where they are combined with the filtrate from the slow sand filters.

Minturn recently completed construction of a new 572,000-gallon unbaffled concrete storage tank. Minturn intends to use the tank to supply water pressure to the distribution system.

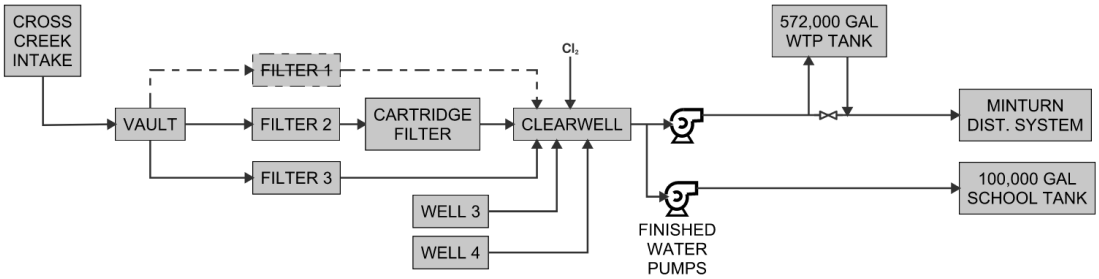

Figure 2. Process Flow Diagram - Existing Treatment Process

The existing infrastructure which may be able to be reused by a new facility would include Filters 1 and/or 2, Filter 3, miscellaneous yard piping, and the 572,000-gallon storage tank.

1.2 Projected Water Demands

Minturn's 2019 Water System Capital Improvement Plan includes a water demand analysis conducted to understand current and projected water demands for Minturn. Table 1 presents a summary of the demand analysis. The results show that the largest demand occurs during the warmer months and is expected to be 0.6 mgd. The demand drops significantly in the wintertime with less outdoor irrigation use. The new WTP flow rate will be 0.6 mgd to meet the existing demands of Minturn. To supplement the WTP, Minturn operates two storage tanks within their distribution system which provide a cumulative approximate 1.2 million gallons (Tank #3 = 572,000 gal, Tank #2 = 588,000 gal).

Table 1. Town of Minturn Existing and Projected Water Demands

Town of Minturn System Demand	Colder Months	Warmer Months
Existing Water Demand (mgd)	**0.1**	**0.4**
Projected Water Demand (mgd)[1]	**0.2**	**0.6**

1.3 Justification for Upgrading Treatment

1.3.1 Sanitary Survey

The Colorado Department of Health and Environment (CDPHE) Water Quality Control Division conducted a sanitary survey of the existing WTP in September of 2018 and observed two significant deficiencies, six violations, and four recommendations/observations. In an October 11, 2018, letter, CDPHE documented several items related to the mechanical process condition of the WTP:

- No liner present in Filters 1 and 2, requiring they be removed from service and significantly decreasing Minturn's production capacity
- Well #3 inadequate source protection; opening on side of casing
- Existing clearwell (bolted steel tank) near end of useful life and experiencing leaks

Minturn is limited in their ability to produce water under their most constrained scenario due to the removal of two slow sand filters from service. Development in Minturn is limited, and existing customers are subject to water restrictions due to the condition of the WTP.

1.3.2 Future Regulations

Minturn is proactive in their endeavors to continue to provide high quality drinking water now and in the future. Although future regulations are difficult to characterize exactly, past trends can be used to estimate what regulations Minturn may be faced with long term.

Near term future regulatory efforts are presently focused on the Lead and Copper Rule Improvements (LCRI) and Per/Polyfluoroalkyl substances (PFAS). The LCRI will address additional key issues and opportunities to reduce risk associated with lead and copper in drinking water. Although lead and copper primarily come from premise plumbing, utilities (i.e. Minturn) will handle addressing corrosion control within their distribution system. PFAS are omnipresent in the environment, and in 2021 the Environmental Protection Agency (USEPA) published their Strategic Roadmap (2021-2024). The roadmap focuses on policy, funding, rules to implement greater investment in PFAS R&D, prevention of PFAS release from point sources, and remediation of contamination. In the near term, monitoring for PFAS may be the impact to Minturn. In addition, the USEPA is evaluating the Stage 2 Disinfection Byproducts Rule to understand the presence of current and unregulated disinfection contaminants. There exists the potential for tightening of current Maximum Contaminant Limits (MCLs) that could impact Minturn's disinfection strategy in the future.

Cross Creek is the only surface water source for the new WTP. There are sufficient water rights on Cross Creek to serve the needs of Minturn and imminent planned infill development. Table 2

presents raw water quality and finished water treatment goals for the Cross Creek source water. The overall raw water quality of Cross Creek is generally good and suitable for all treatment processes being considered. Total Organic Carbon (TOC) has historically trended high in Cross Creek during spring and summer based on available data. TOC causes non-regulated aesthetic issues such as color, taste, and potential odor in water at a minimum. Whereas TOC regulated issues are related to both turbidity and disinfection byproducts. Removal of TOC through flocculation and settled is recommended to prevent formation of disinfection byproducts (regulated through distribution system monitoring).

1.4 Disinfection Considerations for each Alternative

The USEPA's Surface Water Treatment Rule (SWTR) requires surface waters be treated and disinfected to a level which provides 3-log (or 99.9%) removal of giardia and 4-log (or 99.99%) removal of viruses. To reduce dependence on and complications associated with over chlorination, the SWTR allows for well operated treatment processes to provide credit toward the total disinfection requirements. The level of disinfection credit each alternative process (sand filters, packaged conventional treatment, or membranes) provides is presented in the specific sections of this evaluation.

Disinfection credit obtained from the treatment process (e.g. filtration) is not enough to wholly satisfy the required removal of giardia and viruses, so chlorine is typically used to achieve the remaining disinfection requirements. Disinfection with chlorine is validated by the product of chlorine residual concentration and the time which the chlorine was in contact with the water (e.g. contact time). This is referred to as $CT_{required}$. Required CT values are published by USEPA and are a function of water temperature, water pH, chlorine residual concentration, and the level of log-removal required.

Minturn must provide adequate chlorine residual and contact time ($CT_{achieved}$) to validate their disinfection with chlorine (e.g. $CT_{achieved} > CT_{required}$). Each of the proposed process alternatives (sand filters, packaged conventional treatment, or membranes) are being evaluated on the condition that the new 572,000-gallon storage tank will be used as the primary disinfection volume. Modifications to the storage tank are required for the tank to be used for disinfection purposes. Currently, the inlet and outlet of the tank are too close in proximity, which results in a baffling factor of 0 per CDPHE design criteria. The addition of a run of pipe to either the inlet or outlet that extends to the opposite side of the tank would increase the distance between the two and allow the tank to be used for disinfection with a baffling factor of 0.1.

While the value of $CT_{achieved}$ is a factor of both chlorine concentration and contact time, raising the chlorine concentration increases the risk of forming disinfection byproducts (DBPs) which can be harmful to human health with frequent exposure. For this reason, increasing contact time is the preferred method of achieving an adequate CT value.

1.5 Source Water Management

Table 2 shows that Cross Creek experiences levels of total organic carbon (TOC) that are high enough to impact process recommendations. Organic carbon originates from plants, soil, and other organic matter present in the watershed. High TOC occurs in the spring and summer months

when water warms, and biological activity is highest. Water quality sampling conducted in 2023 demonstrated the TOC increased to as high as 12 mg/L during the month of April associated with spring runoff conditions. While having no health effects of its own, TOC functions as an indicator for the potential formation of DBPs such as Total Haloacetic Acids (HAA5) and Total Trihalomethanes (TTHM). In the Town of Minturn 2022 Water Quality Report, Minturn reported HAA5 samples as high as 77.1 ppb, above the MCL of 60 ppb. It is assumed these elevated HAA5 results are due to TOC spikes that occur during spring runoff when the turbidity also spikes, and that Minturn supplements with well water during these times to avoid treatment concerns. Further discussion with Minturn around the extent of any DBP exceedances is necessary to understand the nature of the DBP formation, and whether it is a one off or recurring issue.

Because of this, it is pertinent for TOC to be removed from the water, either through treatment or source water management. Different methods of removing TOC through treatment are discussed in subsequent sections. The removal of sediment and debris from the water, prior to filtration and disinfection, may lead to TOC and HAA5 levels dropping into a more manageable range.In terms of source water management, periodic dredging of Cross Creek at the intake is a potential method for improving raw water quality prior to treatment. Permitting from the US Army Corps of Engineers of other entity may be required to perform dredging.

1.6 Residuals Handling

Alternatives B and C will produce process residuals such as settled sludge and waste streams from backwashing and membrane clean-in-place (CIP) processes. The plan for both alternatives would be to convert the existing outdoor filters (Filters 1 and 2) into detention ponds to hold these residuals. The backwash/CIP waste would be neutralized before being recycled back to the front of the process a rate of < 5% to avoid overloading with TOC. Sludge would accumulate in the bottom of the ponds before being dredged and trucked away for disposal on an annual basis. Having two ponds available provides redundancy and would allow for at least one pond to be receiving residuals at all times. The footprint of the existing filters are large enough to provide an adequate amount of storage time for the plant's residuals. Residuals production from Alternative A include waste sand skimmed from the filters and is typically hauled for disposal by Minturn.

Table 2. Raw Water Quality from Cross Creek Water

Parameter	Number of Samples	Concentration (mg/L)	MCL	SMCL	Treatment Required / Treatment Goal	Comments
Arsenic	10	ND	0.01	N/A	No	Non-detect
Barium	8	MIN: 0.0059 AVG: 0.0091 MAX: 0.0112 90th: 0.0111	2	N/A	No	Sample data 90th percentile is <5% of the MCL/SMCL
Beryllium	9	ND	0.004	N/A	No	Non-detect
Cadmium	10	ND	0.005	N/A	No	Non-detect
Chromium	8	ND	0.1	N/A	No	Non-detect
Copper	8	MIN: 0.0015 AVG: 0.0030 MAX: 0.0048 90th: 0.0047	1.3	1.0	No	Sample data 90th percentile is <5% of the MCL/SMCL. Minturn will employ Caustic feed as CCT
Fluoride	8	ND	4.0	2.0	No	Minturn does not currently, nor has plans for, fluoridation
Lead	8	MIN: 0.0000 AVG: 0.0000 MAX: 0.0002 90th: 0.0001	0.015	N/A	No	Minturn will employ Caustic feed as CCT
Nitrate	13	MIN: 0.00 AVG: 0.13 MAX: 0.25 90th: 0.24	10	N/A	No	Sample data 90th percentile is <5% of the MCL/SMCL
Nitrite	8	ND	1	N/A	No	Non-detect.
Selenium	8	MIN: 0.0000 AVG: 0.0001 MAX: 0.0011 90th: 0.0003	0.05	N/A	No	Sample data 90th percentile is <5% of the MCL/SMCL
Aluminum	12	MIN: 0.012 AVG: 0.068 MAX: 0.253 90th: 0.161	N/A	0.05 - 0.2	No	Sample data 90th percentile is within the SMCL range.
Chloride	13	MIN: 0.00 AVG: 0.43 MAX: 1.53 90th: 0.73	N/A	250	No	Sample data 90th percentile is <5% of the MCL/SMCL
Iron	15	MIN: 0.040 AVG: 0.187 MAX: 0.353 90th: 0.302	N/A	0.3	No	While the 90th percentile of the data is at the SMCL, and colored water events can occur even below the SMCL, treatment is not recommended due to the lack of colored water complaints incurred at Minturn
Manganese	15	MIN: 0.0071 AVG: 0.0117 MAX: 0.0182 90th: 0.0160	N/A	0.05	No	Sample data max value is < the MCL/SMCL
pH	21	MIN: 7.2 AVG: 7.4 MAX: 7.7 90th: 7.5	N/A	6.5-8.5	**8.3 ± 0.2 s.u. 95% of the time**	Minturn will control pH >8 as a measure against corrosion control. Caustic is planned for as part of the new WTP.
Silver	8	ND	N/A	0.1	No	Non-detect.
Sulfate	14	MIN: 5.62 AVG: 13.87 MAX: 23.82 90th: 20.32	N/A	250	No	Sample data 90th percentile is <10% of the MCL/SMCL
Total Dissolved Solids	13	MIN: 27 AVG: 47 MAX: 69 90th: 63	N/A	500	No	Sample data average is <10% of the MCL/SMCL
Zinc	10	MIN: 0.001 AVG: 0.002 MAX: 0.005 90th: 0.003	N/A	5	No	Sample data 90th percentile is <5% of the MCL/SMCL
Turbidity (NTU)	26,085	MIN: 0.30 AVG: 0.70 MAX: 17.35 90th: 1.01	N/A	N/A	**≤ 0.1 NTU for 95% of readings**	At no time can turbidity go higher than 1 NTU, and samples must be ≤ 0.3 NTU in 95% of monthly samples
Hardness (mg/L as CaCO3)	12	MIN: 13.0 AVG: 23.0 MAX: 36.1 90th: 29.4	N/A	N/A	No	Water classified as Slightly Hard (17.1 – 60)
Alkalinity (mg/L as CaCO3)	11	MIN: 8.4 AVG: 14.2 MAX: 19.7 90th: 17.2	N/A	N/A	No	Lower alkalinity waters are more susceptible to changes in pH.
Total Organic Carbon	14	MIN: 1.3 AVG: 3.5 MAX: 12.0 90th: 7.2	N/A	N/A	**> 35% Removal**	General goal for limiting DBP formation potential Will require pretreatment to achieve goal
Alpha Particles (pCi/L)	N/A	MIN: AVG: MAX: 90th:	15	N/A	**< 12**	No data available. **Minturn should consider space for advanced processes for radioactive contaminants.**
Beta Particles (mrem/yr)	N/A	MIN: AVG: MAX: 90th:	4	N/A	**< 3.2**	
Radium 226 and Radium 228 (pCi/L)	N/A	MIN: AVG: MAX: 90th:	5	N/A	**< 4**	
Uranium (ug/L)	N/A	ND	30	N/A	**< 24**	

