PROJECT PLAN AND ENGINEERING REPORT

WATER SYSTEM IMPROVEMENTS
FOR THE
EAGLE RIVER WATER SYSTEM
HOUGHTON TOWNSHIP
KEWEENAW COUNTY, MICHIGAN

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INTRODUCTION AND RECOMMENDATIONS

The majority of the Eagle River water distribution system consists of 1 inch through 4 inch galvanized steel water main. The original water system was funded by the Federal Government through WPA in the 1930s and uses a ground water source that is accessed by a 350 feet long tunnel in rock extending under Lake Superior. The original water distribution system was installed by hand in the 1930s and is typically about 5 feet deep except for the river crossings and in areas of shallow bedrock. The distribution system contains several dead ends and areas that are susceptible to freeze damage. All water customers on the Eagle River system are metered.

The Michigan Department of Environment, Great Lake and Energy (MDEGLE) has requested that the Township address three issues as part of the proposed water improvement project. The first issue is excessive pressure loss due to old, small diameter and dead-end water mains in the distribution system. This will be resolved by installing a looped system with a larger diameter water main. The second issue is insufficient valves to minimize interruptions of service and minimize sanitary hazards during repairs. The proposed water distribution system will have enough valves to isolate the system one block at a time. The third issue is insufficient storage tank capacity. The proposed ground level storage reservoir will address this issue.

The Township's highest priority capital need is to totally upgrade the obsolete drinking water system by replacing the galvanized water main and the construction of a storage reservoir. The storage reservoir is a critical part of the Township's Contingency Plan in the event of a source failure. (From the Houghton Township Contingency Plan, 2023-2033)

The recommended project consists of the construction of 14,315 feet of new 8" and 6" water main to replace the existing 4 inch and smaller pipes on the distribution system and the construction of a two cell 100,000 gallon reinforced concrete partially buried ground level reservoir adjacent to the existing water source. Existing galvanized service lines, between the water main and property line, will be replaced as part of the project. The construction of the 100,000 gallon reservoir and new 6" and 8" diameter water main will allow the Township to provide an increased level of reliability and the ability to meet short term peak demands.

For over 80 years the water system has been operating adequately but now needs to be replaced. There is no way the town can pay for a replacement system by itself. If any small town should have a compelling need for grant dollars to replace an outdate water system, it is Eagle River. There really is no alternative to a replacement system paid for by federal and state funding. The lots in Eagle River all have septic systems and are too small to accommodate a well. There is no way the town can pay for a replacement system by itself.

SECTION I GENERAL DESCRIPTON

The Eagle River Water System serves the Community of Eagle River, the county seat for Keweenaw County. Douglass Houghton perished near here in 1845. The water system serves 61 residential customers and four other customers (65 customers total). The other customers are one commercial user, the County Court House, Sherriff's Department and the renowned Keweenaw County Jail, Houghton Township and the Gitche Gumee Bible Camp. The Gitche Gumee Bible Camp is the largest customer on the Eagle River system. The Bible Camp is in operation the months of May through October. Twelve of the residential customers are year-round customers. Fitzgerald's Inn and Restaurant, a 6 room motel and restaurant, the single commercial customer, is open year-round. A customer list is provided in Table 1.

The source is located in Allouez Township, north of Five Mile Point Road on the westerly limits of the Community of Eagle River. The existing water supply source consists of a 48 feet deep 5' by 5' vertical shaft excavated in bedrock. Connected to the vertical shaft is a 6' high by 4' wide horizontal tunnel extending north from the shaft for 350 feet. The end of the tunnel is under Lake Superior. Water is provided by two submersible pumps that hang in the shaft. The pumps are Goulds 95L07, 7.5 Hp, 230 V pumps rated at 100 gpm at 200 Ft, Total Dynamic Head (TDH). The pumps were installed in 2015.

The existing water distribution system consists of five WX-350 hydropneumatic bladder tanks, about 1,620 feet of 4 inch water main, 6,750 feet of 3 inch water main, 410 feet of 2 inch water main, 930 feet of 1-1/2 inch water main and approximately 740 feet of 1 inch water main. With the exception of 520 feet 1-1/2 inch plastic pipe and 400 feet of ductile iron pipe, all distribution system pipes are galvanized steel pipe. Total length of water main is about 10,450 feet. See Figure 3 in Appendix A for a map of the system. The existing water main is listed in Table 2.

SECTION II PROJECT PLANNING AREA

A. LOCATION

The existing service area and the future service area for the current project include portions of Section 18 and 19 in T58N, R31W and portions of Sections 24 in T58N, R32W. The existing and future service areas are shown on Figure 1 in Appendix A. The existing and future service areas are essentially the same because the proposed project will be replacing the existing small diameter water main. The only areas where new water main will be installed are pipes needed to complete loops.

The service area is not expected to expand significantly in the next 25 years in either area or in population. The service area is essentially residential in nature. No major commercial, industrial development or residential development is expected in the future. It is expected that there will be no significant residential growth in the service area for the next 25 years. Available land and source capacity will restrict large scale development. Significant expansion of the service area is not likely unless water source capacity is increased.

Existing source capacity that must be reserved for future demands by unoccupied housing, vacant property along existing water mains and by Government and existing commercial users, will restrict expansion of the service area. The lack of a sanitary sewer system coupled with the land area and suitable soils for on-site sewage development produce additional obstacles for expansion of the service area.

B. ENVIRONMENTAL RESOURCES PRESENT

The undeveloped property in the Eagle River Water System Service Area is mostly vacant land suitable for residential use. There are no known prime, unique or otherwise highly productive farmlands in the project area. The service area is essentially the Eagle River town site. One private individual owns virtually all the land surrounding Eagle River south and east of Highway M-26.

The topography in the service area varies. It is low slope in most of the developed town site of Eagle River. Moderate to steep slopes are encountered as you travel south from the Eagle River town site. Steep slopes occur along the banks of the river. The surrounding is forested land. Forest areas are comprised of mixed forest including maple, aspen, birch, hemlock, cedar, fir, spruce and pine.

Eagle River soils are a mixture of Arcadian-Nippising, Montreal-Paavola-Waiska Complex and Deer Park Sand soil classifications. These soils are mostly glacial moraines but areas near the shore and on the west side of the river are beach sand deposits. Bedrock is shallow in much of the service area. Rock outcrops are plentiful along partially buried bedrock ridges in the southern sections of the town site.

The service area is bisected by Eagle River. There are two 3” water mains crossing the river that will be replaced as part of the project. These crossings will be done according to the requirements of the MDEGLE permit. Portions of the project’s service area are located in the

coastal zone. All permits will be secured, and no adverse impacts to coastal resources are expected. There are no known endangered or threatened species in the project area.

The majority of Eagle River is designated as an historic district and is listed in the National Register of Historic Places. The State Historical Preservation Office will be contacted as soon as funding status is determined. For the most part, new water main will be installed in public right-of-way, existing easements or new easements that may be required for the river crossings. No impact on historical properties is contemplated.

C. POPULATION TRENDS

The population of Keweenaw County over the past 30 years is as follows:

YEAR	POPULATION
1990	2071
2000	2301
2010	2156
2020	2046

Population projections prepared by the Department of Technology, Management and Budget indicate that Keweenaw County can expect a 8% decrease in population every 10 years by the year 2045. The current population of Houghton Township is 72. The year 2045 population for Houghton Township would be about 60 or so if this prediction becomes reality. If a family with five children moves to Eagle River, the system will see a population growth surge of 10%.

D. GROWTH AREAS

The resident population of Houghton Township is concentrated in the Eagle River town site. There is little available property for development in the Eagle River water system service area indicated on Figure 1 in Appendix A. Potential customer growth is limited to undeveloped areas now served by water main. Source capacity and the challenges with developing on-site sewage disposal systems limit growth.

There are seasonal residents along the shoreline east of Eagle River in Houghton Township and west of Eagle River in Allouez Township but there are too few customers with large distances separating them to make installation of water main to serve those properties economically feasible. Also, there is insufficient source capacity to serve customers in these areas.

SECTION III EXISTING FACILITIES

A. LOCATION AND DESCRIPTION OF EXISTING WATER SYSTEM

The existing water supply consists of a 48 feet deep 5' by 5' vertical shaft excavated in bedrock. Connected to the vertical shaft is a 6' high by 4' wide horizontal tunnel extending north from the shaft for 350 feet. The source is located in Allouez Township, north of Five Mile Point Road on the westerly limits of Eagle River. The end of the tunnel is under Lake Superior but it is not connected to the lake. Water enters the tunnel through holes drilled into the overlying overburden. See Figure 2 in Appendix A.

Water is pumped into the distribution system by two submersible pumps that hang in the shaft. The pumps are Goulds 95L07, 7.5 Hp, 230 V pumps rated at 100 gpm at 200 Ft, TDH. The existing pumps were installed in 2015.

The existing water distribution system consists of five WX-350 hydropneumatic bladder tanks, about 1,620 feet of 4 inch water main, 6,750 feet of 3 inch water main, 410 feet of 2 inch water main, 930 feet of 1-1/2 inch water main and approximately 740 feet of 1 inch water main. With the exception of 520 feet 1-1/2 inch plastic pipe and 400 feet of ductile iron pipe, all distribution system pipes are galvanized steel pipe. Total length of water main is about 10,450 feet. See Figure 3 in Appendix A for a map of the system. The existing water main is listed in Table 2.

