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TECHNICAL MEMORANDUM

Date: June 17, 2025
To: East Range Water Board
16 West 2nd Avenue N
Aurora, Minnesota 55705
From: Brian Guldán - Bolton & Menk, Inc.
Subject: Aurora Water Distribution System Model Summary
East Range Water Board
Project No.: 24X.135759

1. Overview

Bolton & Menk has developed a water model for the East Range Water Board to determine the feasibility for the Aurora tower to feed water to Giants Ridge in various scenarios. SEH did a study in 2024 to evaluate the potential for Biwabik to supply emergency water to Aurora and Town of White. A summary of the information from both studies is included below for the record of the Board.

2. Bolton & Menk Water Model Summary

Bolton & Menk developed a water model to evaluate various scenarios in which the Aurora tower could be used to feed water to the Giants Ridge water system. The results are summarized below for the existing system and the two scenarios developed.

A. Existing System

The first two figures titled, “Existing Average Day – Pressure” and “Existing Maximum Day – Fire Flow” show the pressures under average day flows and available fire flows under maximum day flows throughout the Aurora, Biwabik, and Giants Ridge water systems. This information is based on the standpipe in Giants Ridge being ‘on’ and fed as normal from Biwabik.

B. Giants Ridge Without Standpipe

The next two figures titled, “Giants Ridge Without Standpipe Average Day – Pressure” and “Giants Ridge Without Standpipe Maximum Day – Fire Flow” show the system pressure and available fire flow in the system when the standpipe in Giants Ridge is turned off and the Aurora tower is used to feed the Giants Ridge system by gravity.

(a) System Pressure

The pressure map shows that under this scenario; there is one area that experiences the lower end of recommended water pressure (30psi). This is due to the area being a high point in the system and is located just north of the interconnect at Lake Mine

Road along Voyageurs Trail. In the past when the system was fed this way, there were no complaints of low water pressure by the residents in that area and the system functioned properly under average day conditions.

(b) System Fire Flow

The map of fire flow shows lower than recommended fire flows available in Giants Ridge, specifically around the main recreation area. This is the darker brown color on the map which indicates fire flows are between 500 and 1,000 gpm. Required fire flow for residential areas is at least 1,000 gpm. The reason that fire flows are limited to between 500 and 1,000 gpm in this area is because higher fire flow rates will result in low pressures in other parts of the system, specifically at the high point just north of the interconnect. To maintain all system pressures to at least 20 psi, the model limits the fire flow available in the system.

Although the model limits the fire flow, the actual operation of the system would function quite differently than the model. If a hydrant was opened in the Giants Ridge system, the hydrant would flow at the maximum rate that could be supplied. This would result in pressures elsewhere in the system dropping below 20 psi. When system pressures drop below 20 psi, the Minnesota Department of Health would need to be contacted and it could result in a boil water notice. In the worst-case scenario, opening a hydrant could create a negative pressure (vacuum) at the high point in the system which could cause the watermain to collapse. Neither one of these scenarios is acceptable and therefore fire hydrants should not be used while the standpipe is out of service.

If the system needs to operate with the standpipe out of service, provisions should be made to ensure that no hydrants are opened and there is a secondary water source for fire fighting needs.

C. Giants Ridge with Standpipe & Aurora Tower

The standpipe in Giants Ridge and the water tower in Aurora cannot be used simultaneously to feed the system because the Aurora tower is at a higher elevation than the standpipe and would cause the standpipe to overflow.

3. SEH Model Memorandum Summary

The SEH Memorandum dated November 14, 2024, was written for the city of Biwabik to establish feasible water delivery flow rates between the water systems of Aurora/TOW and Biwabik to identify any bottlenecks or restrictions that would cause issues if Biwabik were providing emergency water supply for Aurora/TOW. The baseline established for the demand to TOW and Aurora is average day flow of 250,000 gallons at a rate of 175 gpm and a fire flow rate of 500 gpm for 3 hours on a once-per-day fire event. The emergency interconnect between the Aurora/TOW and Biwabik water systems is located at the intersection of Voyagers Trail and Lake Mine Road. The valve can be opened to allow the Aurora tower to feed Biwabik's system by gravity, or to pump water from Biwabik's Voyagers Booster Station to Aurora/TOW. The conclusions of the SEH study are summarized as follows.