Table 3. Raw Water Quality and Treatment Goals for Eagle River Water

Parameter	Number of Samples	Concentrations (mg/L)	MCL	SMCL	Treatment Required / Treatment Goal	Comments
Arsenic	5	MIN: 0.00000 AVG: 0.00010 MAX: 0.00060 90th: 0.00040	0.01	N/A	No	Sample data 90th percentile is <5% of the MCL/SMCL
Barium	5	MIN: 0.0440 AVG: 0.0522 MAX: 0.0585 90th: 0.0573	2	N/A	No	Sample data 90th percentile is <5% of the MCL/SMCL
Beryllium	5	ND	0.004	N/A	No	Non-detect.
Cadmium	5	MIN: 0.0000 AVG: 0.0001 MAX: 0.0001 90th: 0.0001	0.005	N/A	No	Sample data 90th percentile is <20% of the MCL/SMCL
Chromium	5	MIN: 0.000 AVG: 0.000 MAX: 0.001 90th: 0.001	0.1	N/A	No	Sample data 90th percentile is <5% of the MCL/SMCL
Copper	4	MIN: 0.0013 AVG: 0.0017 MAX: 0.0020 90th: 0.0019	1.3	1.0	No	Sample data 90th percentile is <5% of the MCL/SMCL. Minturn will employ Caustic feed as CCT
Fluoride	5	ND	4.0	2.0	No	Non-detect.
Lead	4	MIN: 0.0005 AVG: 0.0013 MAX: 0.0021 90th: 0.0019	0.015	N/A	No	Sample data 90th percentile is <5% of the Action Level. Minturn will employ Caustic feed as CCT
Nitrate	4	MIN: 0.00 AVG: 0.04 MAX: 0.16 90th: 0.11	10	N/A	No	Sample data 90th percentile is <5% of the MCL/SMCL
Nitrite	4	ND	1	N/A	No	Non-detect.
Selenium	5	ND	0.05	N/A	No	Non-detect.
Aluminum	8	MIN: 0.014 AVG: 0.023 MAX: 0.034 90th: 0.031	N/A	0.05 - 0.2	No	Sample data 90th percentile is < the MCL/SMCL
Chloride	8	MIN: 1.10 AVG: 2.16 MAX: 3.30 90th: 2.87	N/A	250	No	Sample data 90th percentile is <5% of the MCL/SMCL
Iron	9	MIN: 0.319 AVG: 0.428 MAX: 0.569 90th: 0.503	N/A	0.3	**< 0.10 mg/L**	**Pre-oxidation and settling**
Manganese	8	MIN: 0.0558 AVG: 0.1343 MAX: 0.2184 90th: 0.1912	N/A	0.05	**< 0.02 mg/L**	**Pre-oxidation, settling, filtration**
pH	14	MIN: 6.2 AVG: 8.0 MAX: 8.5 90th: 8.4	N/A	6.5-8.5	**8.5 ± 0.2 s.u. 95% of the time**	**Minturn will control pH >8 as a measure against corrosion control**
Silver	4	ND	N/A	0.1	No	Non-detect.
Sulfate	9	MIN: 12.59 AVG: 30.08 MAX: 38.22 90th: 37.96	N/A	250	No	Sample data 90th percentile is <10% of the MCL/SMCL
Total Dissolved Solids	9	MIN: 59 AVG: 110 MAX: 131 90th: 127	N/A	500	No	Sample data 90th percentile is <20% of the MCL/SMCL
Zinc	5	MIN: 0.038 AVG: 0.062 MAX: 0.087 90th: 0.083	N/A	5	No	Sample data 90th percentile is <5% of the MCL/SMCL
Turbidity (NTU)	N/A	MIN: AVG: MAX: 90th:	N/A	N/A	**≤ 0.1 NTU for 95% of readings**	**At no time can turbidity go higher than 1 NTU, and samples must be ≤ 0.3 NTU in 95% of monthly samples**
Hardness (mg/L as CaCO3)	6	MIN: 62 AVG: 85 MAX: 118 90th: 107	N/A	N/A	No	Water classified as Moderately Hard (60 -120 mg/L)
Alkalinity (mg/L as CaCO3)	6	MIN: 48 AVG: 61 MAX: 80 90th: 72	N/A	N/A	No	Lower alkalinity waters are more susceptible to changes in pH.
Total Organic Carbon	9	MIN: 1.3 AVG: 2.5 MAX: 6.5 90th: 3.7	N/A	N/A	**> 35% Removal**	**General goal for limiting DBP formation potential**
Alpha Particles (pCi/L)	2	MIN: 1.3 AVG: 2.1 MAX: 2.8 90th: 2.7	15	N/A	No	Sample data 90th percentile is <20% of the MCL/SMCL
Beta Particles (mrem/yr)	1	ND	4	N/A	No	Non-detect.
Radium 226 and Radium 228 (pCi/L)	2	MIN: 0.4 AVG: 2.0 MAX: 3.5 90th: 3.2	5	N/A	**< 4**	**Treatment not required, but Minturn should consider space for advanced processes to remove should Radium 226 increase further.**
Uranium (ug/L)	4	MIN: 0.6 AVG: 0.8 MAX: 1.0 90th: 0.9	30	N/A	No	Sample data 90th percentile is <5% of the MCL/SMCL

2 Decision Tool and Criteria Development

The first step in conducting this alternatives analysis was to determine the tool that would be used to compare each of the three alternatives against each other, and the specific criteria that each alternative would be judged upon.

2.1 Decision Tool Background

Process alternatives were evaluated using a Multi-Criteria Decision Analysis tool called decisionSPACE™, a proprietary program developed by HDR. A series of evaluations were conducted throughout the analysis that ultimately result in a final score of each alternative, described below:

Step 1 of the evaluation is to identity a list of qualitative criteria, or goals, specific to Minturn that are the top priorities influencing selection of the new WTP process. The list included the following:

- Capacity flexibility
- Long-term reliability
- Operations & maintenance
- Process modifiability
- Resiliency

The criteria is further defined in the following sections and in Table 4. The criteria were then evaluated against each other to determine which are more or less important and to develop a criterion specific multiplier, or weight, of each qualitative criterion that reflects the level of relative importance.

Step 2 involves evaluation of each proposed alternative against the established criteria. The evaluation ranks an alternative based on its ability to meet a specific criterion on a scale of **Very Low (Worst), Low, Moderate, Strong,** and **Very Strong (Best)**, independent of all other proposed alternatives. These ratings, in combination with the weighting of each criterion, are used to tabulate a "final score" for each alternative. The results of the evaluations were analyzed alongside the estimated capital costs and the estimated annual operations & maintenance cost.

Descriptions of the criteria developed for the analysis are presented in this section and the final scores for each alternative are presented in Section 6.

The following criteria and their relative importance were developed jointly by HDR and the Minturn Water Committee during a workshop on January 12th, 2023. The criteria below are listed in the order of importance to Minturn.

2.2 Criterion 1: Resiliency

Minturn's top priority is to select an alternative that provides resiliency to the water supply. Alternatives will be rated based on their ability to meet the following:

- Meet the demand of the existing customers
- Treat Cross Creek water compliant with established finished water quality goals (See Table 2)
- Maintains treatment capacity during high turbidity events, such as spring runoff in Cross Creek

2.3 Criterion 2: Operations & Maintenance

Minturn employs a contract-based operations company to operate and maintain the existing WTP. The existing WTP is not staffed every day, and Minturn desires a similar level of staffing for the future WTP. Alternatives will be rated based on their respective ability to meet the following:

- Ability to remotely monitor and operate the process
- The level of staffing and level of operator certification required
- The expected maintenance frequency
- Locality and availability of replacement parts and service

2.4 Criterion 3: Long-Term Reliability

Minturn requires the selected WTP process alternative to provide long-term reliability for the water system. Alternatives will be rated based on their ability to meet the following:

- The expected equipment lifespan should be close to 30 years

2.5 Criterion 4: Process Modifiability

Looking forward, Minturn expects that the selected alternative can be modified to adapt to more stringent water quality regulations. Additionally, the alternatives will be evaluated for the ability to treat Eagle River source water, as Minturn is actively trying to acquire a water right on that source. Alternatives will be rated based on their ability to meet the following:

- Degree of modification required to treat Eagle River water (See Table 3)
- Degree of modification required to meet more stringent future water quality regulations

2.6 Criterion 5: Capacity Flexibility

The selected alternative must provide some level of flexibility in treatment capacity to Minturn. This criterion considers the proposed WTP process' ability to turn down to meet low demand conditions and the impact that starting and stopping the process has on water quality. Alternatives will be rated based on their ability to meet the following:

- Water production rate turndown
- Ability to start and stop the process without significant impacts to water quality

2.7 Weighting Criteria Results

HDR and Minturn ranked the relative importance of each of the individual criteria to establish a final weighting. Many high-importance rankings, creates a higher weighting value. Similarly, many low-importance rankings create a lower weighted value. The relative importance and resulting weights are presented in Table 4. The arrows indicate the relative importance of each criterion as it compares to the other four. The weighting for each criterion is applied in the tabulation of the final score for each alternative.

Table 4. Decision Making Criteria Rank and Weight

Criterion		1 Resiliency	2 Operations & Maintenance	3 Long Term Reliability	4 Process Modifiability	5 Capacity Flexibility	Weight
1	Resiliency		→	↗	↗	↑	35%
2	Operations & Maintenance			→	↗	↑	26%
3	Long Term Reliability				↗	↑	22%
4	Process Modifiability					↑	13%
5	Capacity Flexibility						3%

↑	Is extremely more important than	↑	Is much more important than	↗	Is more important than	→	Is as important as
↓	Is extremely less important than	↓	Is much less important than	↘	Is less important than		

3 Alternative A: Rehabilitation of Existing Slow Sand Filters

Of the three existing slow sand filters, only Filter 3 is in use and in compliance with CDPHE drinking water regulations. A 2018 Sanitary Survey discovered Filters 1 and 2 are unlined, and thus do not comply with CDPHE drinking water regulations. Filter 1 has been completely decommissioned and Filter 2 has been retrofitted into a roughing filter with a 1-micron cartridge filter treating its filtrate prior to disinfection. Filter 3 is housed within a below grade, covered concrete structure with a surface area of 3,000 square feet (75 ft x 40 ft). Filter 3 has a capacity of 60 gpm (based on feedback from operations staff), corresponding to a rate of filtration of 28.8 gpd/sf (0.02 gpm/sf).

Discussions with CDPHE revealed that rehabilitation of Filters 1 and 2 is an acceptable alternative for Minturn but did stipulate certain upgrades that must be met for permitting. These upgrades include lining the filters and providing a structure over the filters to protect them from freezing in the winter and algal growth in the summer. The approach laid out for Alternative A is in accordance with CDPHE direction.

The existing earthen filters (Filters 1 and 2) are trapezoidal with a 3:1 slope and a bottom surface area of 1,300 square feet (approximately 36 ft square). New Filters 1 and 2 would be constructed within the footprint of existing filters and similar in design to the existing Filter 3. The new filters would be constructed of cast in place concrete with vertical sidewalls, allowing the surface area of each filter to be increased to approximately 4,800 square ft, or 60 ft x 80 ft. Rehabilitating Filters 1 and 2 would increase the potential production capacity of the WTP by increasing the available filter footprint. CDPHE regulates the nominal rate of filtration between 45 and 150 gallons per day per square foot (gpd/sf) of sand area.

In colder climates, slow sand filters are typically operated at a lower filtration rate to increase contact time in the filter bed for the biological removals to occur. It is recommended that a rate of filtration less than 72 gpd/sf is used when water temperatures are less than 5 °C. Filter 3's rate of filtration has been recorded as low as 28 gpd/sf providing evidence that a slower rate of filtration is required to treat Cross Creek raw water. During warmer months, a design filtration rate of 144 gpd/sf was selected as faster throughput is expected in the rehabilitated filters with warmer temperatures. Table 5 presents the recommended design filtration rates and resulting treatment capacity of the rehabilitated filters and shows the rehabilitated slow sand filters can meet the seasonal water demands presented in Table 1.

Table 5. Temperature Based Design Loading Rates for Rehabilitated Slow Sand Filters 1 & 2

Design Parameter	Colder Months	Warmer Months
Water Temperature (°C)	< 5	> 5
Design Rate of Filtration (gpd/sf)	72	144
Individual Filter Capacity (gpd)[1]	345,600	691,200
Firm Treatment Capacity (mgd)[2]	0.45	0.8
Total Treatment Capacity (mgd)[3]	0.90	1.5

[1] Filters 1 & 2 are 60 ft x 80 ft.

[2] Filter 3 is 75 ft x 40 ft and produces a maximum of 60 gpm (0.1 mgd). Filters 1 and 3 are online producing 0.35 mgd and 0.1 mgd respectively. Filter 2 is out of service.

[3] All filters online

The existing slow sand filter 3 struggles to keep up with the solids loading from elevated turbidity experienced during spring runoff, is subsequently taken offline during this time for annual maintenance, and the groundwater wells are utilized as the source of supply. During spring runoff, the TOC is also observed to spike, and switching to the wells allows Minturn to supplement with a lower TOC water and avoid potential DBP issues related to higher TOC. CDPHE recognizes this as an acceptable operational strategy for Minturn and does not have issue as along as it is part of Minturn's operational plan. However, the wells are only capable of producing approximately 0.25 mgd if utilized simultaneously, and cannot meet the existing water demand of Minturn during spring runoff when the slow sand filters are expected to be unusable.

Figure 3 presents the existing WTP process flow diagram with the rehabilitations and modifications thereto being considered by Alternative A. Roughing filters will be installed upstream of the slow sand filters to improve filter performance due to the known elevated turbidity that occurs during spring runoff and are required by CDPHE if the raw water turbidity is known to be greater than 10 NTU. Roughing filters will reduce the solids loading that increases during spring runoff and reduce the frequency of filter skimming that will be inevitable with increased production, particularly in the summer season. It is important to note that roughing filters are only practical at reducing solids loading when the solids are particulate, and not colloidal. Further analysis of the raw water quality would be necessary to determine the type of solids in the water supply.

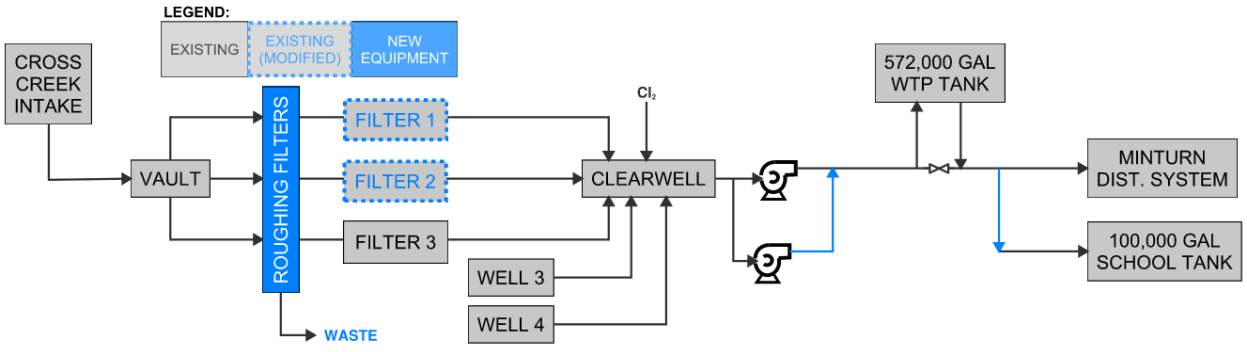

Figure 3. Process Flow Diagram - Alternative A: Rehabilitate Slow Sand Filters

Filter rehabilitation involves complete removal of the existing earthen Filters 1 and 2, excavation, subgrade prep, and construction of the new cast in place filter basins. The basins and surrounding walkways could incorporate some of the foundation which will be needed to support an enclosure required for new slow sand filter installations. An enclosure is required to provide both a cover and freeze protection, both of which are required for plan approval to be issued by CDPHE.

Figure 4. Minturn's Existing Slow Sand Filter (Filter 3)

While rehabilitation of Filters 1 and 2 would increase the current production and address regulatory compliance, it does not resolve issues such as treating high turbidity and high TOC water. Further, future WTP expansions (if necessary) are not possible given the large area required for this technology.

3.1 Resiliency

Rehabilitation of the existing slow sand filters, in addition to the currently operating Filter 3, would provide Minturn with adequate WTP capacity to meet the design flow.

Slow sand filtration is permitted for use by CDPHE on the condition that the raw water turbidity is less than 10 NTU and less than 15 color units. Data available at the time of this evaluation indicates Cross Creek turbidity can exceed these thresholds during spring runoff, but for much of the year, the turbidity is sufficiently low for the filters to perform well. However, a complete set of data during spring runoff has not been collected as the slow sand filters are offline during that time due to high turbidity and strategically scheduled maintenance cleanings. It is typical for raw water turbidity in Colorado mountain streams to exceed 10 NTU during spring runoff and during and during/after wildfire events in the watershed. Minturn's operator for the existing WTP indicates that Filter 3 has struggled to produce turbidity compliant filtrate in the past during spring runoff. With the added concern of elevated TOC contributing to elevated DBPs during spring runoff, the slow sand filters are not expected to perform well during these periods. Therefore, the

groundwater wells are brought online as the main source of supply. CDPHE recognizes this as an acceptable operating strategy, so long as Minturn has an operational plan and adequate storage to maintain water production.

Roughing filters are required by CDPHE to ensure compliance with CDPHE design criteria (feed water turbidity to slow sand filters < 10 NTU) and maximize filter performance. An example of roughing filters are fine basket strainers, which would require a building, electricity, controls/communication, and generate a waste stream which would need to be managed. As noted above, it is not a surefire solution for reducing solids loading, as it depends on the type of solids present in the water supply. If the solids are colloidal, roughing filters will not be an effective solution.