B. HISTORY

In the 1930s, the Federal Government through WPA, paid for the construction of a water supply and distribution system for the small town of Eagle River, Michigan. The town could not have afforded to pay for the system by itself. The initial project consisted of an intake shaft tunneled under Lake Superior and riveted steel hydropneumatic tank, pumps and a 3" and smaller galvanized pipe distribution system. The system has operated for over 80 years and it now needs to be replaced.

The shaft and tunnel were dewatered and accessed by a repair crew in 1953 when flow essentially stopped. Flow into the tunnel was restored by drilling new holes into the overlying overburden. The system has been functioning adequately since that time.

Four inch ductile iron pipe was installed to serve a 4 unit condominium near the mouth of Eagle River in 1995. Several line valves were replaced and flushing hydrants were added in 2007. The original 2,000 gallon bolted steel hydropneumatic tank was removed and replaced with 5 WX-350 bladder tanks in 2014. Twenty-seven of the 65 service connections have been replaced with type K copper or plastic pipe over the years. Lead goosenecks or any type of lead piping has not been noted or observed on the system.

C. CONDITION OF THE EXISTING WATER SYSTEM

The existing water distribution system is the original 1930s galvanized piping with the exception of the 4" ductile iron pipe installed for the condominiums. The condition of the galvanized pipe is what one would expect for steel pipe buried for 90 years. Leaks are becoming more frequent each year.

The valves on the original system are buried with valve boxes or some type of hand hole. Most of the original valves are inoperable or do not shut tight. Several critical valves were replaced in 2007. All valves on the 4" and smaller water mains will be replaced as part of the project.

The system includes two crossings of Eagle River. One crossing, the south crossing, is just above an old dam. The second crossing is a few feet south of the original Eagle River Bridge. Both pipes are shallow and susceptible to high river flow damage. Failure of either pipe will result in loss of water to a majority of water customers until a section can be isolated.

The existing system contains a few flushing hydrants that were installed in 2007 along with a handful of connections for fire departments. The existing hydrants are the bare minimum to flush the small diameter system. Operation of the old valves and the original flushing/fire department connections requires a pre-operation invocation and/or incantation, especially in the winter.

Water storage for the Eagle River water system is provided by five 350 gallon hydropneumatic bladder tanks. The tanks were installed in 2014 as part of the project which replaced the original bolted or riveted steel tank. This system has worked without incident since 2007 but does little for system reliability. Virtually no water is available from storage in the event of pump or power failure.

The existing water supply consists of a 48 feet deep 5’ by 5’ vertical shaft excavated in bedrock. Connected to the vertical shaft is a 6’ high by 4’ wide horizontal tunnel extending north from the shaft for about 350 feet. See Figure 2 in Appendix A. The end of the shaft is under Lake Superior. Ground water enters the shaft through a series of holes drilled into the glacial drift above the tunnel. Pumping tests conducted in 2015 indicated that the source capacity is about 20 gpm. The existing condition of the rock tunnel is not known but the system has operated adequately since the 1953 rehabilitation work described below was completed.

The tunnel contains approximately 62,000 gallons of water. The shaft contains about 1,900 gallons when the water level is 22 feet below the collar. The pump suction is set near mid height of the tunnel so the water available in source storage is about 30,000 gallons.

Two pumps are installed in the shaft. The pumps are Goulds 95L07, 7.5 Hp, 230 V pumps. The pumps are rated at 100 gpm at 200 Ft, TDH. The existing pumps were installed in 2015. The pumps are in good condition.

The shaft and tunnel were dewatered and accessed by a repair crew in 1953 when flow essentially stopped. Flow into the tunnel was restored by drilling new holes into the overlying overburden. The system has been functioning adequately since that time. No work on the tunnel is planned under the current project.

Rules have changed since 1953 so dewatering and inspection of the shaft and tunnel is not an incidental operation. Dewatering and inspection of the tunnel will likely require a one week shut down of the source. An evaluation of the water flowing through the drill holes is an essential part of the inspection. Construction of the storage reservoir proposed herein will provide the time to do the inspection and the facilities to provide more time if additional work is indicated.

The existing well house is in adequate condition and has been well maintained. The five 350 gallon hydropneumatic bladder tanks, the tunnel access shaft and pumps are in a partially buried building under the above ground structure that houses the generator and pump controls. An addition was built in 1990 when the stand-by generator was installed. A new roof was constructed on the partially buried section of the building when the old tank was removed in 2007.

D. FINANCIAL STATUS OF THE EAGLE RIVER WATER SYSTEM

The Eagle River Water System is a metered system. Customers have a flat rate fee of $10/month that includes 1,000 gallon per month. Residential customers have a commodity charge of $3.00/1,000 gallons of water used plus a $10/month maintenance fee. Commercial customers have a commodity charge of $4.00/1,000 gallons of water used. Commercial customers pay a maintenance fee based on the gallons used the previous year. Total gallons are divided by 50,000 then multiplied by $10 to determine the commercial maintenance charge.

The Water System has 61 residential customers and four other customers. A customer list is provided in Appendix B. The other customers are broken down as follows:

Small Commercial	1
Keweenaw County Buildings	2
Bible Camp	1
Houghton Township	1

Revenue and expenses for the Water System accounts over the past two years are as follows:

YEAR	INCOME	EXPENSES
2021	$ 20,112	$ 13,208
2022	$ 20,734	$ 12,722

The water system has no bonded indebtedness. Water rates have been increased and budgeted expenses have been adjusted to include repair and replacement costs recommended in the Water System Asset Management Plan. Previous income and expenses for the years 2018 through 2022 and budgeted income and expenses for the years 2023 through 2028 are given in Table 9.

SECTION IV NEED FOR THE PROJECT

A. HEALTH AND SAFETY

The original water distribution system was installed by hand and is typically five feet deep or less. As a result, several areas are prone to freezing. The system contains several dead ends and areas that must be shut off during winter to guard against freeze damage.

The Michigan Department of Environment, Great Lakes and Energy (MDEGLE) has requested that the Township address three issues as part of the proposed water improvement project. The first issue is excessive pressure loss due to old, small diameter and dead-end water mains in the distribution system. This will be resolved by installing a looped system with a larger diameter water main. The second issue is insufficient valves to minimize interruptions of service and minimize sanitary hazards during repairs. The proposed water distribution system will have enough valves to isolate the system one block at a time. The third issue is insufficient storage tank capacity. The ground level storage reservoir will address this issue.

B. SYSTEM OPERATION AND MAINTENANCE

The Eagle River Water System has been deteriorating in the recent years. The old galvanized water mains are reaching the end of their service lives. As can be seen from the following table, the unaccounted water loss has increased greatly in the last four years.

YEAR	PUMPED	BILLED	LOSS
2018	3,712,300 Gals.	1,791.499 Gals.	1,920,801 Gals.
2019	2,391,100 Gals.	1,896,000 Gals.	495,100 Gals.
2020	3,480,000 Gals.	1,538,382 Gals.	1,941,618 Gals.
2021	2,667,700 Gals.	1,725,000 Gals.	942,700 Gals.
2022	2,382,800 Gals.	1,763,000 Gals.	619,800 Gals.

The unaccounted water is increasing; from 2019 to 2022 water loss has increased from 20.7% to 26.0%. Two substantial leaks were repaired in 2018 and 2020 and one smaller leak in 2021.

Replacing the existing decrepit water main will reduce water loss due to leaking water main and will allow the installation of valves in the water system to minimize loss of service and minimize sanitary hazards during repairs.

Construction of a ground storage tank to increase system reliability and provide storage capacity to meet MDEGLE criteria, in the event of an emergency, is part of the proposed Eagle River Water System Improvement Project. A two cell, partially buried concrete reservoir is proposed.

The concrete reservoir will have lower maintenance costs compared to a steel tank and will be partially buried and insulated to reduce the potential for ice development in the tank. Two cells will allow the Township to clean and repair the tank while in service and will allow flexibility for winter operation. A two cell tank will allow the system to operate with one cell if water quality problems develop as a result of low turnover during winter months.

C. GROWTH

The primary objectives of the project are the elimination of old small diameter water main, the elimination of dead end water main and to increase system reliability by the addition of storage. No new service area is being added as part of the project.

Areas with theoretical potential for the extension of the water system are located west of Eagle River along Five Mile Point Road, east of Eagle River along Highway M-26 and south of Eagle River along Highway M-26. The area is delineated on Figure 1 in Appendix A labeled as Future Service Area. The future service areas are zoned Resort Residential under the Keweenaw County Zoning Ordinance.

Consideration is not being given to construction of water main in these sections at this time. While the system may have the hydraulic capacity to serve the areas, the existing source does not have sufficient reserve capacity to serve customers beyond the existing service area.

SECTION V ALTERNATIVES CONSIDERED

A. DESCRIPTION OF ALTERNATIVES

Water Source

The existing water supply consists of a 48 feet deep 5’ by 5’ vertical shaft excavated in bedrock. Connected to the vertical shaft is a 6’ high by 4’ wide horizontal tunnel extending north from the shaft for 350 feet. The end of the shaft is under Lake Superior. Ground water enters the shaft through a series of holes drilled into the glacial drift above the tunnel. Pumping tests conducted in 2015 indicated that the source capacity is about 20 gpm.