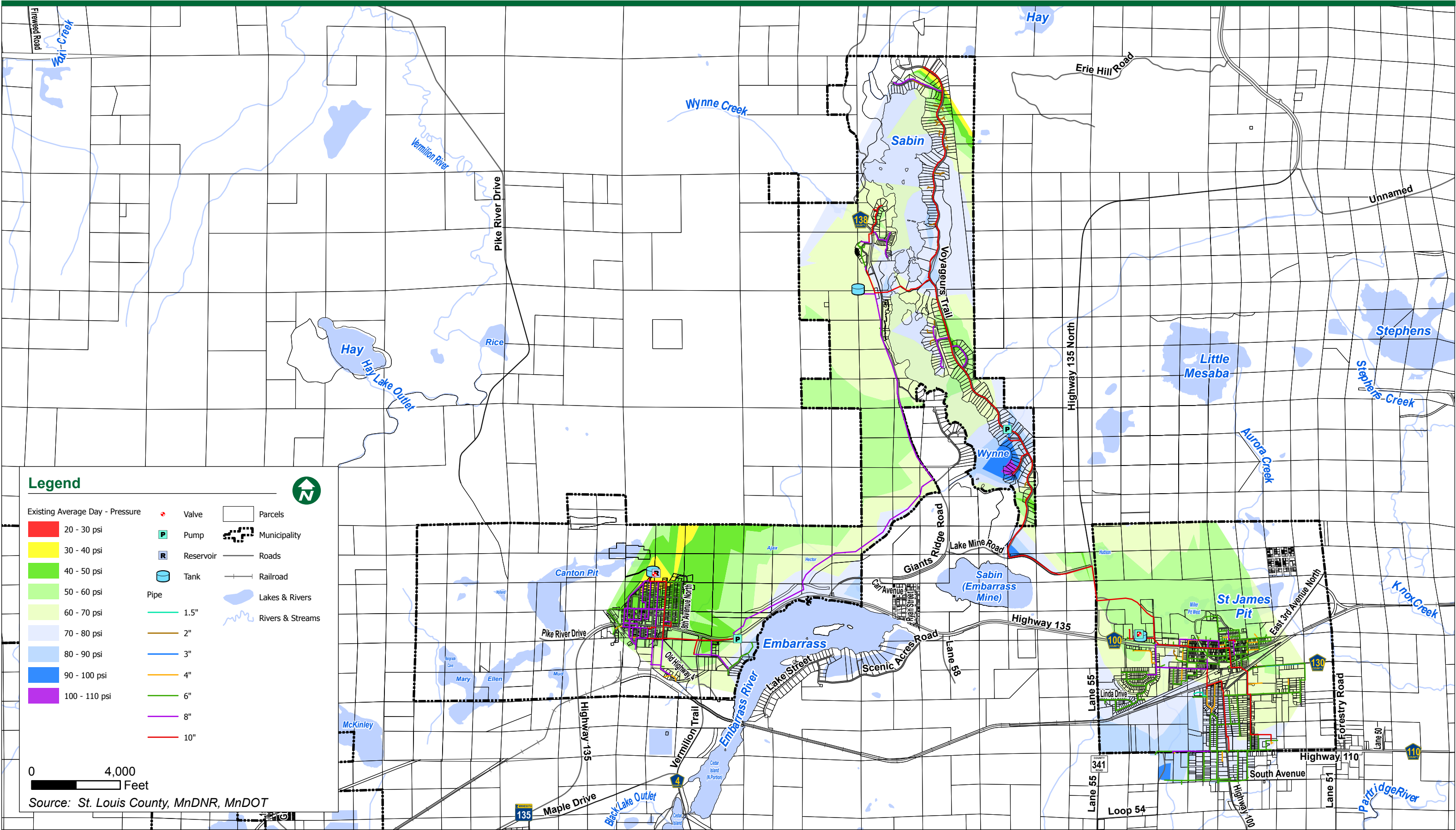
- The Biwabik water treatment facility could provide a constant emergency flow rate of 175 gpm (250,000 gpd) to the Aurora/TOW water system by pumping from the Voyagers Booster Station to the Aurora tower.
- Pumping at the normal operational rate of 300gpm and to sustain the average day demand supply of 250,000 gpd to Aurora/TOW, water would need to be pumped from the Biwabik WTP 24 hours a day with a 4-hour window for backwash and maintenance every 3 days.
- The Beach/Campground Booster Station and Voyagers Booster Station would be critical components that would also need to maintain reliable operation to deliver water from the Biwabik WTP to the Aurora/TOW system.