The disinfection requirements of a slow sand filtration WTP are presented in Table 6. Slow sand filters can provide up to 2-log of credit for both giardia and viral components.

Table 6. Slow Sand Filtration Disinfection Requirements

	SWTR Disinfection Requirements	Slow Sand Filtration Credit	log-disinfection required by chlorine	$CT_{required}$ (Note 1)
Giardia	3-log	2-log	1-log	87
Viruses	4-log	2-log	2-log	4

Notes
1. $CT_{required}$ based on filtered water quality of:
Temperature = 5 ºC
pH = 8.5
Chlorine residual concentration of 1 mg/L

To achieve adequate disinfection of slow sand filter water with a residual of 1 mg/L chlorine, 870 minutes of disinfection contact time is required. This time is determined by dividing the $CT_{required}$ value (87) by the baffling factor (0.1). Under these conditions, the storage tank provides sufficient disinfection up to a flow of 0.95 mgd, which is higher than the design flow of 0.6 mgd. Because groundwater requires less disinfection contact time, contributions from wells #3 and #4 would need to be managed separately from that of the filtered surface water to accurately track disinfection compliance.

Rehabilitation of the existing slow sand filters does allow for increased treatment capacity within the existing footprint. However, slow sand filters are likely non-viable without pre-treatment in the form of roughing filters installed upstream of them. Sand filters are only permissible when the source water they are treating does not exceed 10 NTU. Given the high variable nature of turbidity in Colorado streams, it is unlikely Cross Creek will always be less than 10 NTU, especially during spring runoff and post wildfire. Furthermore, TOC values have recently been recorded as high as 12 mg/L, and slow sand filters will not be able to remove enough TOC to adequately meet Minturn's DBP reduction goals. During these high turbidity or high TOC events, Minturn can utilize wells #3 and #4 as the main water source albeit at a flow that is less than Minturn's existing and projected water demands. So long as Minturn maintains adequate storage during high demand periods, the reduced flow rate from the wells is likely not an issue. This means that Minturn could successfully provide water throughout the year with the combination of the rehabbed filters and

the wells. For these reasons, the slow sand filter alternative was given a rating of **moderate** with respect to resiliency.

3.2 Operations & Maintenance

Minturn has operated the existing slow sand filtration WTP for the past sixty years. The process operates wholly under gravity and little day-to-day operator attention is required beyond observation. There is little instrumentation monitoring the process itself, thus remote operability of slow sand filters is non-applicable.

A slow sand filtration WTP producing up to 0.6 mgd would require a C-level operator (2nd from bottom-most tier); the current and planned operations team for the rehabilitated facility hold A-level treatment licenses which are the highest tier available. The daily operations include monitoring the flow rate, recording the headloss of the filter in operation, and any necessary water quality recording. The proposed modifications for filter rehabilitation would not impact the need for additional licensure nor significantly impact the ability for Minturn to acquire a new operations team should the need arise.

Maintenance of slow sand filters largely requires periodic skimming of the top several inches to remove filtered particles and reduce filtration resistance. The filter to be skimmed must be removed from service, drained, and dried prior to removing the top layer. Minturn has historically conducted this maintenance once per year for skimming during spring runoff as the existing filters have struggled to treat the highly turbid water. As Minturn increases the WTP capacity and operates the filters more consistently throughout the years, the skimming frequency will increase to maintain the filter capacity resulting in an increase in time spent by staff on maintenance. In the past, when Minturn was producing closer to 10 million gallons of water per month (approximately 0.25 mgd), the filters were taken offline every 3-4 months for cleaning. The groundwater wells can be used during these high turbidity periods to reduce the maintenance burden on the filters.

Replacement parts for slow sand filters consist of replacement sand, which can generally be procured from suppliers within the timeframe that coincides with planned skim maintenance. Overall slow sand filters present favorably in the status quo of Minturn's existing operation strategy and resources and were therefore given a rating of **strong**.

3.3 Long-Term Reliability

Slow sand filters benefit from longevity because of their relative simplicity. If well maintained, their ability to operate, in the capacity of which they were originally designed, is expected to exceed 30 years.

Slow sand filter flow rates are temperature dependent and will be different over the course of a year. However, the slow sand filters can meet the design flow of 0.6 mgd even with lower flowrates in the colder winter months.

Slow sand filters in Minturn possess long term reliability due to their sedentary nature; however, the ability to expand flow capacity is limited. Even still, they can meet the projected demands, giving them a rating of **strong** with respect to long-term reliability.

3.4 Process Modifiability

The slow sand filtration process is suitable only for high quality raw water with turbidity and color less than 10 NTU and 15 units, respectively. Slow sand filters, by themselves, are limited to treating water from Cross Creek, so long as the turbidity can be demonstrated as less than 10 NTU. Eagle River is known to have much higher raw water turbidity, as well as the presence of iron and manganese. The Eagle River water quality is at higher risk for contamination due to the level of adjacent development and mines draining to its watershed and will require more attention to ensure proper operation and maintenance.

To reduce iron and/or manganese (both present in Eagle River), oxidation and settling are common and typical strategies. Doing so converts dissolved inorganics to precipitates, thereby increasing turbidity and solids loading. Oxidation with permanganate will be required to remove the manganese in Eagle River; adding another chemical dose to monitor and adjust as influent levels change. Overdosing of permanganate results in pink water events that may require disposal of the affected water to prevent the occurrence at the taps. Furthermore, the increased solids loading from the oxidized precipitates will increase the filter skimming and maintenance frequency, adding more operational burden to Minturn.

Pilot testing will be required to ensure the slow sand filters could treat Eagle River water prior to developing it as a new source for a slow sand filter WTP. It is unlikely the results of the pilot test would be favorable for slow sand filtration. Without pilot testing, it is hard to predict the slow sand filter design parameters for the Eagle River source. The use of roughing filters will improve the performance on Eagle River; however, the use of filtration to pretreat for slow sand filters is a marginal pursuit. Coupled with pre-treatment for dissolved inorganics, Minturn would effectively be installing a WTP process for the sole purpose of maintaining slow sand filter compliance. At this point, there are better and more typical available technologies to treat water. Furthermore, selection of slow sand filters as the treatment technology does not demonstrate Minturn is actively working towards a successful solution to treat Eagle River raw water and runs the risk of losing access to water rights for Eagle River.

Continuing the operation of the slow sand filters with Eagle River source water adds significant need for additional treatment processes and maintenance for Minturn. Due to their inherit limitations with treating highly turbid waters and the potential risk of losing water rights to Eagle River, slow sand filters exhibit little to no process modifiability and were therefore given a rating of **very low**.

3.5 Capacity Flexibility

Due to the biological process necessary for efficient removal, slow sand filters require a healthy biology within the top layer of the filter called the “schmutzdecke”. Therefore, sand filters rely on steady state operations at generally constant flow rates to not disrupt the microorganisms doing all the work. Ideally, the slow sand filters are run at a constant flow rate with minimal “start/stop” operations.

Additionally, the flow rate through the filter bed is critical to maintain that biological removal. Operating at too high of flow, can reduce the efficacy of the biology present in the bed. Conversely,

operating at too low of flow can negatively impact the biology by allowing the water too much time in the filter bed. The minimum production rates from the two rehabilitated filters and Filter 3 are 96 gpm and 60 gpm, respectively. Therefore, the minimum production range of a rehabilitated slow sand WTP is 60 gpm or 0.1 mgd.

Slow sand filters maintain the turndown and flexibility to meet low demand conditions that are often present at Minturn, especially in the low demand winter months. The filters do rely on steady state operations for optimal removal, and a "start/stop" operation could result in less efficient removal. Additionally, slow sand filters may suffer from turbidity breakthrough upon startup and lack the ability to waste water until turbidity drops back down into an acceptable range. Due to these drawbacks with starting and stopping, Alternative A was given a rating of **low** with respect to capacity flexibility.

4 Alternative B: Packaged Conventional Treatment Plant

A packaged conventional treatment plant improves upon the existing treatment process by adding pre-treatment consisting of rapid mixing, flocculation, and settling, followed by dual-media filtration within the same container. Each container, or treatment unit, is referred to as a treatment train. Each treatment train mimics the conventional water treatment process, which is commonly employed and widely successful in treating surface water in Colorado. The system would include two 0.3 mgd treatment trains. The proposed process flow diagram for a new packaged treatment plant is presented in Figure 5.

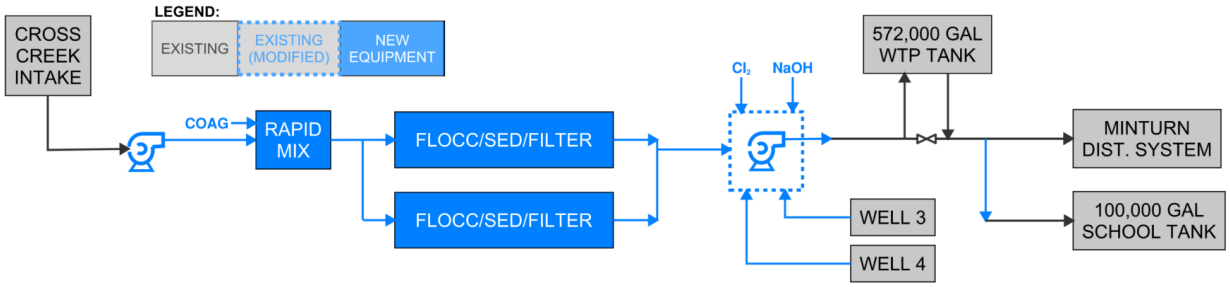

Figure 5. Process Flow Diagram - Alternative B: Packaged Conventional Treatment

When operated properly, the conventional treatment process is capable of treating challenging water with turbidity exceeding 80 NTU. Packaged treatment trains are advantageous to Minturn because of their small footprint and low relative cost compared to a distributed facility with cast-in-place concrete tanks. Their compact nature is a result of steel tank construction and compact arrangement of the process tankage and ancillary supporting equipment such as piping, motors, and valves. An example of a packaged treatment unit is presented in Figure 6.

Figure 6. Example Packaged Treatment Units. Breckenridge, CO.

Settling and filtration both create a waste stream in the form of residuals, or sludge. The sludge produced is typically between 0.1% and 0.5% total solids. The existing outdoor filters (Filters 1 and 2) would be converted into holding ponds for backwash waste and other process residuals. A new building to house the packaged treatment process would be constructed in the unoccupied area owned by Minturn to the south of the existing filters. Filter 3 could ultimately serve as a pumping station where clarified water from the backwash ponds is recycled to the front of the process.

4.1 Resiliency

Packaged conventional treatment units are typical for WTPs of the size and scale being considered by Minturn. The proposed two 0.3 mgd rated trains were selected to provide water at the design WTP capacity of 0.6 mgd. Packaged conventional treatment units can meet the demand of the existing Minturn distribution system.

The disinfection requirements of a conventional filtration WTP are presented in Table 7. A well operated conventional process can provide up to 2.5-log of credit towards disinfection for giardia and 2-log of credit for viral components. These credits reduce the amount of disinfection that must be achieved by chlorine addition, lowering chemical costs, and reducing the potential for DBP formation.

Table 7. Conventional Treatment Process Disinfection Requirements

	SWTR Disinfection Requirements	Conventional Treatment Credit	log-disinfection required by chlorine	$CT_{required}$ (Note 1)
Giardia	3-log	2.5-log	0.5-log	43
Viruses	4-log	2-log	2-log	4

Notes 1. $CT_{required}$ based on filtered water quality of:
Temperature = 5 ºC
pH = 8.5
Chlorine residual concentration of 1 mg/L

To achieve adequate disinfection following conventional filtration with a residual of 1 mg/L chlorine, 430 minutes of disinfection contact time is required. This time is determined by dividing the $CT_{required}$ value (43) by the baffling factor (0.1). Under these conditions, the existing 572,000-gallon unbaffled storage tank provides sufficient disinfection at the 0.6 mgd design flow. The conventional treatment process is highly capable of treating Cross Creek water, is resilient to high turbidity events, and provides for higher disinfection credit allowing Minturn to better manage chlorine and disinfection byproducts. Because groundwater requires less disinfection contact time, contributions from wells #3 and #4 would need to be managed separately from that of the filtered surface water to accurately track disinfection compliance.

Water from Cross Creek is immensely treatable by conventional packaged treatment units, and, if operated properly, is robust against high turbidity water (>100 NTU) such as that found during spring runoff or after the watershed experiences a wildfire event. Additionally, the intrinsically present pretreatment makes Alternative B the best process for removing TOC. Alternative B was given a rating of **strong** with respect to resiliency.

4.2 Operations & Maintenance

There exists a moderate level of motorized equipment, valves, and instrumentation on packaged treatment trains. Each these components can be controlled with a SCADA system that can be operated remotely and automatically. However, it is not recommended to perform a media filter backwash remotely. Backwashing should occur while an operator is in attendance. This requirement may necessitate more frequent visits from operations staff. Additionally, the quantity and complexity of automated equipment is directly proportional to the amount of maintenance required.

The conventional process requires use of a coagulant for flocculation and sedimentation to work effectively; an example chemical storage and feed system of the scale suitable for Minturn is presented in Figure 7. Coagulants consist of a metal salt (e.g. aluminum sulfate) which encourages agglomeration of particles in raw water into larger particles called floc particles. Floc particles are heavier than water and, provided enough time, will settle to the bottom of a tank where they are removed from the process as residuals (or sludge). Application of coagulant introduces a degree of complexity to the operation and would require daily operator involvement to ensure there are no line clogs or leaks in the chemical feed system.

Figure 7. Example Coagulant Feed System

A packaged media filtration WTP producing up to 0.6 mgd would require an A-level operator (highest tier); the current and planned operations team for the new facility hold A-level treatment licenses. The proposed modifications would not impact the need for additional licensure but may impact the ability for Minturn to acquire a new operations team should the need arise.

With the high number of componentry and complexity of the process, maintenance frequency is difficult to predict, but it will be more intensive compared to a slow sand filter process. Most conventional WTPs in Colorado are staffed daily and establish weekly, monthly, quarterly, and annual maintenance schedules for various components.

If selected as an alternative, suppliers of packaged conventional treatment units located in Colorado would be given preference. Additionally, Minturn would be encouraged to stock select spare parts and components in the event of a failure.

Overall, a packaged conventional treatment process has a high degree of required operator involvement due to complexity of operation and chemical feed. Maintenance intervals are increased due to the number of components and steel tank construction. For these reasons, Alternative B was given a rating of **moderate** for operations and maintenance.

4.3 Long-Term Reliability

Steel tanks that hold water experience failures over time due to the corrosive environment in which they reside. Failures are generally minor (e.g. leak at weld seem), but repairs require the unit be completely taken offline and patched. It is not uncommon to have steel tanks be in service for more than 20 years; however, it is likely those tanks will have undergone several in place repairs.

The componentry bolted to the steel tank supporting the process is expected to require replacement on a more regimented schedule. Flocculator chains will likely require maintenance every six months to a year as the chain links stretch and break. Filter media should be replaced in kind every 7 to 10 years. Valves, valve motors, and other miscellaneous equipment should be replaced on an as needed basis and a store of commonly replaced materials should be established by Minturn to minimize downtime.

Overall, the long-term reliability of a packaged conventional treatment process is moderate to high. There are many components that require regimented attention, but a quality manufactured system should last at least 20 years without need for major repairs. For these reasons, Alternative B was rated as **strong** in the realm of long-term reliability.

4.4 Process Modifiability

Packaged conventional treatment units are limited in their ability to treat water they were not originally designed to treat. Additional unit processes may be required to remove dissolved iron and manganese present in the Eagle River. The building and hydraulics of the process should be designed to allow for insertion of polishing processes downstream of the filters, such as pressurized ion exchange or greensand vessels, as presented in Figure 8.