The tunnel contains approximately 62,000 gallons of water. The shaft contains about 1,900 gallons when the water level is 22 feet below the collar. The pump suction is set near mid height of the tunnel so the water available in source storage is about 30,000 gallons. Two pumps are installed in the shaft. The pumps are Goulds 95L07, 7.5 Hp, 230 V pumps. The pumps are rated at 100 gpm at 200 Ft, TDH. The existing pumps were installed in 2015.

Considering the low potential for development in the service area, the existing source has sufficient capacity to meet projected maximum day demand for the next 25 years. The excess source capacity that is available at this time needs to be reserved for future demand from vacant parcels in the existing service area. There is little available property for development in the service area and sewage disposal options further limit the size/demand of a potential development.

Increased demand would most likely occur if the Gitchee Gumee Bible Camp increases usage. However, Gitchee Gumee staff has reported to the Township that the Bible Camp has limited property for development and that sewage disposal option further limit the potential for development.

A proposed increase in demand will require an inspection and reevaluation of the existing shaft and tunnel. This work is best done after more storage is provided on the system to allow time to remove and reset pumps, dewater the shaft and tunnel, set up access equipment, inspect the tunnel and drill holes and to put the system back in service. Shaft and tunnel replacement options are limited should the source experience sudden failure. The chance of find an aquifer capable of supporting two or more wells capable of producing 20 gpm or more each is extremely remote.

No work, other than the work necessary to connect a new storage tank piping, controls and installation of a generator are proposed for the source in the current project. It is recommended that the Township include in the water system budget an investigation of alternate water sources for the Eagle River system. The cost to do hydrogeological and geophysical investigations and construct and test two test wells will likely cost in excess of $300,000. Grants will be needed to implement this work.

Storage

One of the major items of the proposed Eagle River Water System Improvement Project is to construct a ground storage tank to provide storage capacity to improve system reliability in the event of an emergency. The emergency situation that presents the greatest threat to water system customers is failure of the tunnel to provide water to the pumps. The Eagle River Contingency Plan identified water hauling and bottled water as the only available options to provide potable water to system customers. Considerations include sufficient volume to maintain services while water hauling is implemented and site access to permit water delivery to the tank year-round. Sufficient storage must also be available to perform maintenance on the shaft and tunnel.

A 100,000 gallon partially buried concrete reservoir, including service pumps and hydropneumatic tanks on Township property at the existing pump house is the recommended option.

The Eagle River Water System operates off of five (5) WX-350 hydropneumatic bladder tanks. The system operates between 60 psi and 80 psi. There are two pumps in the shaft and operation alternates between the two pumps each cycle. The hydropneumatic tanks contribute little or nothing with respect to system reliability.

The provision of fire flows in accordance with the Insurance Services Office (ISO) criteria is not an objective of Houghton Township at this time so the application of the usual equation (On page 17) to calculate storage capacity required does not apply to Houghton Township. A fire flow at 1,500 gpm for three hours would require a 270,000 gallon reservoir.

The functions of storage for Eagle River are increased reliability and an enhancement of the ability to meet maximum day and maximum hour demands. The primary function of the storage will be to provide time to institute water hauling or other sources of water in case of a failure of the source. Because of the time required to institute and maintain a water hauling operation, it is recommend that the reservoir be capable of furnishing at least five days of supply at maximum day demand. With maximum day demand at 21,000 gallon per day the recommended storage volume is 100,000 gallons in two 50,000 gallon compartments. 100,000 gallons in storage should provide at least two weeks for shaft and tunnel work during off peak demand periods.

Storage alternatives evaluated include elevated steel storage, ground level concrete tank and ground level steel tanks, both welded and bolted. Wood tanks were also considered. Although available, the construction of a wood tank was deemed inappropriate for the Eagle River system for a variety of reasons including that the intent is to provide a structure that will outlive the current residents of Eagle River.

Elevated storage tanks in the Upper Peninsula are prone to freezing especially when reservoir volume is dictated by fire flow requirements or there is a large variation in demand between summer and winter. In the Upper Peninsula climate, elevated storage tanks need to have at least 25%, and preferably 50%, of the water in the tank changed each day to reduce the potential for freezing. It is difficult to attain this change over when average day demand is very low without wasting water. Eagle River does not have the luxury of water to waste.

In Eagle River the average daily consumption during the winter will amount to about 3% of the volume of a 100,000 gallon tank. If sufficient water is not circulated into the tank, an elevated tank will develop an ice cake on the walls, riser and water surface. The ice insulates the remaining water and reduces the rate of heat loss, but it also reduces tank capacity and tends to damage inside coatings, ladders and other interior devices. The ice cake also does very little to keep the riser pipe from freezing.

Welded steel stand pipes and bolted steel tanks were considered. Both ground level steel options were rejected because of high maintenance costs, the expense and difficulty of keeping them ice-free and their susceptibility to damage from bullets.

Buried and partially buried concrete reservoirs provide ice free storage and reduce operation and maintenance costs because there is no need to repaint the tank on regular intervals and repair ice damage. Two concrete buried tank options were considered.

One option is to build a partially buried two cell concrete tank on property to be acquired by the Township along Garden City Road east of Eagle River. Overflow elevation of the tank would be near 804 feet which provides pressure near the current pump stop pressure at 80 psi. This tank would supply water to Eagle River customers by gravity via a 2,000 feet long transmission line. Because of the large volume of water in the transmission line, a second fill line about 2,000 feet long is recommended to provide turnover in the tank for this option.

The second buried concrete tank option is the construction of a two celled partially buried tank on Township property at the existing water source. This tank would be filled by the existing pumps in the shaft. New service pumps would be provided to recharge new or existing hydropneumatic tanks. A high service pump would be included to provide water to volunteer fire departments at a higher rate.

Distribution System Piping

Consideration has been given to using various materials for water main piping. Pipe materials considered include ductile iron, steel, PVC, HDPE and ABS. Ductile Iron pipe is recommended for water main in Eagle River. Reasons to use ductile iron pipe include the following:

1. **Conductivity** - Ductile iron is conductive permitting the use of electrical current to thaw frozen mains and service lines. Water mains rarely freeze when installed deep enough, but service lines freeze nearly every year. Ductile iron water main is used as a conductor to facilitate thawing of service lines.

   In the case of non-conductive pipe, either the corp or curb stop has to be excavated or a large diameter conductor must be installed with the pipe.

2. **Longevity** - Ductile iron and cast iron pipe has been in service for up to 400 years. Plastic pipe has been around for about 50 years. The odds of plastic pipe having the longevity of iron pipe are very slim.

3. **Durability** - Ductile iron pipe has demonstrated the ability to take abuse. The incidental scrape by an excavator tooth does little more than scrape the coating off the ductile iron

pipe. Plastic pipe on the other hand suffers severe damage.

4. **Cost of Installation** - Because of the difficulty of thawing plastic pipe, it needs to be installed at least two feet deeper than ductile iron. The additional two feet often times ends up in bedrock or under water. In either case, installation costs increase or more problems are generated for repair crews because of greater depth.

5. **Chemical Leaching** - Recent studies have indicated that cancer causing chemicals are leached out of PVC water service pipe. Most assuredly the Government will be requiring water suppliers to treat (add more chemicals) to their water so these chemicals are not leached out.

   Ductile iron pipe is recommended to replace the existing galvanized steel pipe. Not only does pipe conductivity facilitate thawing of service lines and water main, it also provides the means to use electronic base pipe location equipment. Tracer wires are required for non-metallic pipe. Even though conductivity is verified for approval, wires break or are cut and not repaired and the ends are often impossible to locate. Non-metallic pipe materials are best suited for locations south of the Mason-Dixon Line. Trying to find tracer wires in the midst of a 200 inch to 300 inch snowfall winter often ends up as an exercise of expletive laden vocabularies.

   The MDEGLE does not allow PVC for monitor wells at landfills. If PVC is not good enough for monitor wells at landfills, it should not be good enough to transport drinking water.

Controls

Two types of control system were considered. One type consists of a control/relay/alarm panel with pump operation and tank alarms controlled and indicated by floats and pressure switches. Some alarms would be detected by pressure transducers. The other option is a programmable logic controller for pump start and stop and alarms.

Currently, pump operation is controlled by pressure switches. The system is easy to operate and easy to repair. The construction of a new reservoir will require some change in the control system. The current system operation requires very low operator attendance and a new control system should allow the same level of operator attention. Siting a new reservoir near the source eliminates the need for telemetry to transmit tank levels to control source pumps. Source pumps will be controlled by floats in each reservoir cell and pump control will be hard wired. Floats in each cell will permit operation of each cell independently or in series. Normal operation will be in series. Service pumps feeding the hydropneumatic tanks will be controlled by pressure switches. Hard wiring the controls eliminates the ability of bad actors to gain access and compromise the water system. The elimination of telemetry will also help keep operation and maintenance costs in line.

A new control/alarm/relay panel is recommended to allow the operator to switch pump operation options and to record pump operation parameters including pump cycles and pump run times. In addition to pump operation, a new control will be used to monitor and annunciate alarm

conditions. Alarm conditions to be monitored include reservoir high and low water levels, system low pressure and high pressure, power failure, tank and pump house entry by miscreants, low water in the shaft and for low temperature in pump rooms. Transducers and chart recorders are included to monitor and record reservoir water levels and shaft water levels. Alarms for tank high and low water and pump failure will be indicated on the panel. Notification of alarm conditions will be sent to selected people by telephone dialer.