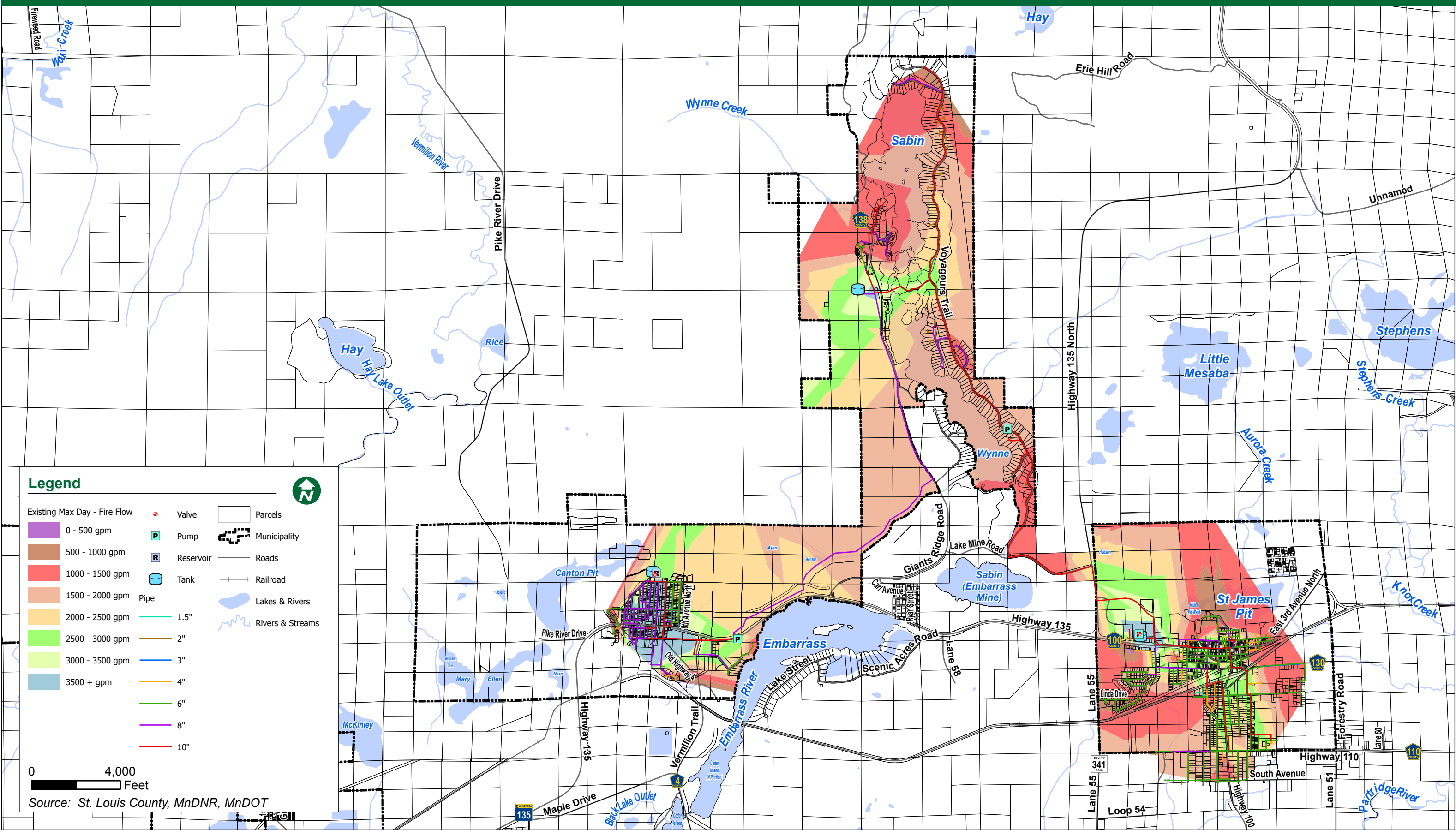
4. Conclusions

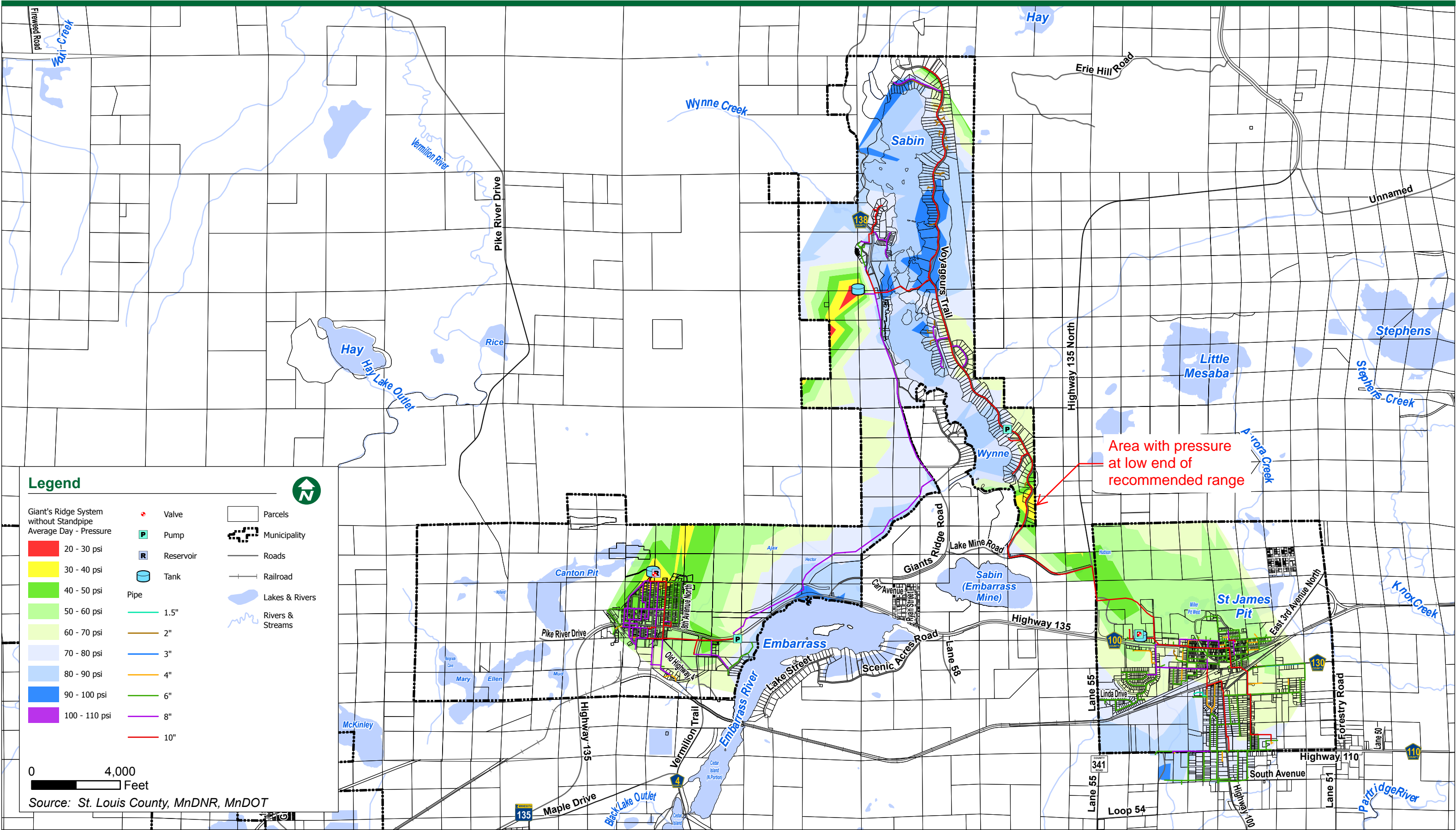
Combined findings of the Bolton & Menk Water Model for the Aurora/TOW system show that the Aurora tower is capable of feeding water to the Giants Ridge system, but the standpipe must be turned off. Operating under this setup creates the potential for low water pressures upon opening a hydrant in the Giants Ridge system. Therefore, hydrants should not be used if the system is operating without the Giants Ridge standpipe. If it is desired to feed the Giants Ridge system from the Aurora system for long periods of time, a control valve station should be installed to open and close to fill the standpipe.