Figure 8. Pressure Filter Tanks for Adsorptive Inorganics Removal

Alternatively, some level of pre-oxidation should be considered. The packaged flocculation and settling basins may not provide enough reaction time for the oxidation-precipitation reaction to reach full yield, so a dedicated reaction basin upstream of the pre-treatment is recommended. This will ensure particulate iron and manganese are introduced to the pre-treatment process where they can coagulate and settle with other particles in the raw water. Without sufficient reaction time, manganese may chemically adsorb onto the filter media and disruptions in water quality could elute the same into the finished water and risk water aesthetics.

The degree of modifiability to a packaged conventional treatment process is limited with respect to the treatment units themselves. Flexibility can be built into the design to accommodate anticipated future process requirements, giving Alternative B a rating of **strong**.

4.5 Capacity Flexibility

Packaged treatment trains can typically be turned down to about 50% of the rated flow. In this instance, each treatment train could be operated as low as 0.15 mgd (50% of 0.3 mgd) providing an estimated treatment range of 0.15 mgd to 0.6 mgd. Starting and stopping a conventional treatment process is challenging. It takes some time for the process to reach steady state and for the coagulant dose to be optimized. Each time a unit starts, it will need to be wasted – meaning filtrate would be routed to the backwash waste ponds until the effluent turbidity is within finished water quality goals. This process typically takes several minutes.

Packaged treatment trains are generally flexible in their ability to turn down but struggle with sporadic start and stoppage. Due to these struggles, Alternative B was given a rating of **moderate** for capacity flexibility.

5 Alternative C: Membrane Water Treatment Plant

Microfiltration (MF) and/or ultrafiltration (UF) membranes represent state-of-the-art filtration technology, do not require pre-treatment to function effectively, and offer an absolute barrier to particles and pathogens common in surface water. They are common and successful in treating Colorado surface waters. Membranes typically benefit from a smaller relative footprint which would fit within the proposed WTP building space.

Membranes typically operate as a direct filtration process, meaning the membranes can effectively operate with little to no pre-treatment depending on the influent water quality parameters. Direct membrane filtration can effectively handle influent turbidity up to 20 NTU without the need for pre-treatment. However, in the presence of elevated total organic carbon (TOC) and other dissolved inorganic contaminants, pre-treatment is recommended to enhance removal efficiencies of those constituents as membrane filtration alone does not meet target removals.

With the Cross Creek TOC spikes discussed in Section 1.4, seasonally operated pretreatment can be implemented should Minturn opt to treat Cross Creek during spring runoff rather than rely on well water to supplement. Coagulant would be added to flocculate suspended and organic materials in the water so that it may be filtered and removed by the membrane system. Downstream of chemical addition, the water would enter the Flocculation Tank, which will consist of a vertical tank and a top mounted mixer. A sweep-flocculation mechanism will occur in this tank, thereby allowing agglomeration of the suspended and organic materials. A vast majority of the coagulated solids will remain in suspension and carry over to the membrane system for removal through filtration. Equipment costs for this type of partial pre-treatment range from $150,000 - $250,000 and are included in the cost estimates developed for Alternative C because while this system would be operated seasonally, the infrastructure would remain in place.

Direct filtration is proposed as Cross Creek water has little dissolved inorganic contaminants throughout much of the year and seasonally operated equipment is planned for periods of high TOC which membranes struggle to remove without pre-treatment. Oxidation would be required to treat Eagle River water for iron and manganese followed by settling to ensure iron and manganese does not carry over to the membranes. The treatment plant would include two 0.3 mgd membrane skids. The proposed process flow diagram for a new membrane treatment plant is presented in Figure 9.

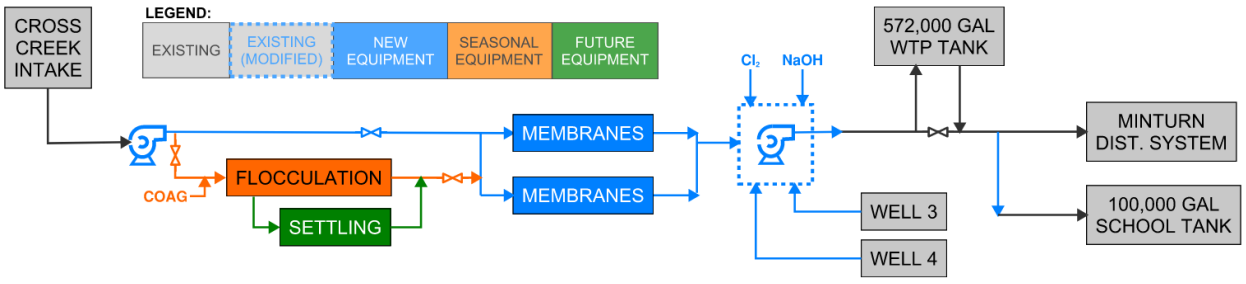

Figure 9. Process Flow Diagram - Alternative C: Membrane Filtration

Membrane skids are made up of many modules, as displayed in Figure 10. Skids are highly automated which simplifies their operation when compared to a conventional filtration treatment plant. The existing outdoor filters (Filters 1 and 2) would be converted into holding ponds for backwash waste. A new building to house the membrane skids and requisite chemical storage systems would be constructed in the unoccupied area owned by Minturn to the south of the existing filters. Filter 3 could ultimately serve as a pumping station where clarified supernatant from the backwash ponds is recycled to the front of the process.

Figure 10. Typical MF/UF Membrane Skids. Bend, OR.

5.1 Resiliency

The proposed two 0.3 mgd rated skids were selected to provide water at the design WTP capacity of 0.6 mgd. The proposed membrane skids can meet the demand of the existing Minturn distribution system with room to spare.

The disinfection requirements of a membrane filtration WTP are presented in Table 8 and consider the use of either MF or UF membranes. When properly operated and validated, membrane filtration can provide 3-log of disinfection credit for giardia, but do not provide any disinfection credit for viral components.

Table 8. Membrane Filtration Disinfection Requirements

	SWTR Disinfection Requirements	Membrane Filtration Credit	log-disinfection required by chlorine	$CT_{required}$ (Note 1)
Giardia	3-log	3-log	None	n/a
Viruses	4-log	None	4-log	8

Notes
1. $CT_{required}$ based on filtered water quality of:
   Temperature = 5 ºC
   pH = 8.5
   Chlorine residual concentration of 1 mg/L

To achieve adequate disinfection of membrane treated water with a residual of 1 mg/L chlorine, 80 minutes of disinfection contact time is required. This time is determined by dividing the $CT_{required}$ value (8) by the baffling factor (0.1). Under these conditions, the existing 572,000-gallon unbaffled storage tank provides ample contact time at the design flow of 0.6 mgd. The use of membranes to treat surface water effectively allows the filtrate, or treated water, to have the same disinfection requirements of ground water, which significantly simplifies the management of chlorine dosing and reporting.

Membrane filtration provides good resiliency and would, with proper operation, produce the highest quality finished water of the three alternatives being evaluated. When considering the relatively high quality of the Cross Creek source, this alternative should have no issues treating the water to finished water quality goals, assuming turbidity and TOC remains low. If the turbidity and TOC spikes during spring runoff increase in frequency or duration, the inclusion of pretreatment would both improve membrane performance and prolong the lifespan of the membrane fibers. Another option would be to run wells #3 and #4 during periods of high TOC. Membranes combined with either wells or pretreatment would result in this alternative providing the most robust resiliency. Therefore, Alternative C was given a rating of **very strong** in this category.

5.2 Operations & Maintenance

Membrane treatment is typical for WTPs of the size and scale being considered by Minturn. Many small neighboring communities have chosen this technology for their system due to its relative simplicity to operate compared to a conventional process (e.g. no coagulation or settling required). Skids can be monitored and controlled remotely, favoring Minturn's contract operations model. There is a high degree of automated valves and monitoring equipment on a membrane skid that will increase the level of operator involvement compared to the existing slow sand filtration process; however, the level of operator involvement is expected to be less compared to a conventional treatment process.

Chemicals consisting of chlorine, an acid (typically citric acid), and a base (typically sodium hydroxide) are used during membrane cleaning cycles. The cleaning cycles are generally automated, and the equipment can be designed and furnished by the membrane supplier.

A membrane WTP producing up to 0.6 mgd would require a B-level operator (2nd from highest tier); the current and planned operations team for the new facility hold A-level treatment licenses (highest tier available). The proposed facility would not impact the need for additional licensure, nor is it expected to impact the ability for Minturn to acquire a new operations team should the need arise. Minturn's existing operations team has experience with membrane WTPs, and it is their preferred process to operate.

With the high number of valves, fittings, and membrane modules on each skid, maintenance frequency is difficult to predict. However, many membrane WTPs in Colorado are not staffed daily. Still, Minturn should establish weekly, monthly, quarterly, and annual maintenance schedules for various components to avoid downtime associated with repair.

If selected as an alternative, membrane skid suppliers located in Colorado would be given preference. Additionally, Minturn would be encouraged to stock select spare parts and components in the event of a failure. Membrane modules are typically not stocked as a spare item, as they need to be kept wet for prolonged storage durations.

Overall, a membrane filtration process poses a reduced level of operator involvement because of its relative simplicity to operate remotely with no coagulation. Maintenance intervals are increased due to the number of components that come with each membrane skid. For these reasons, Alternative C was given a rating of **moderate** in terms of operation and maintenance.

5.3 Long-Term Reliability

The expected lifespan of the membrane modules, which make up the skid, are approximately 7 to 10 years before needing to be replaced. However, the lifespan of membranes is heavily dependent on how they are operated. Methods for extending the lifespan of membranes include pre-treatment, proper cleaning using either clean in place (CIP) procedures, or through chemically enhanced backwashes. It is also recommended to run two skids simultaneously at half capacity to stay below the critical flux; above which fouling is more likely to occur. Flux is the measure of the rate of flow through a single square foot of membrane surface area (e.g. gal/ft^2/day). Higher flux results in more frequent backwashing and cleaning, so lowering loading and fouling potential on the membranes can help to prolong their useful life. The skids include structural framing, supports, and valves which should be able to last up to 30 years with proper maintenance. Overall, Alternative C was given a rating of **strong** with respect to long-term reliability.

5.4 Process Modifiability

Figure 11. Example of Fountain Aeration of Iron

To be able to treat water from Eagle River, pretreatment trains would need to be added to the treatment process. A process including both pretreatment and membranes would be the most robust treatment system of the three alternatives, and the lowest risk solution for meeting future water quality standards. As part of the pretreatment, some level of pre-oxidation would need to be added to successfully remove the higher levels of iron and manganese in the Eagle River. Oxidation of dissolved iron by aeration is successfully employed and can be accomplished with fountains (pictured in Figure 11) or aeration towers. The proposed pre-treatment would include flocculation and high rate settling designed around settling oxidized metal compounds.

The expanded treatment process shown in Figure 9 is the most robust in terms of ability to treat Eagle River water and Cross Creek during spring runoff. Membranes provide a better ability to meet future CDPHE regulations than either slow sand or conventional filtration. For these reasons, Alternative C was given a rating of **very strong** in this category.

5.5 Capacity Flexibility

Membrane skids can be successfully turned down at least 50% of their design flow rate, meaning that each skid could run as low as 0.15 mgd. This flexibility means that periods of low demand would not be a major issue. Further, membrane skids are highly resistant to complications associated with starting and stopping. In fact, a membrane skid may start and stop every 20 minutes as it goes through a short backwash cycle. However, membrane systems are designed for continuous operations, meaning that both skids would need to be run year-round, even during the winter when flows are minimal. In winter months, the two skids would operate in a cycle with one skid operating and one backwashing or primed to come online when the operating skid requires backwashing. This will ensure that both skids remain in continuous operation. Overall, a

membrane WTP provides the highest capacity flexibility of the alternatives being considered, resulting in a rating of **very strong**.

6 Cost Analysis of Alternatives

Within the past couple of years, costs for materials, equipment, and freight have been increasing at significant levels. In addition, lead times for equipment and materials have increased. Supply chain issues have created construction market uncertainty on scheduling sub-contractors and overall completion certainty. This combination has produced a potentially volatile situation for utility owners around the country. On one hand, general contractors are drastically holding down fees (and, by default, bid prices) in order to obtain work, but then are exercising force majeure clauses for substantial change orders or adjustment of completion schedules. A project owner would be wise to retain a higher than usual contingency and seek bid and performance bonds on projects that may not normally require them. HDR has prepared opinions of probable construction cost (OPCCs) for the alternatives described in this report. The OPCCs presented in Table 9 are Class 4 as described by the American Association of Cost Estimating (AACE); they are provided with an accuracy range of -15% to +30%.

Since HDR has no control over the costs of labor, materials, equipment, or services or over the selected Contractor's methods of determining prices, HDR does not guarantee that proposals, bids, or actual project construction costs will not vary from the OPCCs prepared. For the OPCCs prepared for the improvements described in this report, HDR has included the following items:

- General contingency for miscellaneous items for estimating at a planning or programming level – 40%.
- Contractor General Conditions, Mobilization, and Demobilization – 8 to 10%.
- Contractor Overhead and Profit – 8 to 10%.
- Contractor Bonds and Insurance – 2%.
- It should be noted that the OPCCs in this report are in 2023 dollars, and escalation costs have not been included.

The capital cost data used as the basis of the estimates for the improvements at the WTP were compiled from a mixture of previous project bid tabs from recent HDR projects and vendor pricing for the specific process equipment associated with each alternative. Detailed cost backup supporting these estimates is available in Appendix A.

Table 9. Opinion of Probable Construction Cost Summary (AACE Class 4)

Alternative	Low Capital Cost (-15%)	High Capital Cost (+30%)	Annual O&M
A - Rehabilitation of Existing Slow Sand Filters	$5.8M	$8.9M	$120K
B - Packaged Conventional Water Treatment Plant	$10.5M	$16.7M	$200K
C - Membrane Water Treatment Plant	$9.8M	$14.9M	$150K

7 Comparison of Alternatives

A qualitative score was tabulated for each alternative after the Alternatives Analysis workshop held on March 20th, 2023. The score for each was determined by the ratings of each of the five criteria and the relative weights of each criteria.

7.1 Alternative Qualitative Scores

Table 10 provides a summary of the ratings for each alternative, culminating in the final qualitative score for each.

Table 10: Alternative Qualitative Scores

Criteria	Alternative A: Slow Sand Filtration	Alternative B: Packaged WTP	Alternative C: Membrane WTP
Resiliency (35%)	Moderate	Strong	Very Strong
Operations & Maintenance (26%)	Strong	Moderate	Moderate
Long Term Reliability (22%)	Strong	Strong	Strong
Process Modifiability (13%)	Very Low	Strong	Very Strong
Capacity Flexibility (3%)	Low	Moderate	Very Strong
FINAL SCORE	**56**	**64**	**75**

From a qualitative perspective, membranes are the most favorable alternative with respect to being able to meet Minturn's goals for a robust, reliable, and flexible water treatment process. Packaged treatment with conventional filtration placed second of the three alternatives. The process was rated as even or just below membranes in all five categories. Slow sand filtration was the lowest scoring alternative due to its lack of flexibility and inability to treat Eagle River water.

8 Expansion of Existing Groundwater Supply

Upon completion of the analysis of the three surface water treatment alternatives presented thus far, a fourth alternative was proposed to address the treatment capacity issues of the existing WTP. Minturn expressed interest in investigating the possibility of increasing the capacity of the existing wells (Wells #3 and #4) such that Minturn could rely solely on the groundwater supply to meet the water demands and eliminate their dependence on challenging treatment of available

surface water. Because this potential alternative is reliant on the groundwater supply in Minturn, it was not included in the alternatives analysis that focuses on the three surface water treatment process alternatives. This analysis of the groundwater wells will focus on answering three pertinent questions:

1. Will the Minturn's water rights allow for expanded withdrawals from the wells?
2. Do the existing wells have capacity (or yield) to produce at the required rate (0.6 mgd cumulative)?
3. Will the wells be classified as a ground water source at the increased production rate?