B. DESIGN CRITERIA

Water Source

Demand on the system is seasonal. The Houghton Township Water System serves 65 customers in the Community of Eagle River on a year-round basis. There are12 residential and 3 other customers, out of the 65 total customers, on the system during the winter of 2022-2023. The low number of winter customers, low Township population count (72 in 2020), and the high usage by the Gitchee Gumee Bible Camp renders calculation of demand on a per capita basis inadvisable.

The following terms are used in determining water use:

Average Day: Total gallons pumped in one year divided by 365 days.

Maximum Day: The 24 hour period during the year when the most water is used.

Maximum Hour: A 2 or 3 hour period, usually occurring during the maximum day, when the highest rate of water use occurs.

Many important factors affect water use in a community such as the presence of commercial development, industry, quality of water, cost of water, and characteristics of the population, whether or not supplies are metered and the efficiency of the water works administration. Usually, in most communities, the most critical condition, and what generally dictates the basis and design for storage and pipelines, is maximum day plus fire flow.

A commonly accepted design value for domestic water usage is 100 gallons per capita per day (gcd). Surveys have shown that the domestic population water use ranges from 35 to 60 gcd and the balance is used by industrial, commercial, public buildings and unaccounted losses. The estimated average day usage for the 12 Eagle River residential year-round customers is between 55 to 65 g/c/d based on 2022 consumption records. The length of time the other 49 seasonal customers use water is not known or is widely variable so their usage per day is indeterminate.

Water pumped by Eagle River for the years 2011 through 2022 is presented in Table 3.
The average day usage for Eagle River for the 12 year period is 8,176 gallons per day, or about 6 gpm. The average maximum day usage for the 5 year period 2018 through 2022, which occurs in July or August, is 20,836 gallons per day. The peak day for that 5 year period was 25,800 gallons per day. The average minimum day for the 5 year period is 2,793 gallons per day.

Typically, for a system that does not have a very large user, maximum day demand is 2.5 to 3 times average day demand and the maximum hour demand is 5 to 6 times the average day demand. The maximum day demand ratio for Eagle River is 2.55. For most systems, the maximum day occurs during a week or two week period in July or August. For many Upper Peninsula communities, maximum day usage occurs during January and February because of let runs. The Eagle River system experiences maximum day in July and August but instead of a week or two, the high demand on the system lasts for the months of July and August. See the Maximum Gallons Pumped per Month in Table 3.

Use of per capita consumption on an annual basis to evaluate the capacity the Eagle River source on this system is not indicative of actual consumption. The Gitchee Gumee Bible Camp is the largest user on the system. For the period September 30, 2021 through September 30, 2022; the Bible Camp, the Keweenaw County Complex, Houghton Township and the lone commercial user accounted for 44% of the usage for that period. The Gitchee Gumee Bible Camp used 24% of the water billed for this period. See Table 4.

The Gitchee Gumee Bible Camp operates during the months of May through October. Peak water usage in Eagle River occurs during the months of July and August while the Bible Camp is in operation and all the fair weather people have returned. Maximum Day usage and Maximum Month usage for the years 2018 through 2022 are provided in Table 3. For the 5 years listed the maximum day varies from 16,400 to 25,800 gallons per day. The 5 year average Maximum Day is about 21,000 gallons per day. For this period, Maximum Day demand varies from about 11 gpm to about 18 gpm. The 5 year average maximum day demand is about 15 gpm.

The current and projected demands are as follows:

Average Day	-	6 gpm
Maximum Day	-	15 gpm
Maximum Hour	-	36 gpm

Testing that was done in 2015 determined that the recovery rate of the tunnel system is about 20 gpm. The existing shaft pumps can meet the projected maximum day demand and the shorter maximum hour demand. No changes in the shaft pumps are contemplated at this time.

Storage

The required volume of water in storage is usually determined from the following equation:

Storage = Fire Flow + Maximum Day Demand - Source Capacity

With a large variation in usage through the year, low customer count and considering that the system does not provide fire flows in accordance with ISO criteria, the basis of design for storage needs to be tailored to meet the conditions in Eagle River. Fire protection in Houghton Township is provided by Allouez Township with mutual aid from Eagle Harbor Township and Grant Township. These Township Volunteer Fire Departments are trained and have the equipment to fight fires with little or no water available from a public water system. In areas such as Eagle River, these firefighting methods typically involve hauling water to drop suction

tanks used by pumper trucks. Water sources are often dry hydrants installed in ponds, creeks or lakes. Access to these sites can be an adventure in the winter. Design of storage facilities, water main and hydrant placement in Eagle River needs to be factored in the system design to allow access to regulatory storage, especially in winter months.

The functions of storage for Eagle River are increased reliability and an enhancement of the ability to meet maximum day and maximum hour demands. The primary function of the storage will be to provide time to institute water hauling or other sources of water in case of a failure of the source. Because of the time required to institute and maintain a water hauling operation to replace the source, it is recommend that the reservoir be capable of furnishing at least five days of supply at maximum day demand. With maximum day demand at 21,000 gallon per day the recommended storage volume is 100,000 gallons in two 50,000 gallon compartments.

Sufficient storage must also be available to perform maintenance on the shaft and tunnel. 100,000 gallons in storage should provide at least two weeks for shaft and tunnel work during off peak demand periods.

System Analyses

The construction of a new ground level reservoir and changes in pipe size required to upgrade the existing distribution system so it has capacity to meet peak flows will result in substantial changes in system hydraulics. Six inch and 8 inch diameter water mains are proposed to replace existing 4" and smaller pipes. The Eagle River water system is not a typical municipal water system. First it is very small. Second, the system does not provide fire protection. However, a 400 gpm to 500 gpm capacity pump is proposed to provide water from storage for Volunteer Fire Department water hauling operations.

Systems are typically analyzed under maximum day plus fire flow conditions. Maximum Day demand is estimated to be 15 gpm. Maximum hour demand is 26 gpm. Even at maximum hour of 36 gpm the effects on pressure are minimal considering the size and lengths of pipe involved. Analysis of the system at 500 gpm is realistic. If there is that big a fire in Eagle River, all 72 residents will likely be at the fire and maximum day or maximum hour demand will probably not occur while the larger pump is running.

The highest service location in Eagle River is the second floor of the Court House. The second floor elevation is about 680 Ft. In the proposed system, delivery of water to this location involves about 1,200 feet of 8" water main and two loops of 6 inch water main each being about 3,000 feet long. The head loss in 8" pipe is about 7.8 feet per 1,000 feet at 500 gpm at a C factor 100. The head loss in 6" pipe is about 5 feet per 1,000 feet at 250 gpm at a C factor 100. The head loss in 6" pipe is about 14 feet per 1,000 feet at 500 gpm at a C factor 100. Total head loss at the Court House under a 500 gpm demand near the courthouse will be about 26 feet or about 11 psi.

The hydraulic grade line (HGL) at the Court House with pump shut down at 80 psi is Elevation 804 Ft. Second floor pressure is about 53 psi. With a demand of 500 gpm at the Court House, the residual pressure would be about 42 psi on the second floor.

Pressure at the Court House was also checked if one of the river crossings was out of service. Under these conditions, 500 gpm flowing through the 6" water main the pressure drop would be about 54 feet in total dynamic head (TDH) or about 23 psi. Residual pressure would be about 30 psi on the second floor of the courthouse.

In order to maintain a 35 psi minimum residual at the Court House, the high service pump will have to maintain a HGL of about 815 at the pump house. At this HGL the pressure on Front Street will be about 88 psi.

C. PROPOSED WATER SYSTEM SCHEMATIC LAYOUT

The existing system is shown in Figure 3. The system consists of 4", 3", 2" and smaller distribution mains. The system contains numerous dead ends. The recommended distribution system improvements are replacement of all existing galvanized steel and plastic water main with ductile iron water main. The work includes two new crossings of Eagle River. HDPE pipe installed by directional drilling methods may be an option for the two river crossings depending, in part, of information to be gleaned from soil borings. The proposed distribution system improvements and the location of the proposed reservoir are shown in Figure 4. Proposed water main is listed by street in Table 6.

New service lines will be installed to an estimated 37 customers that still have galvanized service lines. Replacement will be from the new main to the curb stop at the property line. Lead goosenecks or lead pipe was not observed in any of the 27 galvanized service lines that have been replaced over the years. Eagle River lead level test results have never exceeded the MDEGLE action level. The 37 customers will be required to replace their service lines from the property line to their meter if they have not done so prior to the installation of new water main.

Only marginal consideration has been given to expansion of the services to the south, east and west of Eagle River. If service to these areas becomes likely, then additional source capacity will have to be developed.

D. ENVIRONMENTAL IMPACTS

An outline environmental review has been prepared for the project.

The reservoir will be constructed on Township property at the pump house.

Water main construction consists of replacement of existing water main close to or in the same location as the existing water main. The two new river crossings are an exception. The current plan calls for one new crossing near the mouth of Eagle River and one crossing above the dam.

There are no known wetlands on the tank site or on the water main routes although it is pretty wet long the banks of Eagle River at the proposed south river crossing and near the shore line and river at the proposed north crossing. The Deer Park, maintained by Houghton Township, is surely a wetland but the existing water main and proposed water main are across the street. The Keweenaw County Final Wetland Inventory map published by the Department of Technology, Management and Budget has the project area mapped as soil areas which include wetland soils.