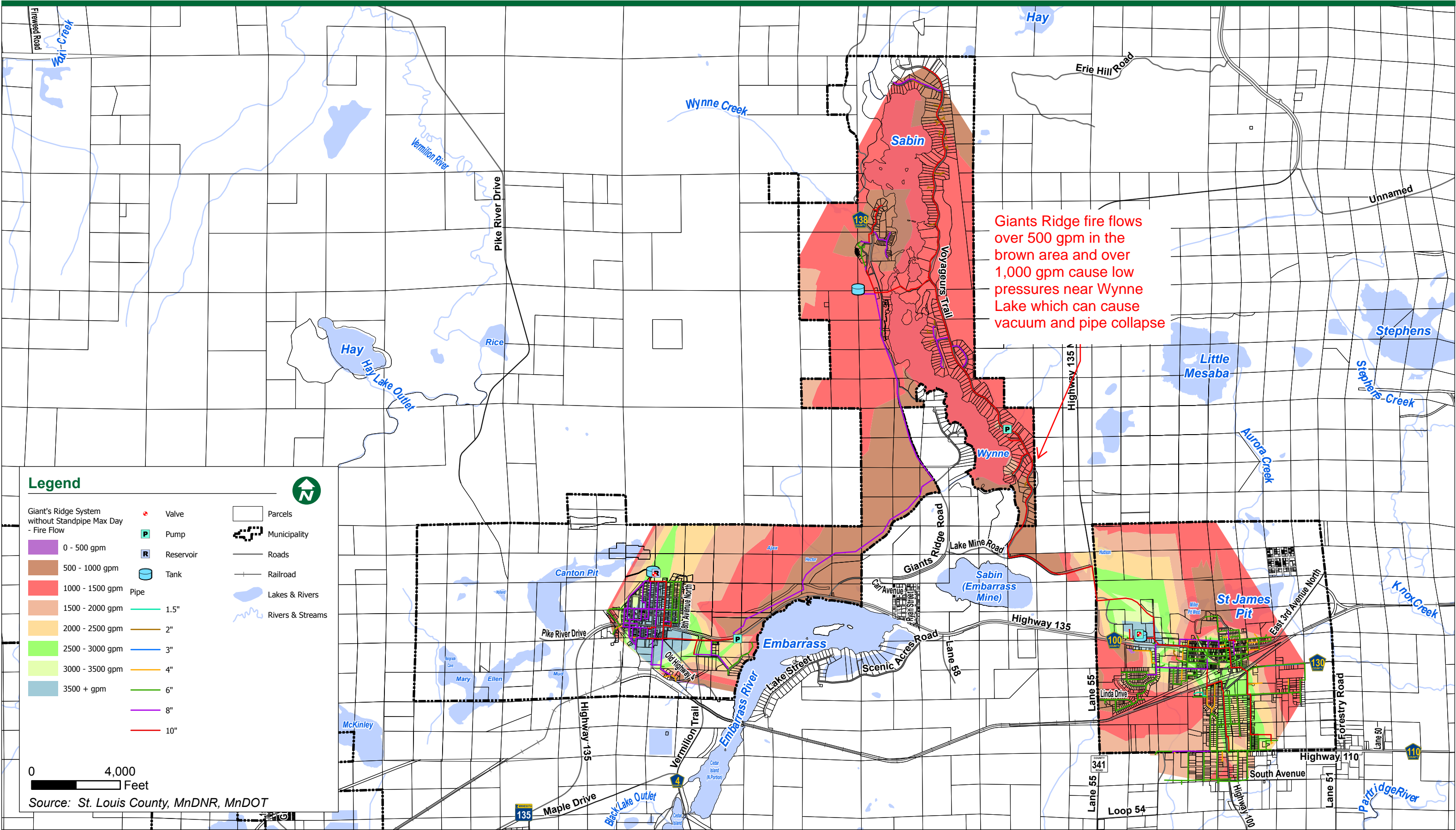
The SEH memorandum for Biwabik shows that the Biwabik water system is capable of supplying emergency water to the Aurora/TOW system at a rate of 250,000 gallons per day but requires 24 hour per day operation of the Biwabik Treatment Plant. Therefore, supply from Biwabik to the Aurora/TOW system could be used in an emergency situation but is not sustainable for long period of time. Furthermore, the Aurora/TOW system is currently being planned for expansion to include the City of Hoyt Lakes. This will increase the average day used to over 550,000 gallons. Once this expansion occurs, the Biwabik system will not be capable of supplying enough water for the demands. Therefore, it is not recommended to make significant capital investments to maintain the emergency supply from Biwabik to the Aurora/TOW/Hoyt Lakes system.

Enclosures: SEH Water Model Memorandum, 11-14-2024











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MEMORANDUM

TO: Biwabik Public Utilities Commission

FROM: Chad T. Katzenberger, PE (Lic.CO, MN, SD, WI)

DATE: November 14, 2024

RE: Emergency Operation Testing & Model Simulation - Water Supply to Town of White/City of
Aurora from Biwabik
SEH No. BIWAB 159723 14.00

The purpose of this memorandum is to summarize recent activities related to water system field testing for a potential water supply interconnect between the City of Biwabik and the Town of White/City of Aurora (TOW/COA) for the purpose of emergency water supply. The primary goal of this effort is to establish feasible water delivery flow rates between the two water systems and determine if there are any potential bottlenecks and restrictions that would cause concerning issues with the operation.

BACKGROUND

Water Supply Capacities to be Delivered

Previous emergency agreement planning discussion has established the following baseline demands for the water systems.

- Biwabik must be able to provide the Town of White/Aurora water system with:
 - an average day flow of 250,000 gallons at a rate of **175 gpm**, and
 - a fire flow rate of 500 gpm for 3 hours on a once-per-day fire event.
- Town of White/Aurora must be able to provide the Biwabik water system with:
 - an average day flow of 150,000 gallons at a rate of **105 gpm**, and
 - a fire flow rate of 500 gpm for 3 hours on a once-per-day fire event.

Town of White/Aurora Water System

The TOW/COA water system serves customers in the Town of White and the City of Aurora. It operates as a single pressure zone, with the hydraulic grade maintained at 1,630 feet by a 500,000-gallon water tower.