Do Minturn's existing water rights allow for expanded use of the groundwater wells?
In short, yes. The existing water right on Cross Creek could be modified with an "alternative point of diversion" to allow Minturn to exercise its right to that water (with the conditions of consumptive use) from the wells. This process would require going through water court to amend the water right and would be subject to contest.

Do the existing wells have capacity (or yield) to produce at the required rate?
Minturn presently operates two groundwater wells (Wells #3 and #4) at a capacity of 80 gpm each. The wells are used to supplement the surface water treatment plant during the spring runoff when the surface water becomes more difficult to treat. Minturn's well permit allows for up to 225 gpm to be diverted from each well, but pumping limitations result in a maximum flow rate of 80gpm. To increase the yield, larger pumps and casing improvements are necessary to address the pumping limitations.

To determine if the wells are capable of producing at a higher yield, a well test is needed. A well test is performed by a licensed well contractor wherein the well is inspected, cleaned (if necessary), and outfitted with a temporary pump that is designed to pump at the target flow rate. The well is pumped for several days while the water level in the well casing is monitored. Minturn, in cooperation with Martin & Wood Water Consultants is currently reviewing proposals from several well pumpers to perform this testing in the summer of 2024. Both wells need to be yield tested to confirm they are capable of meeting the required 0.6 mgd total demand. Any production capacity less than this negatively impacts the viability of the wells being the only source of water supply in Minturn.

If the wells can produce water at 225 gpm each, will that water still be classified as groundwater (thus not requiring treatment)?

Increasing the well production from 80 gpm to 225 gpm introduces the potential for the water coming from the wells to be influenced by the water in Cross Creek. If that were to occur, this would classify the well water as Ground Water under the Direct Influence (GWUDI) of surface water. shows the location of the wells #3 and #4 which are approximately 160 ft and 80 ft away, respectively, from Cross Creek. Given their proximity to Cross Creek and shallow depth (between 60 and 70 ft to bottom of well), the wells are in a type III aquifer which requires a GWUDI evaluation.

Minturn performed a GWUDI evaluation on the wells in 2017 which resulted in a groundwater classification while the wells were producing at 80 gpm. At the increased flow rate there exists real potential for the groundwater to be influenced by the surface water at the flow rates needed by Minturn prompting a change in classification to GWUDI. Additional data at 225 gpm needs to be collected to evaluate whether the wells are GWUDI at the higher production rate. GWUDI water must be treated the same as surface water; if the wells are found to be GWUDI, this alternative is non-viable.

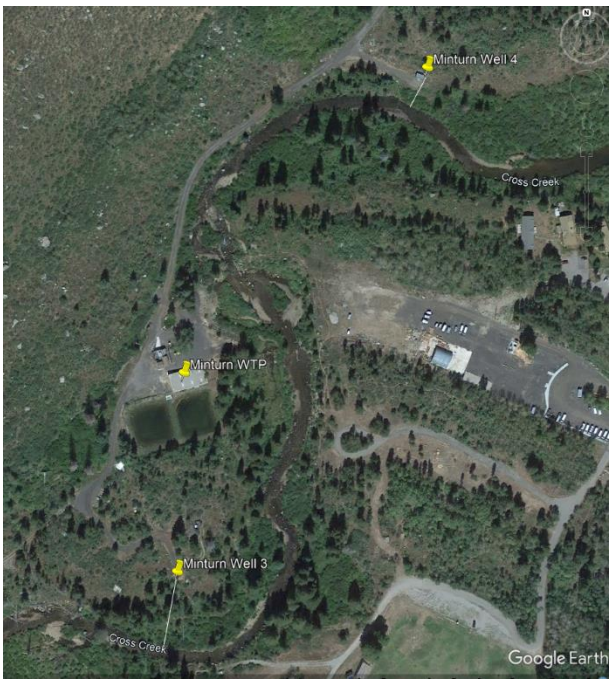

Figure 12. Proximity of Wells #3 and #4 to Cross Creek

Minturn, HDR, and CDPHE had a conference call in June 2023 to discuss the specific requirements of evaluating a well for GWUDI based on their Policy 003. The testing requirements for a GWUDI evaluation are summarized in Table 11. The results from Well #4 will apply to Well #3, as Well #4 is the more conservative well to analyze given it's closer proximity to Cross Creek. The earliest Minturn can proceed with this GWUDI evaluation is April 1st, 2024. The sampling period runs through October 2024. Therefore, Minturn may not have a decision on the groundwater classification at 225gpm until the end of 2024.

Table 11. CDPHE Groundwater Quality Performance Testing Requirements

Parameter	Location	Frequency	Sampling Dates
Temperature, Turbidity and Conductivity	Well #4 and Cross Creek	2 times per 7-day period	April 1st – October 31st
Total Coliform (with E. Coli)	Well #4	1x month	April 1st – October 31st
Total Aerobic Bacterial Spores	Well #4 and Cross Creek	3 times	April 1st – April 30th July 1st - August 31st September 1st – October 31st
Microscopic Particulate Analysis (MPA)	Well #4	3 times	April 1st – April 30th July 1st - August 31st September 1st – October 31st

9 Recommendations & Conclusions

Based on the results of this alternative analysis, it is recommended that Minturn move forward with construction of a new membrane filtration plant. It resulted in the highest qualitative score and is recognized to best address the priorities Minturn has for a providing a resilient and reliable treatment system. While rehabilitation of the slow sand filters ultimately had the lowest cost of the alternatives, the drawbacks of continuing to rely on an aging technology and cutting off the option for the addition of Eagle River water in the future far outweigh the cost savings associated with the option. Membrane filtration allows Minturn to address the needs of its existing customers, while leaving open the option for future development and water rights.

Appendix A – Detailed Cost Estimates

OPINION OF PROBABLE CONSTRUCTION COST
ALTERNATIVE A - SLOW SAND FILTER RECONSTRUCTION

#	Component		Quantity	Unit	Estimated Cost	Total	*Notes*
	Process Mechanical						
	Sand Filter Underdrains	Qty (2) 60x80 Filters	4800	SF	$ 40	$ 192,000	*Perforated Pipe*
	Sand Filter Media & Support Gravel	Qty (2) 60x80 Filters, 4 ft sand, 1 ft gravel +10%	2078	CY	$ 200	$ 415,556	*Red Flint Sand quote @ $150/CY for sand/gravel.*
	Roughing Filters	Building, Self clenaing Strainers	1	LS	$ 250,000	$ 250,000	
	Structural - Sub and Superstructure						
	Cast-in-place filter basin - Slab	12" thick bottom slab	280	CY	$ 500.00	$ 140,000	
	Cast-in-place filter basin - Walls/Spread Footings	7 ft deep spread footing walls, extedned 8 ft above grade	227	CY	$ 800.00	$ 181,867	
	Cast-in-place building foundation - Spread Footings	7 ft deep spread footing walls	131	CY	$ 800.00	$ 104,948	
	Cast-in-place Walkways around Filters	6 ft wide, perimeter access	47	CY	$ 500.00	$ 23,333	
	Metal Truss Roof System	Enclsure req'd to cover filters	10656	SF	$ 150.00	$ 1,598,400	
	Finished Water Metering Vault	Precast Structure	1	LS	$ 45,000.00	$ 45,000	
A	**Unit Processes + Buildings + Demolition = Subtotal 1**					$ 2,951,103.70	
B	Sitework + Soil Conditions				10%	$ 295,110.37	
C	Piping, Valves, Manholes				5%	$ 147,555.19	
D	Mechanical				2%	$ 59,022.07	
E	Electrical				5%	$ 147,555.19	
F	Instrumentation and Controls				3%	$ 88,533.11	
G	**Construction Subtotal 2 = A+B+C+D+E+F**					**$ 3,688,879.63**	
H	Miscellaneous Elements Not Itemized				40%	$ 1,475,551.85	
I	**Construction Subtotal 3 = G + H**					**$ 5,164,431.48**	
J	General Conditions, Mobilization, Demobilization				8%	$ 413,154.52	
K	**Construction Subtotal 4 = I + J**					**$ 5,577,586.00**	
L	General Contractor Overhead + Profit				8%	$ 446,206.88	
M	**Construction Subtotal 5 = K + L**					**$ 6,023,792.88**	
N	Bonds + Insurance				2%	$ 120,475.86	
O	**Construction Total Today = M + N**					**$ 6,144,268.74**	
P	Projection to Midpoint of Construction = 3.5%/year X 3 years				10%	$ 614,426.87	
Q	**Construction Bid Total = O + P**					**$ 6,758,695.61**	
R	Engineering, Legal, Fiscal, Administration				0%	$ -	*Not included in estimate*
S	TOTAL PROJECT OPINION OF PROBABLE CONSTRUCTION COST = Q + R					$ 6,758,695.61	
	TOTAL PROJECT OPINION OF PROBABLE CONSTRUCTION COST -15%					**$ 5,744,891.27**	
	TOTAL PROJECT OPINION OF PROBABLE CONSTRUCTION COST +30%					**$ 8,786,304.29**	

OPINION OF PROBABLE CONSTRUCTION COST
ALTERNATIVE B - PACKAGED MEDIA FILTER WTP

#	Component	Description & Assumptions	Quantity	Unit	Estimated Unit Cost	Total	*Notes*
	Process Mechanical						
	Cross Creek Pump Station	(3) Pumps/Piping/Valves/Inst inc'l Precast Vault	1	LS	$ 75,000	$ 75,000	
	Rapid Mix Tank	(1) 4,000-gal Steel, 5'D x 12'	1	EA	$ 50,000	$ 50,000	
	Rapid Mixer	(1) Radial Mixer	1	EA	$ 20,000	$ 20,000	
	Packaged Treatment Units	(3) Floc/Sed/Media Filters	1	LS	$ 1,987,500	$ 1,987,500	*Tonka Water Quote*
	Filtered Water Pump Station	(5) Submersible Pumps in Cast Vault	1	LS	$ 60,000	$ 60,000	
	Recycle Pump Station	(2) Pumps/Piping/Valves in Filter 3 Inlet Box	1	LS	$ 50,000	$ 50,000	
	Chemical Systems						
	Coagulant Storage and Dosing	1000 gal tank & feed system, (2) Pumps	1	LS	$ 27,000	$ 27,000	
	Caustic Storage and Dosing	Tote storage & feed system, (2) Pumps	1	LS	$ 15,000	$ 15,000	
	Acid Storage and Dosing	Drum/Tote storage & feed system, (2) Pumps	1	LS	$ 15,000	$ 15,000	
	Hypochlorite Storage and Dosing	500 gal tank & feed system, (2) Pumps	1	LS	$ 20,000	$ 20,000	
	Structural - Sub and Superstructure						
	Building foundation - Spread Footings	7 ft deep spread footing walls	108	CY	$ 800.00	$ 86,696	
	Building Slab	100'x90'	222	CY	$ 500.00	$ 111,111	
	Pre-Engineered Metal Building	Building with provision for expansion	9000	SF	$ 250.00	$ 2,250,000	
	Interoir Rooms	CMU Walls w/CIP deck ceiling	5	LS	$ 25,000.00	$ 125,000	
A	**Unit Processes + Buildings + Demolition = Subtotal 1**					$ 4,892,307.41	
B	Sitework + Soil Conditions				15%	$ 733,846.11	
C	Piping, Valves, Manholes				12%	$ 587,076.89	
D	Mechanical				6%	$ 293,538.44	
E	Electrical Including Generator				20%	$ 978,461.48	
F	Instrumentation and Controls				10%	$ 489,230.74	
G	**Construction Subtotal 2 = A+B+C+D+E+F**					**$ 7,974,461.07**	
H	Miscellaneous Elements Not Itemized				40%	$ 3,189,784.43	
I	**Construction Subtotal 3 = G + H**					**$ 11,164,245.50**	
J	General Conditions, Mobilization, Demobilization				10%	$ 1,116,424.55	
K	**Construction Subtotal 4 = I + J**					**$ 12,280,670.05**	
L	General Contractor Overhead + Profit				10%	$ 1,228,067.01	
M	**Construction Subtotal 5 = K + L**					**$ 13,508,737.06**	
N	Bonds + Insurance				2%	$ 270,174.74	
O	**Construction Total Today = M + N**					**$ 13,778,911.80**	
P	Projection to Midpoint of Construction = 3.5%/year X 3 years				10%	$ 1,377,891.18	
Q	**Construction Bid Total = O + P**					**$ 15,156,802.98**	
R	Engineering, Legal, Fiscal, Administration				0%	$ -	*Not included in estimate*
S	TOTAL PROJECT OPINION OF PROBABLE CONSTRUCTION COST = Q + R					$ 15,156,802.98	
	TOTAL PROJECT OPINION OF PROBABLE CONSTRUCTION COST -15%					**$ 12,883,282.53**	
	TOTAL PROJECT OPINION OF PROBABLE CONSTRUCTION COST +30%					**$ 19,703,843.87**	

OPINION OF PROBABLE CONSTRUCTION COST
ALTERNATIVE C - MEMBRANE WTP

#	Component	Description & Assumptions	Quantity	Unit	Estimated Unit Cost	Total	*Notes*
	Process Mechanical						
	Cross Creek Pump Station	(3) Pumps/Piping/Valves/Inst inc'l Precast Vault	1	LS	$ 75,000.00	$ 75,000.00	
	Membrane Influent EQ Tank	(1) 4,000-gal PE, 7.5'D x 13.5'	1	EA	$ 20,000.00	$ 20,000.00	
	Membrane System	(3) Membrane Skids @ 0.4 mgd ea	1	LS	$ 1,100,000.00	$ 1,100,000.00	*Price from Memcor and Wigen proposal*
	Feed System w/ Pumps and Strainers						
	Instrumentation						
	Backwash/CIP Skid with Pumps and Tank						
	Filtered Water Pump Station	(3) Pumps/Piping/Valves/Inst in Cast Vault	1	LS	$ 60,000.00	$ 60,000.00	
	Recycle Pump Station	(2) Pumps/Piping/Valves in Filter 3 Inlet Box	1	LS	$ 50,000.00	$ 50,000.00	
	Chemical Systems						
	Caustic Storage and Dosing	Drum/tote storage & feed system, (2) Pumps	1	LS	$ 15,000.00	$ 15,000.00	
	Acid Storage and Dosing	Drum/tote storage & feed system, (2) Pumps	1	LS	$ 15,000.00	$ 15,000.00	
	Hypochlorite Storage and Dosing	500 gal tank & feed system, (2) Pumps	1	LS	$ 20,000	$ 20,000	
	Structural - Sub and Superstructure						
	Building foundation - Spread Footings	7 ft deep spread footing walls	108	CY	$ 800.00	$ 86,696	
	Building Slab	100'x90'	222	CY	$ 500.00	$ 111,111	
	Pre-Engineered Metal Building	Building with provision for expansion	9000	SF	$ 250.00	$ 2,250,000	
	Interoir Rooms	CMU Walls w/CIP deck ceiling	5	EA	$ 25,000.00	$ 125,000	
A	**Unit Processes + Buildings + Demolition = Subtotal 1**					$ 3,927,807.41	
B	Sitework + Soil Conditions				12%	$ 471,336.89	
C	Piping, Valves, Manholes				9%	$ 353,502.67	
D	Mechanical				4%	$ 157,112.30	
E	Electrical Including Generator				20%	$ 785,561.48	
F	Instrumentation and Controls				7%	$ 274,946.52	
G	**Construction Subtotal 2 = A+B+C+D+E+F**					**$ 5,970,267.26**	
H	Miscellaneous Elements Not Itemized				40%	$ 2,388,106.90	
I	**Construction Subtotal 3 = G + H**					**$ 8,358,374.16**	
J	General Conditions, Mobilization, Demobilization				10%	$ 835,837.42	
K	**Construction Subtotal 4 = I + J**					**$ 9,194,211.58**	
L	General Contractor Overhead + Profit				10%	$ 919,421.16	
M	**Construction Subtotal 5 = K + L**					**$ 10,113,632.74**	
N	Bonds + Insurance				2%	$ 202,272.65	
O	**Construction Total Today = M + N**					**$ 10,315,905.39**	
P	Projection to Midpoint of Construction = 3.5%/year X 3 years				10%	$ 1,031,590.54	
Q	**Construction Bid Total = O + P**					**$ 11,347,495.93**	
R	Engineering, Legal, Fiscal, Administration				0%	$ -	*Not included in estimate*
S	TOTAL PROJECT OPINION OF PROBABLE CONSTRUCTION COST = Q + R					$ 11,347,495.93	
	TOTAL PROJECT OPINION OF PROBABLE CONSTRUCTION COST -15%					**$ 9,645,371.54**	
	TOTAL PROJECT OPINION OF PROBABLE CONSTRUCTION COST +30%					**$ 14,751,744.71**	

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Memorandum

To: Michelle Metteer

From: William Berg, P.G.
Chase Van Alstine, P.G.