Final water main routes may be adjusted to avoid sensitive areas or the use of directional drilling will be used to reduce impacts in areas deemed to be sensitive.

Letters will be sent to the Michigan SHPO, Fish and Wildlife Service, MDEGLE Permit Coordinator, the MDEGLE Land and Water Management Division and other involved parties after funding has been offered and accepted by the Township. A plethora of permits and approvals will be required before construction will be allowed to begin.
Environmental considerations follow.

EXISTING NATURAL ENVIRONMENT

1. Climate: Keweenaw County has a typical continental climate characterized by cold dry winters and warm and humid summers.

The average annual temperature is 39.1^{o}F. Annual precipitation averages 29.6 inches of which 61% occurs during the six month period of April through September. Heaviest precipitation occurs in August, while February has the least. Average snowfalls are in excess of 270 inches of snow, with records of well over 300 inches.

2. Air Quality: The air quality in the project area meets standards established by the Federal Environmental Protection Agency. (2020) Air Quality Report, MDEGLE).

3. Wetlands: The Keweenaw County Final Wetland Inventory map published by the Department of Technology, Management and Budget has the project area mapped as soil areas which include wetland soils. A letter will be sent to MDEGLE for verification and permitting upon approval of funding.

4. Coastal Zones: The project area is located in a coastal zone.

5. Flood Plains: The tank and water main projects site are not located within a designated floodplain.

6. Natural or Wild and Scenic Rivers: There are no natural or wild and scenic rivers within the project area or in Keweenaw County(US Fish and Wildlife Service).

7. Major Surface Waters: Water main will cross Eagle River at two locations. Both crossings will likely be made by directional drilling. Lake Superior will not be impacted by construction in the project area.

8. Topography: The tank site is wooded with second or third growth aspen and soft maple trees and pine and hemlock on the precipice overlooking Lake Superior. The site has low to moderate grades.

9. Geology: The underlying bedrock geology is the Portage Lake lava Series and the Copper Harbor Conglomerate. (Geological Map of Houghton and Keweenaw Counties).

The surface geology at the project site is glacial deposits on till plains, moraines and basalt or conglomerate bedrock composed of moderately well drained and permeable soils (SCS Soils Descriptions).

10. Soils: Arcadian-Nippising, Montreal-Paavola-Waiska Complex and Deer Park Sand soil classifications. These soils are mostly glacial moraines but areas near the shore and on the west side of the river are beach sand deposits. (SCS Soil Survey).

11. Agricultural Resources: There are no prime, unique or otherwise highly productive farmlands in the project area.

12. Existing Plant/Animal Communities and Environmental Sensitive Habitats: Endangered or threatened plant species, including the rare pine drop, have been identified in Keweenaw County. A letter will be sent to the U.S. Fish and Wildlife Services for verification of other endangered or threatened plant and animal species upon approval of funding.

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13. Historical Properties: The Eagle River Historic District is listed in the National Register of Historic Places.

14. Sole Source Aquifers: No sole source aquifers have been identified within the project area. (Traverse Engineering Services)

15. Solid Waste Disposal: Keweenaw County is served by a licensed hauler with ultimate disposal in the K & W Landfill. Solid waste, not including soils, rock, trees, brush and other woody materials, generated from the project, will be disposed of at the K & W Landfill.

16. Man-Made Hazards: No man-made hazards will be produced by the project. (Traverse Engineering Services)

E. PROJECT IMPACTS

1. Surrounding Physical Environment

a. Air quality - no impact.
b. Groundwater - no impact.
c. Soil suitability - no impact; there are slight limitations for excavations.
d. Surface water - no impact.
e. Vegetation and wildlife - small impact due to clearing of plants and trees on tank site and easements.
f. Noise - there will be limited noise associated with rock excavation and general construction operations.
g. Coastal zone - no impact.
h. Sole source aquifer - no impact.
i. Floodplains - no impact.
j. Wetlands - no impact.
k. Water resources - no impact.
l. Unique features - no impact.
m. Agricultural land - no impact.

2. Community Facilities and Services

a. Educational facilities - no impact.
b. Employment and income patterns - no impact.
c. Commercial facilities – Disruptions will occur during water main installation.
d. Health care - no impact.
e. Solid waste - no impact.
f. Wastewater - no impact.
g. Storm water - no impact.
h. Water supply - beneficial impact. The project will improve system reliability and efficiency.
i. Public safety - minimal impact. The project will improve peak flows to the community.
j. Recreation and cultural facilities - no impact.
k. Transportation - no impact.

3. Social Factors

a. Historic properties - no anticipated impact. The State Historic Preservation Officer will be notified of the project.
b. Displacement of families/individuals - no displacement of families or individuals will occur.
c. Character changes of Community - no impact.

4. Land Development

a. Conformance with plans and zoning - the project is consistent with the

Houghton Township Development Plan.

b. Compatibility - no impact.
c. Slope - no impact. The slope of the area is generally from two to six percent or less.
d. Erosion - no impact.
e. Soil suitability - no impact; the soils are not highly subject to erosion.
f. Hazards and nuisances - no impact.
g. Energy consumption - no impact.
h. Noise - limited impact. There will be short-term noise associated with the excavation for the water main and appurtenances and the construction of the reservoir.

F. EVALUATION OF ENVIRONMENTAL IMPACTS

It is expected that the project will receive a categorical exclusion from an environmental assessment.

Direct environmental impacts are limited to use of the land for the reservoir site and odor, noise, dust and construction traffic associated with the construction of the improvements.

The project will have no effect on development patterns within the Community of Eagle River nor are any changes expected in land use on property adjoining the project. No part of the project is predicated on growth in particular, and there is only minimal land near project elements that are susceptible to development. The project is not designed specifically to serve these areas.

Construction related jobs will be generated and local contractors will have an equal opportunity to bid on the work. Local suppliers of building materials will also benefit.

Noise and dust will be generated during construction. Traffic patterns will be affected a construction of water main proceeds through Eagle River. Spoil from excavations will be subject to erosion. The aesthetics of the immediate construction area will be temporarily affected until restoration is complete.

G. SHORT AND LONG TERM ENVIRONMENTAL IMPACTS

The short term adverse environmental impacts associated with construction activities will be minimal in comparison to the long term supply of safe drinking water that will be available to the residents of Eagle River, the county seat of Keweenaw County.

No long term risks to public health or safety due to the proposed project are anticipated.

H. MITIGATION OF ENVIRONMENTAL IMPACTS

The largest environmental impacts will be associated with construction activities including odor, noise, dust and traffic. The contract documents stipulate contractor's working hours, requires traffic control and has provisions for control of nuisances caused by dust, etc.

All construction in residential areas will be in existing right-of-ways or public easements. Short term disruption can be expected during construction. This disruption will be limited to daylight hours on week days. Special permission is required for weekend work.

Some environmental impacts are expected that are associated with erosion and sediment control. Soil erosion and sedimentation will be controlled by the construction of cobble and/or sod ditches, check dams, and the installation of seed and mulch and other measures as soon as possible after the construction is complete.

Noise during construction will be unavoidable, but the effects will be reduced by performing construction during daylight hours and by the use of standard noise abatement equipment on construction machinery.

Permits will be required for the construction of the improvements. Permits will be required for MDEGLE, MDOT, the Keweenaw County Drain Commissioner, Keweenaw County Building Department and the Keweenaw County Road Commission.

I. IRREVERSIBLE OR IRRETRIEVABLE IMPACTS

Fossil fuels, labor, building materials such as concrete and wear on equipment will be committed in the construction of the proposed project. Financial resources of Houghton Township, the State of Michigan and the Federal Government will be committed.

J. DIRECT IMPACTS

No effects on historical, archaeological, geological, cultural or recreational areas are anticipated as a result of the construction of the project .

No detrimentally affect the water quality of the area, air quality, wetlands, endangered species, wild and scenic rivers or agricultural land are anticipated as a result of the construction of the project.

The proposed project will not require the relocation of residents or businesses. A grant is being pursued from the Drinking Water Revolving Fund (DWSRF) to help finance the project. Average user charges of at least $50 per month for a typical residential customer will be needed after completion of the project. User charge adjustments to cover the debt service on a loan if a 100% grant is not offered will increase the average user charge above $50 per month.

K. INDIRECT IMPACTS

The proposed project will provide safe and reliable drinking water at a reasonable pressure to the customers of the Eagle River Water System.

L. CUMULATIVE IMPACTS

Continued protection of the Eagle River water supply and distribution system is the primary cumulative impact anticipated by the construction of the proposed project.

M. LAND REQUIREMENTS

The water main will be constructed predominately within dedicated road rights-of-way. Easements may be required to install the water main in sections that are not in public ROW if formal easements are not in place for existing water main. The new ground level reservoir will be constructed on property owned by Houghton Township at the existing pump house. Preparation of final construction documents may indicate the need for other easements for the water main. Easements will be acquired by the Township before construction begins.

N. CONSTRUCTION PROBLEMS

Construction of the water main may be affected by high water table. Ordinary construction techniques will be adequate provided additional depth is not required to accommodate the mandated use of non-conductive pipe. The use of a directional boring for the Eagle River crossings is expected to diminish the magnitude of the problems that might be encountered in the river crossings.