Biwabik Water System

The Biwabik water system serves the City of Biwabik and operates across three pressure zones: the Main Zone, the Giants Ridge Zone, and the Voyagers Booster Zone. The Main Zone's hydraulic grade is maintained at +/-1,580 feet by a 750,000-gallon ground storage reservoir (GSR) at the Biwabik water treatment plant (WTP), which has a normal operational capacity of 300 gpm. The max operational capacity of the WTP is 400 gpm. The WTP operates to maintain water levels in the GSR, with the WTP turning on when tank levels drop to 69' and off when they reach 75'. The Giants Ridge Zone is supplied from the Main Zone via combination gravity and pumped flow through the Campground (Beach) Booster Station. This facility maintains water levels in the 300,000-gallon GSR at Giants Ridge. The on/off flow

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control valve (Responsible for gravity flow) in the booster station maintains tank levels in the tank between 22' and 25'. One of the 10 HP booster pumps is programmed to operate if the tank level drops to 18' with the pump turning off at 21'. Further out in the system, the Voyagers Booster Zone is fed from the Giants Ridge Zone, with pressure maintained at 1,630 feet by booster pumps at the Voyagers Booster Station. The Voyagers booster station contains two small 50 gpm pumps that sustain normal operational pressures and a third larger pump rated for 550 gpm that can be activated to provide larger flows, such as for fire protection. This pump has been identified as an important element to deliver water from the Biwabik – Giants Ridge Tank to the TOW/COA water system.

Emergency Interconnect

An emergency interconnection exists between the TOW/COA and Biwabik water systems at the intersection of Voyagers Trail and Lake Mine Road. Normally, a valve isolates the two systems. In an emergency affecting the Biwabik system, this valve can be opened to allow the TOW/COA system to feed the Biwabik system by gravity. Conversely, if the TOW/COA system faces an emergency, the valve can be opened, but the Voyagers Booster Station would be required to pump water into the TOW/COA system.

This interconnection has not yet been used to supply water from the Biwabik system to the TOW/COA system. The efforts summarized in this memo are intended to take the next step to verify that the TOW/COA system can be adequately served in an emergency from the Biwabik water system.

Biwabik to TOW/COA Sequence of Water Delivery & Operational Capacities

Raw Water Supply.....	300 – 400 gpm (300 gpm normal)
Water Treatment Plant	
Normal Operational Rate.....	300 gpm
Max Operational Rate.....	400 gpm
Main Biwabik Storage Tank.....	750,000 Gallons, Overflow = 1580'
WTP On – Level.....	69'
WTP Off – Level.....	75'
Campground/Beach Booster Station	
Varied Gravity Flow Fill / (Valve on/off).....	0-100 gpm
*Booster Pump (2 @ 10 HP each).....	1130-260 gpm
Giants Ridge Tank.....	300,000 Gallons, Overflow = 1580' +/-
Gravity Fill On Level.....	22'
Gravity Fill Off Level.....	25'
Booster Pump Fill On Level.....	18'
Booster Pump Fill Off Level.....	21'
Voyager's Booster Station	
Jockey Pumps 2 HP (2).....	50 gpm @ 70'
Large Duty Pump 30 HP (1).....	550 gpm @ 160'
Biwabik-TOW/COA Interconnect	
Close Gate Valve.....	Normally Closed

*Estimated flow capacity based on pump HP and field testing completed by GPM on February 8th, 2023.