Date: December 29, 2023

Subject: Minturn Wells 3 and 4 Testing Summary

BACKGROUND

This memorandum summarizes the Minturn Well Nos. 3 and 4 testing activities that were performed by Cascade Environmental (Cascade) from October 31, 2023 through November 16, 2023. The purpose of the Minturn Wells 3 and 4 testing program was to assess whether Minturn Well Nos. 3 and 4 could each reliably produce approximately 225 gallons per minute (gpm) and to gather some preliminary information regarding whether the wells would be classified as groundwater under the direct influence of surface water (GWUDI).

Both Minturn Well Nos. 3 and 4 have two screened intervals: one shallow and one deep. Due to the concern over the wells being classified as GWUDI, the upper screened interval in each well was to be sealed off during the aquifer testing so that only the lower screened interval was producing groundwater. This was achieved by using an inflatable packer to isolate the lower screened interval. The remainder of this memorandum describes the aquifer testing activities that took place during the testing program.

AQUIFER TESTING ACTIVITIES

Cascade mobilized from Arizona on October 30th and arrived onsite to Well No. 3 on the morning of October 31st. The rest of the 31st was spent on activities including site familiarization, coordination of well operations and well shutdowns with the Town of Minturn public works supervisor, recovering the pump column that fell of the pitless adapter in Well No. 3, and conditioning the well for the initial well video.

Well No. 3 Well Videos and Well Cleaning

The initial well video on Well No. 3 was performed on the morning of November 1. Due to conflicting well construction reports, well testing reports, and well diagrams, it was uncertain what the specifics regarding the well diameter and well construction were prior to the video. The initial well video showed that the casing size was approximately 7 inches in diameter from

the top to bottom of the well and that there was both an upper and lower screened interval. Had the upper well screen been approximately 5 inches in diameter, as indicated in the well construction and test report, the inflatable packer may not have fit in the well and the well testing would have been limited to a pump that could only produce approximately 100 gpm, regardless of aquifer ability. Construction details for Well No. 3 observed from the well videos are shown in Table 1.

The well video on November 1 showed the presence of both bacteria and mineral fouling on the well screens. Because of this, on November 1 through November 3, mechanical and chemical cleaning of the Well No. 3 screens was performed. This included using brushes of varying stiffness, an acidizing chemical treatment, and airlifting the water in the well to remove residue and chemicals from the cleaning process. Chemicals used to clean Well No. 3 were neutralized in a 500-gallon tank and released into small kettle depression approximately 60 feet east of and below the elevation of the well to avoid flow back toward the well. A second well video of Well No. 3 was performed on November 2, which showed that chemical cleaning and brushing removed some of the bacterial film on both screens, and it was Martin and Wood's opinion that more mechanical brushing was required to adequately clean out the lower screen. A third well video was taken on the morning of November 3, following the mechanical brushing, which showed additional improvement, but more brushing was considered necessary to remove material from corrosion near the joints between the top part of the lower screen, and the blank casing. Following the additional brushing, a final video on the afternoon of November 3 showed that the lower screen was cleaner, and the remaining oxidation at the joints between the casing and lower screen was considered by Cascade to not be removable and would not noticeably affect well performance.

Well No. 3 Specific Capacity Testing and Yield Results

On November 3, a specific capacity test was run for approximately two hours, where the goal was to maximize the pumping rate from the well utilizing its current pump with the discharge valve completely open, in order to estimate the maximum pumping rate from the well in its just-cleaned condition. A PVC sounding tube was installed to house the transducer for water level drawdown measurements during well testing. The static water level prior to the test was measured at 20.15 feet below ground surface (bgs), and the pump intake was set to a depth of around 77.9 feet bgs. The specific capacity test for Well No. 3 was initially run at a pumping rate of 80 gpm to measure the effect of cleaning on the screens, which indicated an improved specific capacity of 2.61 gpm/foot of drawdown from the original 2.17 gpm/foot of drawdown. The pumping rate was then increased to approximately 90 gpm, which is the maximum pumping rate that the pump and discharge valve would allow. The pumping rate needed to be maximized to stress the aquifer as much possible without reducing the water level below the level at which pump cavitation occurs (pump cavitation is when air enters the pump and is harmful to the pump). A maximum pumping water level of 61.71 feet bgs, which is the water level in the well during pumping, was obtained during the specific capacity test.

The specific capacity calculated at the maximum pumping rate of 89 gpm with a drawdown of 41.56 feet (61.71 feet bgs – 20.15 feet bgs = 41.56 feet bgs) was 2.14 gpm/foot of drawdown (89 gpm ÷ 41.56 feet of drawdown = 2.14 gpm/foot of drawdown). The decrease in specific capacity from pumping at 80 gpm to pumping at 89 gpm shows a decreasing ability

of the aquifer to keep up with increased pumping rates. Given the specific capacity, the pump intake depth, current static water level, and a maximum estimated pumping water level of approximately 68 feet bgs (cavitation will likely occur when the submergence depth of the pump is less than around 10 feet), an estimated maximum pumping rate of approximately 102 gpm was estimated for Well No. 3 (2.14 gpm/foot of drawdown × [pumping water level of 68 feet bgs – static water level of 20.15 feet bgs]) without damaging the pump components at the current static water level. Note that this test was performed without packing off the upper screen interval. A packer test was not performed on Well No. 3, as the estimated maximum pumping rate with both screens open is far less than the 225 gpm target for the well to deliver to the proposed water treatment plant.

Completion of Work at Well No. 3

Cascade disinfected and reinstalled the Town's existing pump for Well No. 3 by the end of the day on November 2. Cascade demobilized from Well No. 3 and mobilized to Well No. 4 on November 4.

Well No. 4 Initial Well Videos and Evaluation

The static water level at Well No. 4 was initially measured at a depth of 16.43 feet bgs. With some difficulty, Cascade was able to remove the pump assembly from the well and lower a bailer to remove sediment on November 4. Cascade was unable to get the bailer past the top of the lower screen, which is at a depth of approximately 67.7 feet bgs. The depth of the screened intervals and tagged bottom depth of Well No. 4 are shown in Table 1. The reasons for the difficulty in removing the pump and lowering the bailer to the bottom of Well No. 4 were made clear during an initial well video before conditioning the well. The initial well video showed warping in the lower screen at a depth of approximately 69.7 feet bgs that occluded nearly half of the 6-inch diameter. The video also showed the well contained sediment below a depth of approximately 78.2 feet bgs, along with a bend in the well casing above the lower well screen. The severity of the warping of the lower screen precluded mechanical brushing to clean the screen and would reduce the effectiveness of cleaning the lower screen with chemicals. Flocculant was added in attempts to obtain a clearer video of the well screens. A second well video was performed on November 5, which was still obscured by turbidity, despite the flocculants that were added the day prior. A static water level was measured at a depth of approximately 11.6 feet bgs from the video. The video also showed rubbing from the bailer cable on the well casing string below the upper screen at a depth of approximately 43 feet bgs. This indicates that the well is not plumb below the bottom of the upper screen at 38.4 feet bgs. An attempt was made to install a 1-inch PVC sounding tube with the original 3-inch PVC pump column pipe. The PVC sounding tube was intended to house the transducer for water level drawdown measurements during well testing. However, because of the deformed nature of the Well No.4 casing, the original pump and pump column were not able to be installed inside the casing together with the 1-inch PVC sounding tube. Cascade substituted the 3-inch PVC pipe with 2-inch steel pipe to carry out a specific capacity test for the well.

Well No. 4 Specific Capacity Testing

A specific capacity test was carried out at Well No. 4 on November 5 to see if it could yield close to 225 gpm. The intake of the pump was set to a depth of approximately 58 feet bgs. The pumping water level at Well No. 4 at approximately 89 gpm was approximately 16.7 feet bgs (19.48 feet below top of casing). Given a calculated drawdown of approximately 5.1 feet (16.7 feet bgs – 11.6 feet bgs = 5.1 feet of drawdown), the estimated specific capacity of Well No. 4 prior to cleaning was approximately 17.45 gpm/foot of drawdown (89 gpm ÷ 5.1 feet of drawdown = 17.45 gpm/foot of drawdown). Given the pump intake depth and specific capacity of Well No. 4 prior to cleaning, the well could potentially produce the 225 gpm needed for the water treatment plant.

Well No. 4 Well Cleaning and Additional Well Videos

Because of the favorable results of the initial testing, Cascade was instructed to attempt to airlift near the lower screened interval to clean out the sediment at the bottom of the well and to clean out the screens as much as possible with that same method. A well video was performed on November 6, which confirmed that the Well No. 4 lower screen was compromised (as seen on November 4) so that approximately 50% of the screen diameter was still open. The lower screen otherwise appeared to be intact and there was little evidence of screen clogging noted during the video. As described above, the well screen compromise prevented mechanical cleaning of the lower screen. The sediment in the bottom of the well appeared to be fine grained, with no evidence of filter pack sand. Because there was no evidence of filter pack sand in the well and the lower screen appeared to be intact, the well was airlifted and surged in an attempt to remove the fine grained sediment in the bottom of the well.

On November 7, a final well video of Well No. 4 was taken to see if airlift development of the screens achieved additional well cleaning. The lower screen in Well No. 4 appeared clearer, and about 5 feet of sediment was cleared from the bottom of the lower screen. There was no sign of further lower well screen compromise.

Well No. 4 Further Testing and Well Yield Results

Cascade received the packer to isolate the lower well screen from the upper well screen on November 7, and spent that day and part of November 8 setting up for further testing by running transducer cable through the packer. Martin & Wood obtained the transducer to measure water levels during testing and brought it to the site on November 8. Most of that day was spent setting up by threading the transducer cable through the packer port and splicing the cable together. Splicing was finished on November 9, and Cascade personnel left the site for a four-day break (following 10 days of work, as scheduled).

Cascade remobilized to the site on November 13. November 14 was spent testing and troubleshooting the packer assembly and installing the test pump. On November 15, additional packer assembly and transducer connection troubleshooting were performed before the testing could begin.

The bottom of the test pump was set to a depth of approximately 69 feet bgs and the pump intake was set at 66 feet bgs. The static water level could not be obtained as the packer

unfortunately prevented a depth to water measurement with a water level meter. The static water level was at 14.4 feet on November 14 and was used as the static water level on November 15 for Well No. 4 testing. At the beginning of testing of the lower screened interval in Well No. 4, the pumping rate was mistakenly set too high by Cascade, which resulted in a pumping rate of approximately 250 gpm and a drawdown of approximately 48 ft, which reduced the water level in the well to the pump intake quickly. The pump was shut down after a few minutes and the water level was left to recover.

Once the water level was 95% recovered after approximately 30 minutes, the test was restarted with a lower pumping rate of 150 gpm. Well No. 4 experienced 40 feet of drawdown immediately, resulting in a pumping water level (water level during pump testing) of approximately 54 feet. At this point it was clear that Well No. 4 was not going to be able to sustain a pumping yield much above 100 gpm from only the lower screened interval. The pumping water level at a pumping rate of approximately 100 gpm was found during testing to be approximately 57 feet bgs, which is approximately 9 feet above the pump intake. The water level was adjusted based on the drawdown observed at each pumping rate. Because the well could not sustain the original 150 gpm, the pumping rate was decrease to a point where the water level was constant at an acceptable level above the pump intake.

The Town's original pump was disinfected and reinstalled on November 16.

Conclusions and Recommendations

Well No. 3 appears to be capable of a maximum pumping yield of approximately 100 gpm with groundwater contributions from both screens. The drawdown in Well No. 3 during testing suggests that the well yield limitation for Well No. 3 is a combination of both geology and well diameter. The combination of geology and well diameter limit the rate of groundwater production from a well. The largest pump that can be installed can only produce about 100 gpm, due to well diameter limitations on what size pump can fit down the well. Because of both the well drawdown, which suggests aquifer conductivity limitations, and well casing size, Well No. 3 will be limited to approximately 100 gpm.

Well No. 4 may be capable of a maximum pumping yield of approximately 250 gpm with the groundwater contributions from both screens. However, this pumping rate was not tested due to GWUDI concerns. When the well is limited to only the lower screen, the estimated pumping yield was limited to approximately 100 gpm (during testing with the packer installed) because of the drawdown within the well approaching the pump intake. The packer limited water production to only the groundwater entering the well from the lower screen, which is the most likely non-GWUDI interval. The 100 gpm lower screen well yield limitation suggests that a significant portion of the Well No. 4 yield is from the upper screen. Because of concerns of surface water impacts from the upper screen, we conclude that Well No. 4's water production from the lower interval is limited to a well yield of approximately 100 gpm. Additionally, the lower screen in Well No. 4 is compromised and will have to be replaced at some point in the future due to well cleaning limitations.

If the Town continues to be interested in utilizing wells for its water supply. it is estimated that at least two new wells would be required to meet the demand of up to 450 gpm. We inquired with Cascade about the estimated cost for a new alluvial well in the area near the existing wells. The estimated well construction cost was approximately $75,000 to $85,000, depending on the well casing size. Pumping and power considerations would be separate, but at this cost, multiple additional wells may still be an attractive option to Minturn. Further testing is needed to evaluate the GWUDI status of the groundwater.

Table 1
Town of Minturn
Well No. 3 and Well No. 4 Construction Details

Well Construction	Well No. 3	Well No. 4
Inner Diameter, inches	7	6
Well Depth in feet below ground surface	87	78*
Casing material	Mild steel	Mild steel
Top of upper screen, in feet below ground surface	46	18
Bottom of upper screen, in feet below ground surface	51	38
Top of lower screen, in feet below ground surface	73	67[1]
Bottom of lower screen, in feet below ground surface	83	78
Screen material	Stainless steel wire wrap	Stainless steel wire wrap
Static water level, in feet below ground surface	20.15	11.40

Notes:

Screen and well depths rounded to the nearest interger.

*: Bottom not reached due to sediment intrusion at this depth. Well is likely deeper.

[1]: Screen is compromised approximaely 2 feet below this depth.

Holland & Hart

M E M O R A N D U M

January 31, 2024

TO: Michelle Metteer, Town Manager

FROM: Holland & Hart LLP (Susan Ryan)

RE: Analysis of Minturn Well Nos. 3 and 4

The purpose of this memorandum is to provide a summary of the water rights that currently divert at Minturn Well Nos. 3 and 4, which are located along Cross Creek in Minturn Wellfield 1, and an analysis of the possible options for diverting additional water rights at Minturn Well Nos. 3 and 4.

1. Current Diversions from Wells 3 and 4. The Town diverts both senior and junior water rights at Wells 3 and 4.

    a. Well 3. The following water rights are diverted at Well 3:

        i. Senior: "1962 Well 1" water right for 80 gpm with 9.0 ac-ft annual consumptive use limit and subject to additional limits when considered along with other of the Town's water rights.

        ii. Junior: "2005 Minturn Municipal Diversion - Well 3 Enlargement" water right for 225 gpm.

    b. Well 4. The following water rights are diverted at Well 4:

        i. Senior: "1962 Well 2" water right for 80 gpm with 2.31 ac-ft annual consumptive use limit and subject to additional limits when considered along with other of the Town's water rights.

        ii. Junior: "2005 Minturn Municipal Diversion - Well 4 Enlargement" water right for 225 gpm.

    c. Pumping is limited to 225 gpm per well pursuant to Well Permit 83889-F (Well 3) and Well Permit 83890-F (Well 4).