Bedrock will be encountered during the construction of the water main and possibly the reservoir. Most rock removal will be done by drilling and blasting. There may be areas that will dictate the use of other techniques because of the distance between the water main and a structure. If bedrock is encountered at the reservoir site as indicated by soil borings, adjustments will be made to the design to minimize the amount of rock removal needed to build the reservoir.

O. COST ESTIMATES

PART 1 CONSTRUCTION

Total project cost opinions for the two viable partially buried concrete storage tank options are provided in Table 5A and 5B in Appendix B. The proposed distribution system improvements are shown in Figure 4 and tabulated in Table 6. A total project cost estimate for the construction of the distribution system is provided in Table 7, in Appendix B. Ductile iron pipe is recommended to replace the existing galvanized steel pipe.

Not only does pipe conductivity facilitate thawing of service lines and water main, it also provides the means to use electronic base pipe location equipment. Tracer wires are required for non-metallic pipe. Even though conductivity is verified for approval, wires break, or are cut, and not repaired and the ends are often impossible to locate. These materials are best suited for locations south of the Mason-Dixon Line. The effort of trying to find tracer wires in the midst of 200 to 300 inches of snowfall winters often ends up as an exercise of expletive laden vocabularies.

PART 2 NON-CONSTRUCTION AND OTHER PROJECTS

There are no non-construction, or other project costs, associated with this project.

PART 3 ANNUAL OPERATION AND MAINTENANCE

Operation and maintenance budgets were not prepared for the storage options. Operation and maintenance costs associated with system operation will not change materially for either concrete storage tank options with the exception of telemetry and power costs for the Garden City Road tank location. Additional O&M charges that need to be budgeted for a concrete tank include roof replacement and maintenance inspections. About one dollar per month per customer is required to accumulate these costs. The Garden City Road tank option will have additional O&M costs associated with it because, in part, of additional snow plowing costs and additional operator attention that will be needed in the winter. Additional power and telephone/telemetry will also be required. Detailed calculation of these costs is not cost effective.

Operation and maintenance cost for the steel tank options were not enumerated because the costs are orders of magnitude higher that for partially buried concrete tanks. If steel insulated storage tanks are constructed, the Township will have to budget for at least $8,000 per year for maintenance of insulation, at least another $8,000 per year for repainting and about $1,000 per year for maintenance inspections. That amounts to about $22/month/per customer just for steel tank maintenance. That does not include the additional operator time required in the winter to control ice issues.

Power costs will increase slightly with the construction of a storage tank. The addition of two more service pumps will increase electricity costs because there are more pumps. The energy consumption for pumping should not materially increase because the gallons pumped and the total dynamic head will not change. There will be a slight power increase due to efficiency of electric motors. It will be harder to keep up with power rate increases.
Adding alarm notification will require an increase in rates. The provision of a dialer for alarm notification will require the installation of telephone service at the location of the tank and pump house. Telephone service will require a rate increase of about $2/month per customer.

PART 4 PRESENT WORTH

A present worth analysis of the storage reservoir alternatives is not included. A partially buried concrete reservoir is the only viable and practical alternative for the Eagle River water system. The two viable reservoir options are identical except for difference in construction costs and annual operation and maintenance costs brought about by the difference in location. A description of the advantages and disadvantages of the storage alternatives considered is provided below. See also the discussion of storage alternates in Section V, Part A on page 12.

A present worth analysis of distribution pipe was not prepared. The benefits of the ability to provide conductivity of the pipe, exceeds the cost difference between metallic and non-metallic pipe. Non-metallic pipe must be buried at least two feet deeper to provide additional protection from frost penetration. A minimum of 2 feet of additional depth is recommended for freeze protection. The additional cost of rock excavation and the additional depth of bury for hydrants

exceed the cost difference between pipe materials. A description of the advantages and disadvantage of alternate pipe materials alternatives considered is provided below.

P. ADVANTAGES AND DISADVANTAGES OF ALTERNATIVES CONSIDERED

RESERVOIRS

Elevated storage tanks in the Upper Peninsula are prone to freezing especially when reservoir volume is dictated by fire flow requirements or there is a large variation in demand between summer and winter. In the Upper Peninsula climate, elevated storage tanks need to have at least 25%, and preferably 50%, of the water in the tank changed each day to reduce the potential for freezing. It is difficult to attain this change over when average day demand is very low without wasting water on small system such as the Eagle River system.

In Eagle River the average daily consumption during the winter will amount to about 3% of the volume of a 100,000 gallon tank. If sufficient water is not circulated into the tank, an elevated tank will develop an ice cake on the walls, riser and water surface. The ice insulates the remaining water and reduces the rate of heat loss, but it also reduces tank capacity and tends to damage inside coatings, ladders and other interior devices. The ice cake also does very little to keep the riser pipe from freezing.

Welded steel stand pipes and bolted steel tanks were considered. Both ground level steel options were rejected because of high maintenance costs, the expense and difficulty of keeping them ice-free and their susceptibility to damage from bullets.

The construction of a wood tank was deemed inappropriate for the Eagle River system for a variety of reasons including that the intent of the project is to provide a structure that will outlive the current residents of Eagle River.

Buried and partially buried concrete reservoirs provide ice free storage and reduce operation and maintenance costs because there is no need to repaint the tank on regular intervals and repair ice damage. Two concrete buried tank options were considered.

1. Partially buried concrete reservoir on Garden City Road

   Advantages

   1.1 Provides system reliability in the event of a source failure.
   1.2 Provides system reliability in case of power outages.
   1.3 Provides year-round source water for volunteer fire departments water hauling operations.
   1.4 Can be used as a receptor for hauled water in case of source failure.
   1.5 Provides time to isolate leaks and reduces the chances for loss of system pressure in the event that leaks occur.
   1.6 Low annual maintenance costs. Painting is not required.
   1.7 Buried or partially buried reservoirs facilitate the control or elimination of ice formation.

1.8 Long transmission main will provide some heat gain in the winter months to help control ice formation in the winter months.
1.9 Lower initial construction costs and life cycle cost.
1.10 Concrete that is buried or submerged gains strength throughout its entire life.
1.11 The reservoir is built with two compartments so the reservoir can remain in service for maintenance and repair.
1.12 Small head range allows more water to be withdrawn with smaller pressure fluctuations.
1.13 Concrete roof deck protects the water supply in the event the roof membrane is damaged.

Disadvantages

1.1 The Township must purchase the land required for the reservoir.
1.2 Low system demand in the winter causes challenges to turn over water in storage.
1.3 Increased snow removal costs to maintain access in the winter.
1.4 Requires telemetry to monitor reservoir levels at the pump house resulting in increased monthly O & M costs.
1.5 Longer transmission main than is needed for an elevated steel tank and for a buried reservoir near the water source.
1.6 The volume of water in a 2,000 feet long water main from the reservoir to the distribution system contains at about 4 days' supply during low demand periods if the main is 12" diameter. An 8" transmission main contains about three days' supply.
1.7 Because of the large volume of water in the transmission main from the reservoir to the distribution system, a separate 2,000 feet long fill line is recommended.
1.8 Remote location increases security concerns.

2. Partially buried concrete reservoir near the existing pump house with re-pumping to a new or existing hydropneumatic system and a high service pump.
Advantages

2.1 The Township owns the property required for the reservoir.
2.2 Provides system reliability in the event of a source failure.
2.3 Provides system reliability in case of power outages.
2.4 Provides year-round source water for volunteer fire departments water hauling operations.
2.5 Can be used as a receptor for hauled water in case of source failure.
2.6 Easier to effect change over of water in storage.
2.7 Provides time to isolate leaks and reduces the chances for loss of system pressure in the event that leaks occur.
2.8 Low annual maintenance costs. Painting is not required.
2.9 Buried or partially buried reservoirs facilitate the control or elimination of ice formation.
2.10 Lower initial construction costs and life cycle cost.
2.11 Concrete that is buried or submerged gains strength throughout its entire life.
2.12 The reservoir is built with two compartments so the reservoir can remain in service for inspections, maintenance and repair.

2.13 Concrete roof deck protects the water supply in the event the roof membrane is damaged.
2.14 Lower snow removal costs than the Garden City Road site. With the tank and pump house on the same site, only one site needs to be plowed.
2.15 Telemetry is not required. Controls will be hard wired.
2.16 Location near major roads increase visibility and can alleviate some security concerns.

Disadvantages

2.1 Additional pumping will increase power and maintenance costs.
2.2 To maintain reliability, stand-by power is required to maintain pressure in the event of a power outage. The existing stand-by generator will likely have to be replaced.

3. Welded elevated steel tank-pedestal type or legged type

Advantages

3.1 Shorter transmission main than required for the Garden City Road buried reservoir site.
3.2 Can locate the tank near peak demands if land is available.
3.3 Provides a landmark if residents can agree on paint color and artwork.
3.4 Vandal resistant if a pedestal tank is constructed.