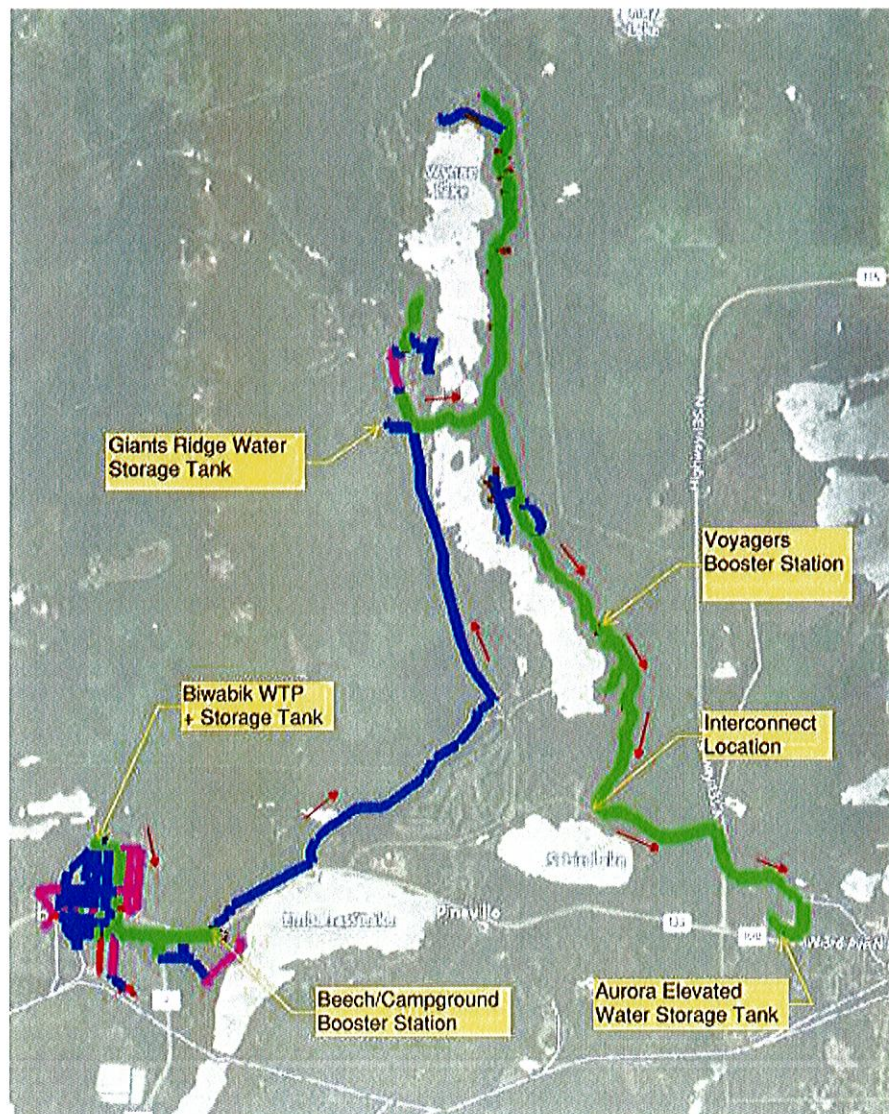
FIELD TESTING

Previously, a field-testing plan was developed and verified by the joint system hydraulic distribution system model to confirm the TOW/COA water system can be served by Biwabik. On October 22, 2024, representatives from SEH visited Biwabik and conducted a simulated water supply flow test. This involved opening a hydrant downstream of the City's Voyager booster station near the connection with the

TOW/COA water system. A single fire hydrant was adjusted to operate at a flow rate of 250 gallons per minute for 3 hours. Multiple hydrant locations were fitted with remote pressure monitors to analyze system pressure and fluctuating water storage tank levels. This data was compared with the existing water system hydraulic model, and the model was adjusted to reflect the field data. In addition, added pump performance information for the Campground/Beach booster station was included in the model based on pump testing completed by GPM Pump of Duluth. This provided for an estimate of maximum operational pump performance for the existing booster station pumps, which have limited information with respect to pump curve information and flow capacities.

HYDRAULIC WATER MODEL – INTERCONNECTION OPERATIONAL SIMULATION

Recent field-testing efforts provided for an opportunity to modify and verify the accuracy of the existing Biwabik water model with respect to the critical water supply, storage and distribution components within the water system. An effort to simulate the operation of a potential interconnect supply scenario was conducted within the water model, simulating the operation of system(s) for a period of 3 days.



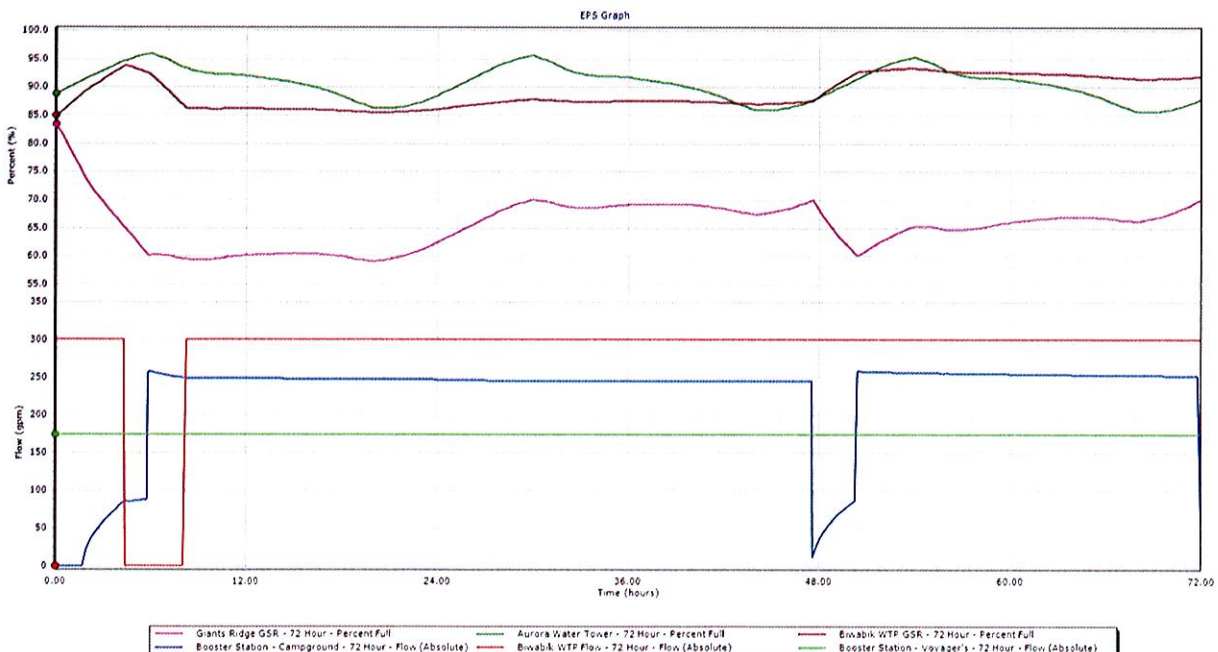
The demand levels identified in the preliminary emergency agreement for the two communities were assumed in the model (150,000 gpd demand in the Biwabik system and 250,000 gpd in the TOW/COA system). Demand in the Biwabik model was divided across the system, with an assumed point demand at Giants Ridge Resort to represent a larger use period for this area. Delivery of water to TOW/COA was represented in the model with an assumed 10-inch water main extended from the Interconnect location all the way to the Aurora Water Tower