2. Ability to Change Existing Well Rights to New Wells *Within* Minturn Wellfield 1.

    a. The Minturn Wellfield 1 extends 100 feet on both sides of Cross Creek.

b. The two senior well rights currently diverted at Wells 3 and 4 (1962 Well 1 and 2 water rights) have decreed alternate points of diversion (APODs) within Minturn Wellfield 1. Accordingly, the two senior well rights could be moved to a new well or wells located within the Minturn Wellfield 1 without any Water Court action. New well permit(s) would be required.

c. The Town also has junior well rights (2005 Minturn Municipal Diversion – Well 3 and 4 Enlargements) within Minturn Wellfield 1. Accordingly, the Town could divert junior well rights from well(s) within Minturn Wellfield 1. New well permit(s) would be required.

3. Ability to Change Existing Well Rights to New Wells *Outside of* Minturn Wellfield 1. Water Court action would be required to move the senior well rights currently diverted at Wells 3 and 4 (1962 Wells 1 and 2 water rights) to new well(s) located outside of Minturn Wellfield 1.

4. Ability to Change Senior Ditch Right to be Diverted Via Wells.

a. The Town's senior ditch right is the "1912 Minturn Water System Ditch" water right for 7 cfs, subject to annual, seasonal, and monthly consumptive use limits for the Town's senior water rights which apply to the 1912 Minturn Water System Ditch water right and the two senior well rights (1962 Wells 1 and 2 water rights).

b. Water Court action would be required to change the 1912 Minturn System Ditch water right to allow it to be diverted from a well or wells. The Town would need to file an application in Water Court to seek new alternate points of diversion [APOD(s)] for the senior ditch right. Potential APODs include: (i) Wells 3 and 4, (ii) well(s) within Minturn Wellfield 1, or (iii) well(s) outside of Minturn Wellfield 1. Importantly, this type of application would not increase the amount of the senior ditch right—it would just allow the Town to also divert the senior ditch water right at one or more wells.

c. Potential APODs for the 1912 Minturn Water System Ditch right:

i. Wells 3 and/or 4. The Town could seek new APOD(s) for the senior ditch right at Wells 3 and/or 4. The wells are already decreed as APODs for multiple water rights, which complicates seeking an APOD for the senior ditch right at these locations.

ii. New Well(s) in Minturn Wellfield 1. The Town could seek new APOD(s) for the senior ditch right within Minturn Wellfield 1. In prior Water Court proceedings, the Court determined that diversions for wells within Minturn Wellfield 1 resulted in instantaneous depletions to the stream—as such, the Town was not required to calculate lagged depletions from wells constructed within the wellfield. This prior determination could help

simplify a future application concerning the senior ditch right. On the other hand, opposers or the Division Engineer may be unwilling to accept the prior determination regarding instantaneous depletions.

iii. New Well(s) outside of Minturn Wellfield 1. The Town could seek new APOD(s) for the senior ditch right from wells located outside of Minturn Wellfield 1. Depending on their location, the Town would likely be required to calculate lagged depletions resulting from the new well(s) and may be required to provide replacement water for those depletions.

d. Obtaining water court approval to divert the senior ditch right at the APOD(s) described above benefits the Town by reducing the augmentation requirements on Cross Creek. The senior priority of the ditch right allows it to be diverted more frequently than the Town's junior water rights and without augmentation at times.

i. Diverting junior water rights at the wells will likely result in the need for additional sources of augmentation water on Cross Creek and the Eagle River.

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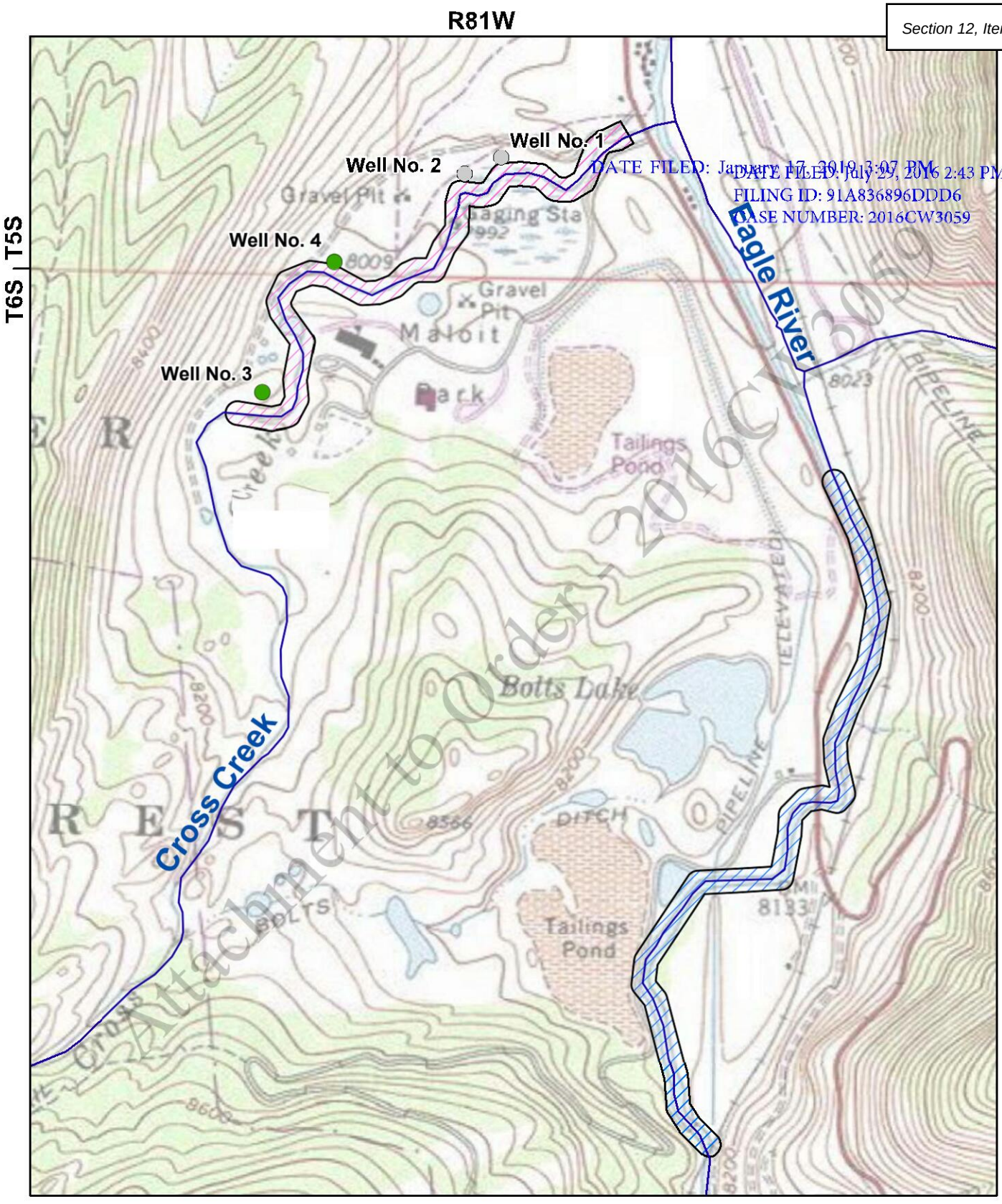

Job No.:	649.1
Date:	9-Jun-2010
Drawn:	JPB
Checked:	JTW

Town of Minturn
Diligence for
Case No. 05CW263

Minturn Wells and
Well Fields

Exhibit A

MARTIN AND WOOD
WATER CONSULTANTS, INC.
602 Park Point Drive
Suite 275
Golden, CO 80401
(303) 526-2600
www.martinandwood.com

MEMO

TO: Michelle Metteer, Manager

DATE: February 1, 2024

FROM: James Mann, Financial Analyst

RE: Membrane Water Treatment Plant – Rate Impact Estimate

As requested, I have reviewed the HDR report dated August 1, 2023, related to water treatment plant upgrade options. In looking at the options for a Membrane Treatment Plant, the HDR report provided a range of costs from $9.8MM to $14.9MM, with a midpoint of $12.35MM. The below analysis attempts to break down the impact of the above plant costs on the water user rates of the town.

In evaluating the impact of the proposed treatment plant replacement, the following assumptions were used:

- Current rates based on the Adopted 2024 Fee Schedule
- Test Year usage and SFEs based on 2023 January through December actual usage as reported by the Town
- Projected Growth:
  - Minturn North – 54 Single Family Units
  - Malloit Park – 120 Single Family Units
- 30-Year Leveraged Loan borrowing through the Colorado Water Resources and Power Development Authority (CWRPDA)
- Issuance costs for the CWRPDA Leverage conservatively estimated at $25.00/$1,000 of borrowing
- Interest Rate of 3.50%
- $3.0MM of Congressionally Directed Spending to offset cost of new plant
- Development of an annual water main replacement program
- Target Water Utility Reserves equal to six months of operations plus the trailing year's debt service

As noted in the first paragraph, the HDR report identified a high and low estimate for development of a membrane water treatment plant. In evaluating the impacts, a mid-point cost figure was developed as well. In addition, the high-cost membrane plant estimate did not include design and engineering fees, which were estimated at $2.0MM. For the mid and low-cost estimates, the design and engineering fees were simply proportionately reduced.

On the next page is a summary of borrowing sizing:

		2025 High	2025 Mid	2025 Low
CIP Projects				
WTP		14,900,000	12,350,000	9,800,000
WTP Design/Engineering/CM		2,000,000	1,657,718	1,315,436
Other Projects		120,085	120,085	120,085
Less Other Sources				
Grants/Aids		(3,000,000)	(3,000,000)	(3,000,000)
Special Assessments		0	0	0
Equipment Replacement Fund		0	0	0
Cash		(120,085)	(120,085)	(120,085)
Net to be borrowed		**13,900,000**	**11,007,718**	**8,115,436**
Issuance Expenses per $1,000/debt issued	$ 25.00	356,500	282,250	208,125
Total Financed		14,256,500	11,289,968	8,323,561
Rounding		3,500	32	1,439
Net Bond Size		**14,260,000**	**11,290,000**	**8,325,000**

The above does not take into consideration any funds currently on hand, or funds anticipated to be on hand through development occurring in the Town. As an example, the Minturn North development of 54 single family equivalents (SFEs) will generate approximately $700,000 in tap fees and an estimate of $1,175,000 in System Improvement Fees. If those fees are paid prior to the issuance of debt, then the Town could apply those fees towards offsetting the gross borrowing. Similarly, the Malloit Park development of 120 new SFEs will generate approximately $2.6MM of system improvement fees, however it is unknown whether any tap fees will be generated from the development.

Not taking into consideration any fee offset for the borrowing, the debt service on the new borrowing would range from a low of $450,000 to a high of $775,000. When added to the existing debt that the Town has outstanding for the Water Utility, the annual payment maximum for the high-cost estimate would be approximately $980,000.

As you may recall, when issuing revenue backed debt (fee revenue generated by the utility used to pay the debt) you will covenant to ensure that after you operate the utility, that the funds left over to make the debt payment will be a minimum of 1.10x the actual debt payment. In developing the rate methodology, I used a 1.20x minimum factor to provide greater financial flexibility. Based on the above, the Town's Debt Fee would need to generate $1,176,000 annually.

Based on the current 756.5 SFEs, the monthly debt fee would need to increase at least $69.53/month on the low-end, to $112.19/month on the high-end, bringing the monthly utility debt fee to between $86.90 and $129.56. As the number of SFEs increase, the monthly debt fee would decrease as the amount of annual debt does not change.

The current base fee and volumetric fees that are in place are not anticipated to increase beyond two to three percent per year going forward. Given all the above, the utility would meet the recommended reserve requirement in 2029 and would maintain a debt service coverage ratio above 1.20x for the 10-year planning window.

Attachments
Table 1 – Operating Cash Flow (High-Cost Option)
Table 2 – Capital Improvement Plan (High-Cost Option)
Table 3 – Debt Sizing (High, Mid and Low-Cost Options)
Table 4 – Debt Amortization Schedule (Includes High-Cost Option Debt Service)

Table 1
Town of Minturn
Water Utility Operations Cash Flow Analysis 2024

Water Charges - User Fee Increase						3.00%	2.00%	2.00%	2.00%	2.00%	2.00%	2.00%	2.00%	2.00%	2.00%	
Water Charges - Debt Fee Increase						645.86%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	
Water Charges - Volumetric Increase						3.00%	2.00%	2.00%	2.00%	2.00%	2.00%	2.00%	2.00%	2.00%	2.00%	
Other Revenue Increase						2.00%	2.00%	2.00%	2.00%	2.00%	2.00%	2.00%	2.00%	2.00%	2.00%	
Expenditure Increase						3.00%	3.00%	3.00%	3.00%	3.00%	3.00%	3.00%	3.00%	3.00%	3.00%	