Disadvantages

3.1 The Township must purchase the land required for the reservoir.
3.2 High initial construction cost.
3.3 High maintenance costs. Steel tanks need to be repainted every 10 to 20 years. If insulated, the insulation requires repair or replacement every 5 to 6 years,
3.4 Elevated tanks are susceptible to freezing unless BTU's are added. Insulating elevated tanks tends to delay the inevitable and it is costly to maintain.
3.5 Long lead time is required for construction.
3.6 Specialists are needed to inspect the interior and exterior.
3.7 Must be taken out of service for inspection and repair.
3.8 Legged tanks are susceptible to vandalism. Both pedestal and legged tanks are susceptible to bullet damage.
3.9 Will likely generate involvement by the State Historical Preservation office.
3.10 Requires telemetry to monitor reservoir levels and transmit to the pump house.

4. Welded or bolted steel standpipe

Advantages

4.1 Lower construction costs than a welded elevated pedestal or legged tank.
4.2 Slightly shorter transmission main than needed for the Garden City buried reservoir option because of higher head range.

Disadvantages

4.1 The Township must purchase the land required for the standpipe.
4.2 Pressure fluctuations can occur because of the high head range. Typically only about 30% of the volume in storage is available for use.
4.3 Susceptible to freezing unless heated and insulated.
4.4 High maintenance costs including repair of insulation and repainting.
4.5 Need specialists to inspect the interior and exterior.
4.6 Must be taken out of service for inspection and repair.
4.7 Susceptible to bullet damage.
4.8 Requires telemetry to monitor reservoir levels and transmit to the pump house.

WATER MAIN MATERIALS

Consideration has been given to using various materials for water main piping. Pipe materials considered include ductile iron, steel, PVC, HDPE and ABS. Ductile Iron pipe is recommended for water main in Eagle River. Reasons to use ductile iron pipe include the following:

1. **Conductivity** - Ductile iron is conductive permitting the use of electrical current to thaw frozen mains and service lines. Water mains rarely freeze when installed deep enough, but service lines freeze nearly every year. Ductile iron water main is used as a conductor to facilitate thawing of service lines.

   In the case of non-conductive pipe, either the corp or curb stop has to be excavated or a large diameter conductor must be installed with the pipe.

2. **Longevity** - Ductile iron and cast iron pipe has been in service for up to 400 years. Plastic pipe has been around for about 50 years. The odds of plastic pipe having the longevity of iron pipe are very slim.

3. **Durability** - Ductile iron pipe has demonstrated the ability to take abuse. The incidental scrape by an excavator tooth does little more than scrape the coating off the ductile iron pipe. Plastic pipe on the other hand suffers severe damage.

4. **Cost of Installation** - Because of the difficulty of thawing plastic pipe, it needs to be installed at least two feet deeper than ductile iron. The additional two feet often times ends up in bedrock or under water. In either case, installation costs increase or more problems are generated for repair crews because of greater depth.

5. **Chemical Leaching** - Recent studies have indicated that cancer causing chemicals are leached out of PVC water service pipe. Most assuredly the Government will be requiring water suppliers to treat (add more chemicals) to their water so these chemicals are not leached out.

   The MDEGLE does not allow PVC for monitor wells at landfills. If PVC is not good enough for monitor wells at landfills, it should not be good enough to transport drinking water.

1. Ductile Iron pipe

Advantages

1.1 Proven life span. Cast iron pipe has been in service for over 400 years.
1.2 Conductivity facilitates pipe location.
1.3 Resistant to damage from incidental machine contact during excavation.
1.4 Low life cycle cost.
1.5 Conductivity allows thawing of frozen copper service lines.
1.6 Has proven the ability to outlast bond issues.

Disadvantages

1.1 Presumed higher initial cost.
1.2 Susceptible to corrosion if corrosive soils are present. (Galvanized pipe has been in service in Eagle River since the 1930s. Corrosion damage has not been an issue.)

2. Nonmetallic pipe (PVC, HDPE, etc.)

Advantages

2.1 Lower shipping costs
2.2 HDPE can be used where excavation is not possible or cost prohibitive.
2.3 Plastic pipe is usually not subject to damage by corrosive soils.

Disadvantages

2.1 Difficult to locate. Tracer wires often break or are not accessible in the winter.
2.2 Thawing of water main or service lines is generally not feasible.
2.3 Prone to damage by incidental contact by excavation machinery.
2.4 Lower proven life span than ductile iron.

SOURCE IMPROVEMENTS

The primary purpose of this report is to provide information required to complete the requirements stipulated by MDEGLE to apply for funding being offered by the State of Michigan. Improvements to the shaft and tunnel are not proposed in the current request for funding. The project includes costs to make changes to the existing buildings to accommodate new equipment, piping changes and new control panels or components and to improve access and security.

Shaft and tunnel replacement options are limited should the source experience sudden failure. The chance of finding an aquifer capable of supporting two or more wells capable of producing 20 gpm or more each is extremely remote. The Township needs to include in the water system budget an investigation of alternate water sources for the Eagle River system. The cost to do hydrogeological and geophysical investigations and to construct and test two test wells will likely cost at least $300,000.

SECTION VII PROPOSED PROJECT

A. PROJECT DESIGN

WATER SUPPLY

The existing water supply will not be changed. Minor changes are required to construct the improvements described herein.

TREATMENT

No treatment of the water supply is proposed for this project. The existing water supply is disinfected by chlorination, if needed, at the pump house and no changes are contemplated as part of this project.

STORAGE

A proposed 100,000 gallon, two compartment, partially buried concrete ground storage reservoir will be used to supply the five hydropneumatic tanks which now provides regulatory storage for the system. The reservoir will be built on the site of the existing pump house.

The construction of the new reservoir near the water supply shaft will require the installation of service pumps to charge the existing hydropneumatic tanks. The existing well pumps will fill the new reservoir. Fire protection is not being provided by these improvements but a 400 gpm to 500 gpm pump is included to provide sufficient water for flushing and to make the water available in storage to volunteer fire departments for water hauling operations.

PUMPING STATIONS

Theoretically, no booster pumping stations are contemplated as part of the project. The new reservoir will be filled by the existing submersible pumps in the shaft. New centrifugal service pumps will be installed to charge the hydropneumatic tanks and to provide higher flow for water main flushing. See the discussion under STORAGE above.

DISTRIBUTION LAYOUT

The project includes the installation of 4,080 feet of 8” ductile iron water main, 10,235 feet of 6" ductile iron water main, 26 hydrants and 54 gate valves installed in gate wells. No new service connections are included in the project but service lines serving existing customers will be replaced to the property line as part of the project.

A schematic drawing of the proposed water distribution system is provided in Figure 4 in Appendix A.

HYDRAULIC CALCULATIONS

The highest service location in Eagle River is the second floor of the Court House. The second floor elevation is about 680 Ft. In the proposed system, delivery of water to this location involves about 1,200 feet of 8” water main and two loops of 6 inch water main each about 3,000 feet long. The head loss in 8” pipe is about 7.8 feet per 1,000 feet at 500 gpm at a C factor 100. The head loss in 6” pipe is about 5 feet per 1,000 feet at 250 gpm at a C factor 100. The head loss in 6” pipe is about 14 feet per 1,000 feet at 500 gpm at a C factor 100. Total head loss at the Court House under a 500 gpm demand near the courthouse will be about 26 feet or about 11 psi.

The HGL at the Court House with pump shut down at 80 psi is Elevation 804. Second floor pressure is about 53 psi. With a demand of 500 gpm at the Court House, the residual pressure would be about 42 psi on the second floor.

Pressure at the Court House was also checked if one of the river crossings was out of service. Under these conditions, 500 gpm flowing through the 6 inch water main the pressure drop would be about 54 feet in TDH or about 23 psi. Residual pressure would be about 30 psi on the second floor of the courthouse.

B. COST ESTIMATES

Total project cost estimates have been prepared for the current project. The project has been broken down into two sections. Section 1 is the reservoir and pump house improvements. This cost estimate is provided in Table 5A.

Section 2 is water main, appurtenances and service line replacement. This estimate is provided in Table 7. A tabulation of the proposed water main is provided in Table 6, in Appendix B.

TOTAL PROJECT COST SUMMARY

PROJECT 1 - CONCRETE RESERVOIR AND PUMP HOUSE	$1,388,500.00
PROJECT 2 - WATER MAIN AND APPURTENANCES	$5,311,575.00
ESTIMATED TOTAL PROJECT COST	**$6,700,575.00**

A Total Project Cost Summary is provided in Table 8, in Appendix B.

C. ANNUAL OPERATING BUDGET

The improvements proposed for the DWSRF Project are not expected to have a significant impact on current operation and maintenance costs. Power consumption will increase slightly because of the addition of centrifugal service pumps. Gallons pumped per day and the TDH will not change as a result of the project change as the pumps will be operating under similar head conditions, so power cost increase should be manageable.

The construction of the water mains described herein should reduce system distribution O & M costs. As old, small diameter galvanized pipes are replaced with ductile iron water main at sufficient depth to resist freezing; distribution system repair and maintenance costs will be reduced.

A new control system will increase operation and maintenance costs slightly because there are more components. Alarm notification, including a low pressure alarm is included. A new control system, without telemetry should not materially affect monthly costs. Alarm notification is another issue that can or will increase monthly O & M costs. There is no telephone service at the pump house. Installation of phone service will likely cost more than $120 per month.

Maintenance of a buried concrete reservoir consists of roof maintenance, periodic cleaning and crack repairs. Virtually all routine maintenance, including roof repairs, can be done by readily available local craftsmen.