Model Simulation Results

The Model indicates that the existing system may be capable of providing emergency flow at a constant rate of 175 gpm to the TOW/COA water system. The chart below shows simulated results from the 3-day water model operation – using existing Biwabik operational set points and the “normal” operational treatment rate of 300 gpm at the WTP. The results below show nearly constant operation of the Biwabik WTP, constant operation of the Voyagers booster station and nearly constant operation of the Beach/Campground booster station (to maintain water levels in the Giants Ridge Tank). Additional extended period simulations indicate that the WTP would be able to turn off for up to 4 hours every 3 days, which would provide time to complete maintenance and required filter backwashing. An alternative approach would be to operate the WTP for 22.5 hours per day to produce the required water, leaving 1.5 hours each day for maintenance and backwashing. The estimated demand allotments would require the systems to run without issue or near system capacity.

The City could potentially operate the WTP at a production rate of 400 gpm to reduce run times as needed – this would result in the WTP operating in the range of 16-18 hours per day during interconnect operations.

In summary, the existing water system appears to be capable of delivering emergency flow to the TOW/COA water system for an extended period. However, if current operational strategies were maintained (300 gpm), such operations would cause the water system to operate at or near capacity, leaving little margin for error. Confirming the ability to operate the WTP at full capacity of 400 gpm would be recommended.



SUMMARY AND CONCLUSIONS

- The Biwabik water system can potentially provide a constant emergency flow rate of 175 gpm to the TOW/COA water system.
- In order for Aurora/TOW to receive water from Biwabik, water would need to be pumped to lift the water to the Aurora water tower.
- The elevation difference between the Giants Ridge tank and Aurora Tank is 55' plus
- The maximum water delivery rate to the TOW/COA water system is limited by the Campground/Beach booster station
- In order to sustain average day demand supply, water would need to be pumped at a rate of 175 gpm for 24 hours
- The proposed emergency operation would require the Biwabik Water Treatment Plant (WTP) to operate on a nearly continuous basis, with a narrow window for backwash and maintenance. (Assuming current/normal operational rate of 300 gpm)
- The Voyagers Booster Station and Beach/Campground Booster Station are also critical components that would need to maintain reliable operation to deliver water to the TOW/COA water system.
- An increase in delivery capacity of water from Biwabik to TOW/COA would require pump upgrades at the Campground booster station.

RECOMMENDATIONS:

- Prepare an emergency response plan detailing the steps to activate the interconnection and manage water flow between the systems.
- Ensure all personnel are trained on the operation of the interconnection and emergency procedures.
- Water Treatment Plant
 - Pursue operational procedures to be able to operate WTP at a rate of 400 gpm +/-
 - Implement regular maintenance schedules for the WTP to ensure reliable operation during emergencies.
- Campground/Beach Booster Station
 - Conduct additional field tests to further validate the operational capacities of the booster pumps.
 - Adjust the on/off set points of the pumps to maintain a higher level of water in the Giants Ridge Tank (To match the on/off valve setpoints)
 - Consider adding backup power to maintain reliable operation.
- Voyagers Booster Station
 - Confirm automated operation of the pumps within the Booster station.
 - Consider adding control system capable of receiving an emergency operations signal to maintain water levels in the Aurora water tower.
 - Alternatively, develop operational ability to maintain a set downstream pressure, set to maintain desired water levels in the Aurora Water Tower.
 - Consider adding backup power to maintain reliable operation.

- Interconnect
 - Clearly mark interconnect valve location with appropriate markers for ease of access and operation.
 - Consider adding an access manhole at interconnect to include a check valve for backflow prevention and a water meter in addition to plumbing to flow from TOW/COA to Biwabik.

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