		Audited			Year End	Current	Projected									
		2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034
1	Operating Revenues															
2	Water Charges - User Fees	916,491	984,318	968,607	1,220,000	1,060,038	1,091,839	1,113,676	1,135,950	1,158,668	1,181,842	1,205,479	1,229,588	1,254,180	1,279,264	1,304,849
3	Water Charges - Debt Fees	65,921	67,146	65,724	205,111	157,685	1,176,106	1,176,106	1,176,106	1,176,106	1,176,106	1,176,106	1,176,106	1,176,106	1,176,106	1,176,106
4	Water Charges - Volumetric					348,669	356,093	363,215	370,480	377,889	385,447	393,156	401,019	409,039	417,220	425,565
5	New Growth Revenue (not indexed)						33,840	135,360	216,576	284,256	351,937	419,617	487,297	554,977	588,817	588,817
6	Water Tap Fees	4,855	66,495	141,538	127,500	685,000										
7	Other	13,827	9,989	28,528	19,000	19,000	19,380	19,768	20,163	20,566	20,978	21,397	21,825	22,262	22,707	23,161
8																
9	Total Operating Revenues	1,001,094	1,127,948	1,204,397	1,571,611	2,270,392	2,677,258	2,808,125	2,919,274	3,017,486	3,116,309	3,215,754	3,315,835	3,416,563	3,484,113	3,518,497
10																
11	Operating Expenses															
12	Operations and Maintenance	909,645	1,239,504	1,106,985	1,278,718	1,055,408	1,087,070	1,136,955	1,224,284	1,326,857	1,422,625	1,522,411	1,626,382	1,734,710	1,847,573	1,934,078
13	Added Costs due to Growth					0	16,769	51,671	63,926	54,332	55,444	56,600	57,802	59,050	30,173	0
14	New Plant Operational Costs						0	150,000	154,500	159,135	163,909	168,826	173,891	179,108	184,481	190,016
15	Augmentation Costs (70 AF)				105,000	105,000	108,150	111,395	114,736	118,178	121,724	125,375	129,137	133,011	137,001	141,111
16	O&M Capital Items															
17	Depreciation	104,516	101,495	106,993	108,200	108,200	108,200	671,533	671,533	671,533	671,533	671,533	671,533	671,533	671,533	671,533
18																
19	Total Operating Expenses	1,014,161	1,340,999	1,213,978	1,491,918	1,268,608	1,320,190	2,121,554	2,228,980	2,330,036	2,435,235	2,544,747	2,658,745	2,777,412	2,870,761	2,936,738
20																
21	Net Operations	(13,067)	(213,051)	(9,581)	79,693	1,001,784	1,357,069	686,571	690,294	687,450	681,073	671,007	657,089	639,151	613,352	581,759
22																
23	Non-Operating Revenues/(Expenses)															
24	Interest Income 2.00%						18,262	29,476	30,014	34,750	38,559	41,393	44,012	46,319	48,226	49,643
25	Interest Expense - Existing Debt	(8,266)	(8,024)	(7,685)	(6,994)	(6,625)	(6,237)	(5,830)	(5,403)	(4,956)	(4,486)	(3,992)	(3,475)	(2,932)	(2,362)	(1,764)
26	Interest Expense - New Debt				(5,625)	(66,584)	(562,885)	(550,355)	(537,422)	(524,072)	(510,292)	(496,067)	(481,384)	(466,226)	(450,578)	(434,424)
27	Debt Cost of Issuance						(356,500)									
28																
29	Net Increase/(Decrease) in Resources	(21,333)	(221,075)	(17,266)	67,074	928,575	449,708	159,862	177,482	193,172	204,854	212,340	216,243	216,312	208,638	195,214
30																
31	CIP Funding															
32	Purchase of Capital Assets - Water			(2,701,312)	0	(344,500)	(17,020,085)	(170,688)	(221,308)	(271,947)	(280,106)	(288,509)	(297,164)	(306,079)	(315,262)	(324,719)
33	Capital Contributions		143,898	263,222	0	0	3,000,000	0	0	0	0	0	0	0	0	0
34	Principal Payments on Existing Debt	(6,575)	(6,816)	(7,156)	(7,487)	(7,856)	(8,244)	(8,650)	(9,077)	(9,525)	(9,995)	(10,488)	(11,006)	(11,549)	(12,119)	(12,717)
35	Future Debt Principal				(9,967)	(123,688)	(402,722)	(415,252)	(428,186)	(441,535)	(455,315)	(469,540)	(484,223)	(499,381)	(515,029)	(531,183)
36	Bonds Issued			1,807,188	0	0	13,900,000	0	0	0	0	0	0	0	0	0
37	Advance from (to) other funds															
38	Principal Payments on Advance from other funds															
39																
40	Beginning Cash		1,286,101	1,303,603	755,272	913,092	1,473,824	1,500,681	1,737,486	1,927,931	2,069,628	2,200,599	2,315,935	2,411,318	2,482,153	2,519,915
41	Add Net Operations		(213,051)	(9,581)	79,693	1,001,784	1,357,069	686,571	690,294	687,450	681,073	671,007	657,089	639,151	613,352	581,759
42	Add Non-Operating		(8,024)	(7,685)	(12,619)	(73,209)	(907,360)	(526,709)	(512,812)	(494,278)	(476,219)	(458,667)	(440,847)	(422,839)	(404,714)	(386,545)
43	Add Depreciation		101,495	106,993	108,200	108,200	108,200	671,533	671,533	671,533	671,533	671,533	671,533	671,533	671,533	671,533
44	Add CIP Funding		137,082	(638,058)	(17,453)	(476,044)	(531,051)	(594,590)	(658,571)	(723,008)	(745,416)	(768,537)	(792,394)	(817,010)	(842,410)	(868,620)
45	Net Change in Balance Sheet Items		0	0	0	0	0	0	0	0	0	0	0	0	0	0
46																
47	Ending Cash	1,286,101	1,303,603	755,272	913,092	1,473,824	1,500,681	1,737,486	1,927,931	2,069,628	2,200,599	2,315,935	2,411,318	2,482,153	2,519,915	2,518,043
48																
49	Target Reserves (6 months operating plus trailing year debt service)				950,712	1,614,392	1,640,183	2,040,865	2,094,578	2,145,106	2,197,706	2,252,461	2,309,461	2,368,794	2,415,469	2,448,457
50	Pass/Fail				Fail	Fail	Fail	Fail	Fail	Fail	Pass	Pass	Pass	Pass	Pass	Pass
51																
52	Annual Debt Payment	14,841	14,840	14,841	30,073	204,753	980,088	980,088	980,088	980,088	980,088	980,088	980,088	980,088	980,088	980,088
53	Net Operations	(13,067)	(213,051)	(9,581)	79,693	1,001,784	1,357,069	686,571	690,294	687,450	681,073	671,007	657,089	639,151	613,352	581,759
54	Depreciation	104,516	101,495	106,993	108,200	108,200	108,200	671,533	671,533	671,533	671,533	671,533	671,533	671,533	671,533	671,533
55	Net Available for Debt Service	91,449	(111,556)	97,412	187,893	1,109,984	1,465,269	1,358,105	1,361,827	1,358,983	1,352,607	1,342,541	1,328,623	1,310,685	1,284,885	1,253,292
56	Coverage (min 1.20x Target)	6.16	(7.52)	6.56	6.25	5.42	1.50	1.39	1.39	1.39	1.38	1.37	1.36	1.34	1.31	1.28

Table 2
Town of Minturn
Capital Improvement Plan 2024

Year	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034
Project											
Water Treatment Plant	75,000	16,900,000	0	0	0	0	0	0	0	0	0
Water Treatement Plant Analysis	250,000	0	0	0	0	0	0	0	0	0	0
Water Storage	0	0	0	0	0	0	0	0	0	0	0
Water Main Replacement	0	100,000	150,000	200,000	250,000	257,500	265,225	273,182	281,377	289,819	298,513
Misc. Water Fund	19,500	20,085	20,688	21,308	21,947	22,606	23,284	23,983	24,702	25,443	26,206
Total Project Cost	344,500	17,020,085	170,688	221,308	271,947	280,106	288,509	297,164	306,079	315,262	324,719
Sources of Funding											
Debt	0	13,900,000	0	0	0	0	0	0	0	0	0
Grants/Aids	0	3,000,000	0	0	0	0	0	0	0	0	0
Special Assessments	0	0	0	0	0	0	0	0	0	0	0
Equipment Replacement Fund	0	0	0	0	0	0	0	0	0	0	0
Cash	344,500	120,085	170,688	221,308	271,947	280,106	288,509	297,164	306,079	315,262	324,719
Total Sources	344,500	17,020,085	170,688	221,308	271,947	280,106	288,509	297,164	306,079	315,262	324,719

Table 3
Town of Minturn
Debt Sizing 2024

			2025 High	2025 Mid	2025 Low
CIP Projects					
WTP			14,900,000	12,350,000	9,800,000
WTP Design/Engineering/CM			2,000,000	1,657,718	1,315,436
Other Projects			120,085	120,085	120,085
Less Other Sources					
Grants/Aids			(3,000,000)	(3,000,000)	(3,000,000)
Tap/SIF Funds			0	0	0
Equipment Replacement Fund			0	0	0
Cash			(120,085)	(120,085)	(120,085)
Net to be borrowed			**13,900,000**	**11,007,718**	**8,115,436**
Issuance Expenses per $1,000/debt issued	$	25.00	356,500	282,250	208,125
Total Financed			14,256,500	11,289,968	8,323,561
Rounding			3,500	32	1,439
Net Bond Size			**14,260,000**	**11,290,000**	**8,325,000**

Table 4
Town of Minturn
Debt Amortization Schedule 2024

NAME	Water Rev Bonds (40-yr) Series 1997 (Rural Development)				Water Rev Bonds (30-yr) Series 2021				Water Rev Bonds (30-yr) Series 2025			
AMT									$14,260,000			
DATED					10/1/22							
MATURE	4/1 & 10/1				5/1 & 11/1				5/1 & 11/1			
RATE	4.875%				2.25%				3.50%			
Year	Principal	Est. Rate	Interest	Total	Principal	Est. Rate	Interest	Total	Principal	Est. Rate	Interest	Total
2023	7,487	4.875%	6,994	14,481	9,967	2.25%	5,625	15,592				
2024	7,856	4.875%	6,625	14,481	123,688	2.25%	66,584	190,272				
2025	8,244	4.875%	6,237	14,481	126,487	2.25%	63,785	190,272	276,235	3.50%	499,100	775,335
2026	8,650	4.875%	5,830	14,481	129,349	2.25%	60,923	190,272	285,903	3.50%	489,432	775,335
2027	9,077	4.875%	5,403	14,481	132,276	2.25%	57,997	190,272	295,910	3.50%	479,425	775,335
2028	9,525	4.875%	4,956	14,481	135,268	2.25%	55,004	190,272	306,267	3.50%	469,068	775,335
2029	9,995	4.875%	4,486	14,481	138,329	2.25%	51,943	190,272	316,986	3.50%	458,349	775,335
2030	10,488	4.875%	3,992	14,481	141,459	2.25%	48,813	190,272	328,081	3.50%	447,254	775,335
2031	11,006	4.875%	3,475	14,481	144,660	2.25%	45,612	190,272	339,564	3.50%	435,772	775,335
2032	11,549	4.875%	2,932	14,481	147,933	2.25%	42,339	190,272	351,448	3.50%	423,887	775,335
2033	12,119	4.875%	2,362	14,481	151,280	2.25%	38,992	190,272	363,749	3.50%	411,586	775,335
2034	12,717	4.875%	1,764	14,481	154,703	2.25%	35,569	190,272	376,480	3.50%	398,855	775,335
2035	13,345	4.875%	1,136	14,481	158,204	2.25%	32,069	190,272	389,657	3.50%	385,678	775,335
2036	14,003	4.875%	478	14,481	161,783	2.25%	28,489	190,272	403,295	3.50%	372,040	775,335
2037	6,642	4.875%	162	6,804	165,444	2.25%	24,828	190,272	417,410	3.50%	357,925	775,335
2038					169,187	2.25%	21,085	190,272	432,020	3.50%	343,315	775,335
2039					173,015	2.25%	17,257	190,272	447,140	3.50%	328,195	775,335
2040					176,930	2.25%	13,342	190,272	462,790	3.50%	312,545	775,335
2041					180,933	2.25%	9,339	190,272	478,988	3.50%	296,347	775,335
2042					185,027	2.25%	5,245	190,272	495,753	3.50%	279,583	775,335
2043					94,078	2.25%	1,058	95,136	513,104	3.50%	262,231	775,335
2044									531,063	3.50%	244,273	775,335
2045									549,650	3.50%	225,685	775,335
2046									568,887	3.50%	206,448	775,335
2047									588,799	3.50%	186,537	775,335
2048									609,406	3.50%	165,929	775,335
2049									630,736	3.50%	144,600	775,335
2050									652,811	3.50%	122,524	775,335
2051									675,660	3.50%	99,675	775,335
2052									699,308	3.50%	76,027	775,335
2053									723,784	3.50%	51,551	775,335
2054									749,116	3.50%	26,219	775,335
2055												
2056												
TOTALS	152,704		56,831	209,535	3,000,000		725,898	3,725,898	14,260,000		9,000,056	23,260,056

PROPOSED Water Utility Debt Service Summary				
Year	Total Prin	Total Int	Total P&I	Prin Outstanding
0				
0				
0				17,412,704
2023	17,453	12,619	30,073	17,395,250
2024	131,544	73,209	204,753	17,263,706
2025	410,966	569,122	980,088	16,852,740
2026	423,903	556,185	980,088	16,428,838
2027	437,263	542,825	980,088	15,991,575
2028	451,061	529,027	980,088	15,540,514
2029	465,311	514,777	980,088	15,075,203
2030	480,028	500,060	980,088	14,595,175
2031	495,229	484,859	980,088	14,099,946
2032	510,930	469,158	980,088	13,589,015
2033	527,148	452,940	980,088	13,061,867
2034	543,900	436,188	980,088	12,517,967
2035	561,205	418,883	980,088	11,956,762
2036	579,081	401,007	980,088	11,377,681
2037	589,496	382,915	972,411	10,788,185
2038	601,207	364,400	965,607	10,186,978
2039	620,156	345,452	965,607	9,566,822
2040	639,720	325,887	965,607	8,927,102
2041	659,921	305,686	965,607	8,267,181
2042	680,780	284,828	965,607	7,586,401
2043	607,182	263,290	870,471	6,979,219
2044	531,063	244,273	775,335	6,448,157
2045	549,650	225,685	775,335	5,898,507
2046	568,887	206,448	775,335	5,329,620
2047	588,799	186,537	775,335	4,740,821
2048	609,406	165,929	775,335	4,131,415
2049	630,736	144,600	775,335	3,500,679
2050	652,811	122,524	775,335	2,847,868
2051	675,660	99,675	775,335	2,172,208
2052	699,308	76,027	775,335	1,472,900
2053	723,784	51,551	775,335	749,116
2054	749,116	26,219	775,335	0
2055	0	0	0	0
2056	0	0	0	0
	17,412,704	9,782,785	27,195,489	

Notes:
1) Rates estimated at 80% of Market Rates for Leveraged Loans

To: Mayor and Town Council
From: Michelle Metteer, Town Manager
Date: 2/7/2024
Agenda Item: Minturn Tank #2 Tank Rehabilitation & PRV Work

REQUEST:
Discuss the concept of installing a liner in water tank #2 (steel bolted tank) and installing a PRV vault in HWY 24.

INTRODUCTION:
Council originally sought the installation of two concrete tanks as part of the 2019 Water Capital Improvements Plan but with prices increasing, when bids came back, the town was only able to afford one tank. This proposed option may be a way to have two functioning tanks for the total cost of approximately $3M (the value of the tank loan) and stay within the original budget.

ANALYSIS:
With the possibility of taking tank #2 offline, there would be additional waterline work to ensure water service to neighboring properties. This waterline work would be to support the service of a few properties, but necessary to ensure water service. The rehabilitation of tank #2 allows for an upgrade in water storage to the entire town while also ensuring service to these properties thereby providing value to the private property owners and the overall community.

COMMUNITY INPUT: Requested

BUDGET / STAFF IMPACT: $750,00.00 out of the current water tank loan

STRATEGIC PLAN ALIGNMENT:
PRACTICE FAIR, TRANSPARENT AND COMMUNICATIVE LOCAL GOVERNMENT.
SUSTAIN AND INVEST IN THE THINGS THAT DEFINE MINTURN AS A PROUD, STURDY MOUNTAIN TOWN TO "KEEP MINTURN MINTURN"
ADVANCE DECISIONS/PROJECTS/INITIATIVES THAT EXPAND FUTURE OPPORTUNITY AND VIABILITY FOR MINTURN

RECOMMENDED ACTION OR PROPOSED MOTION:
Direct staff to investigate option and report back with further information.

ATTACHMENTS:

- None

Town of Minturn
301 Boulder St #309
Minturn, CO 81645
970-827-5645
council@minturn.org
www.minturn.org

FUTURE MEETING AGENDA ITEMS

Below reflects proposed topics to be scheduled at future Town Council meetings and is informational only. Dates and topics are subject to change.

February 21, 2024

- Ord__ - Series 2024 (Second Reading) An Ordinance Disconnecting the Parcels of Gilman, Rex Flats and Roster Pile 5 from the Town of Minturn
- Ord__ - Series 2024 (First Reading) An Ordinance Amending the Exemption Plat Process
- Ord__ - Series 2024 (First Reading) An Ordinance Rezoning the Battle North Property
- Ord__ - Series 2024 (First Reading) An Ordinance Amending Chapter 13 and Appendix C of the MMC to Exempt Battle North Water Service Requirements
- Ord__ - Series 2024 (First Reading) An Ordinance Amending MMC Sec. 16-21-710(b)(2) Addressing Development Agreements and Vested Rights
- Res __ - Series 2024 362 Taylor Avenue Conditional Use Permit for Duplex

March 6, 2024

- Ord__ - Series 2023 (Second Reading) An Ordinance Amending the Exemption Plat Process
- Ord__ - Series 2023 (Second Reading) An Ordinance Rezoning the Battle North Property
- Ord__ - Series 2023 (Second Reading) An Ordinance Amending Chapter 13 and Appendix C of the MMC to Exempt Battle North Water Service Requirements
- Ord__ - Series 2023 (Second Reading) An Ordinance Amending MMC Sec. 16-21-710(b)(2) Addressing Development Agreements and Vested Rights

March 20, 2024

- Res__ - Series 2024 Appointing Planning Commission Members

Dates to be Determined:

- Reassessment of the Minturn Single Family Equivalent (SFE) Definition
- Irrigation Tiered water rate structure
- Single Family Tiered Water Rate Structure