A rate adjustment will be needed to fund repair and replacement funds for the reservoir, pumps and water main and appurtenances. Preliminary budget projections for the years 2024 through 2028 are provided in Table 9 in Appendix B. The water system budget does not include costs for debt service because the grant/loan ratio of the funds that may be offered by EGLE is indeterminate. Debt service costs will be determined after, and if, EGLE offers a grant and loan combination that is actually affordable by the water customers in Eagle River.

D. FINANCIAL

The construction of the water distribution improvements and the construction of water storage facilities described herein will cost an estimated $6,700,575.

The median annual household income (MAHI) for Houghton Township is $51,250 according to the 2020 census. The blended MAHI for this project , with 61 customers in Houghton Township and 4 customers in Allouez Township is $51,104. Houghton Township qualifies as an Overburdened Community with the debt of this project.

It is proposed to use grants from the DWSRF to finance the improvements. If a combination grant and loan package is offered, debt service to repay the loan will be generated by adjusting user rates. The Eagle River water system currently has 64 paying customers and one non-paying customer (total, 65 customers). Houghton Township is not currently billed for water use. This policy is under review. A total of 61 customers are residential, and the other four are commercial, Government and the Bible Camp. The revenue needed to repay a loan will come from the users. With 65 customers there is very little ability to generate debt service revenue.

Current water rates for the Eagle River Water System are as follows:

Residential

Base Rate:	$10.00 per month. Includes 1,000 gallons of metered water.
Maintenance Charge:	$10.00/ month.
Consumption Charge:	$3.00/1,000 gallons over the initial 1,000 gallons

Commercial and Other Customers

Base Rate:	$10.00 per month. Includes 1,000 gallons of metered water.
Consumption Charge:	$4.00/1,000 gallons over the initial 1,000 gallons

The Eagle River water budget for the current year is attached as Table 9 in Appendix B. The total estimated revenue from water sales at the existing rate is included in the budget table.

There are many methods of distributing the rate increase across the customers. Three methods are discussed herein. To illustrate the effects of debt service on rates we have arbitrarily selected

a $1,000,000 loan to be financed over twenty years at 2.5%. These conditions are purely arbitrary and are not based on information provided or hinted at by EGLE personnel or anybody else.

The most straight forward method is to permit each customer to share equally in increase needed to generate the debt service payment. For a $1,000,000 loan at 2.5% with a 20 year term the annual debt service would be about $74,000 per year. The cost per customer would be about $96 per month for debt service only. The cost per customer including the existing base rate and not including metered water would be at least $116/month for each customer for each month during the year. Partial year customers would have to pay the minimum each month whether they are in Eagle River or not.

A second method is to base the needed rate increase on consumption. This method would adjust the rate per 1,000 gallons used. The total gallons billed for the period September 2021 through September 2022 was 1,832,495 gallons. The rate per 1,000 gallons would be about $40.40 to generate $74,000 in debt service. No minimum usage per month would be included, but the existing base rate needs to be included to cover O&M costs. Every metered gallon would be charged. The monthly bill for a residential customer using 3,000 gallons per month would be at least $140. Using the 2021-2022 gallons used by the Bible Camp, their bill for the year would be at least $18,000.

A third method distributes the rate increase between the base monthly (bi-monthly) charges and consumption. There are an infinite number of combinations that can be used with this method. Whichever one combination still must generate the debt service, the other O&M costs and money to fund the repair and replacement accounts and the bond reserve account.

It is difficult to predict total revenue if rate increases are based on consumption. Typically, usage goes down as rates increase and revenue deceases accordingly.

It is often recommended that consideration be given to using a combination of an increase in the monthly base rate plus an increase in the consumption rate to generate funds required to make the loan payments and fund the required reserve accounts. For small systems, debt service, or most of it, should be in the base rate. It is not unheard of for small systems to lose 10% of the customers to funerals in a single year. The bereaved and other survivors need to keep paying the minimum charge because the debt does not disappear.

Until the State decides on the grant and/or loan combination that might be offered to Houghton Township, if any, the calculation of rate structure options are just an exercise.

The Township has been in contact with bond attorney Steve Mann from Miller Canfield and financial advisor Mr. Andy Campbell from Baker Tilly to assist with the development of the project in the event that the State offers affordable assistance.

PUBLIC PARTICIPATION

This section will be updated after the Public Meeting

The Township held a public meeting on April 17, 2023 to discuss the proposed project, project alternatives, costs, and methods of generating revenue to pay off debt from a potential loan. The meeting was attended by the Township Board, interested citizens and representatives of Traverse Engineering Services, P.C. A copy of the meeting notice and a transcript of the discussions held at the meeting are reproduced in Appendix C.

After the meeting, the Board approved a resolution accepting the proposed alternative, authorizing the submission of the Project Plan and agreeing to implement the project if approved and provided the project is in the affordable range of the water customers.

APPENDIX A

FIGURE 1

DRAWN:
DESIGN: RDS

SCALE: VERT. N.T.S (11x17)
HORIZ. 1" = 200' (24x36)

REVISIONS	MARK	ADDENDUM/CHANGE ORDER	DATE	MARK	ADDENDUM/CHANGE ORDER	DATE	MARK	ADDENDUM/CHANGE ORDER	DATE

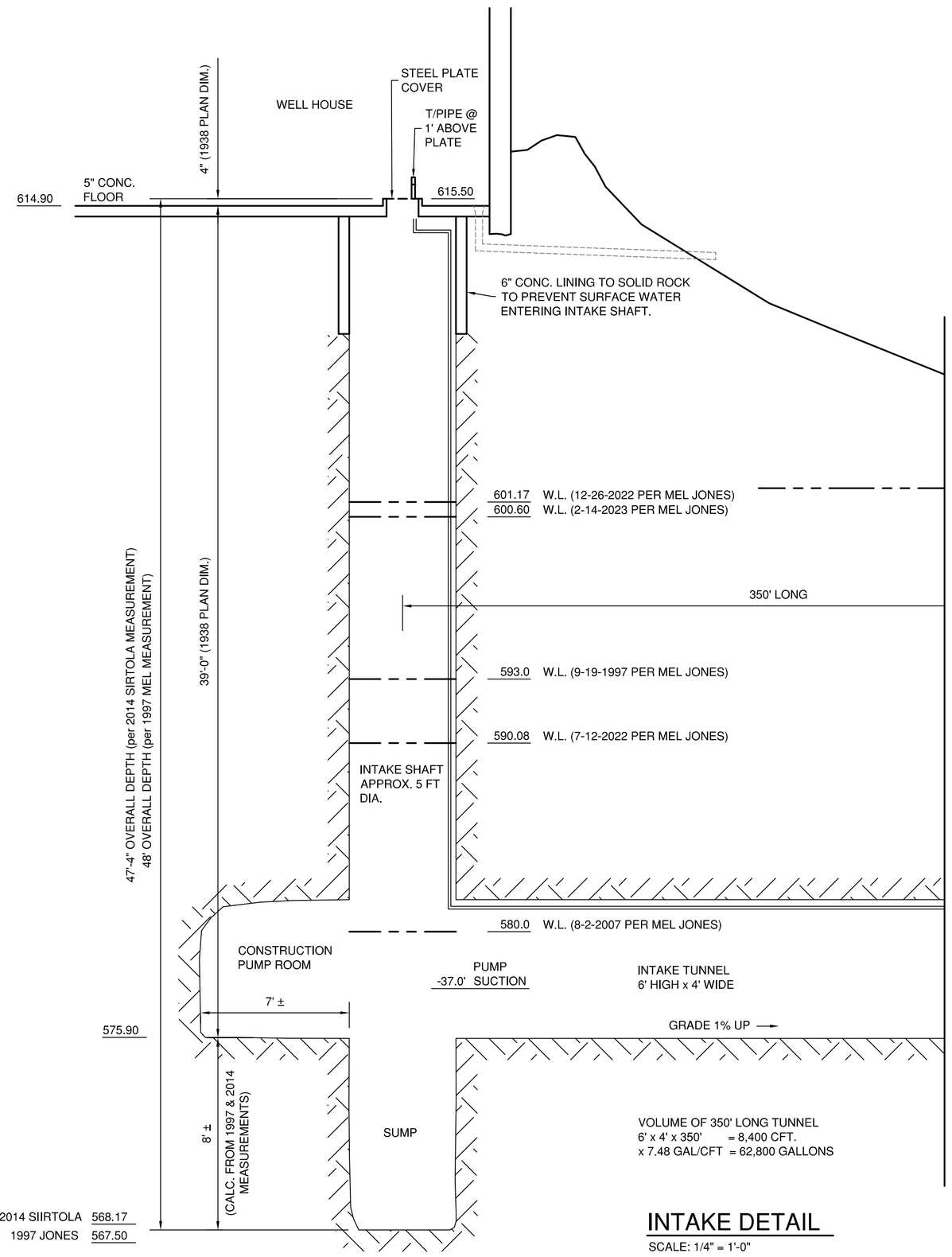
EAGLE RIVER
KEWEENAW COUNTY, MICHIGAN

TRAVERSE ENGINEERING SERVICES, P.C.
701 HANCOCK STREET, HANCOCK MICHIGAN
ENGINEERS - SURVEYORS - GEOLOGISTS
(906) 482-6696 E-MAIL: traverseengineering@gmail.com

EAGLE RIVER

EXISTING AND FUTURE SERVICE AREAS

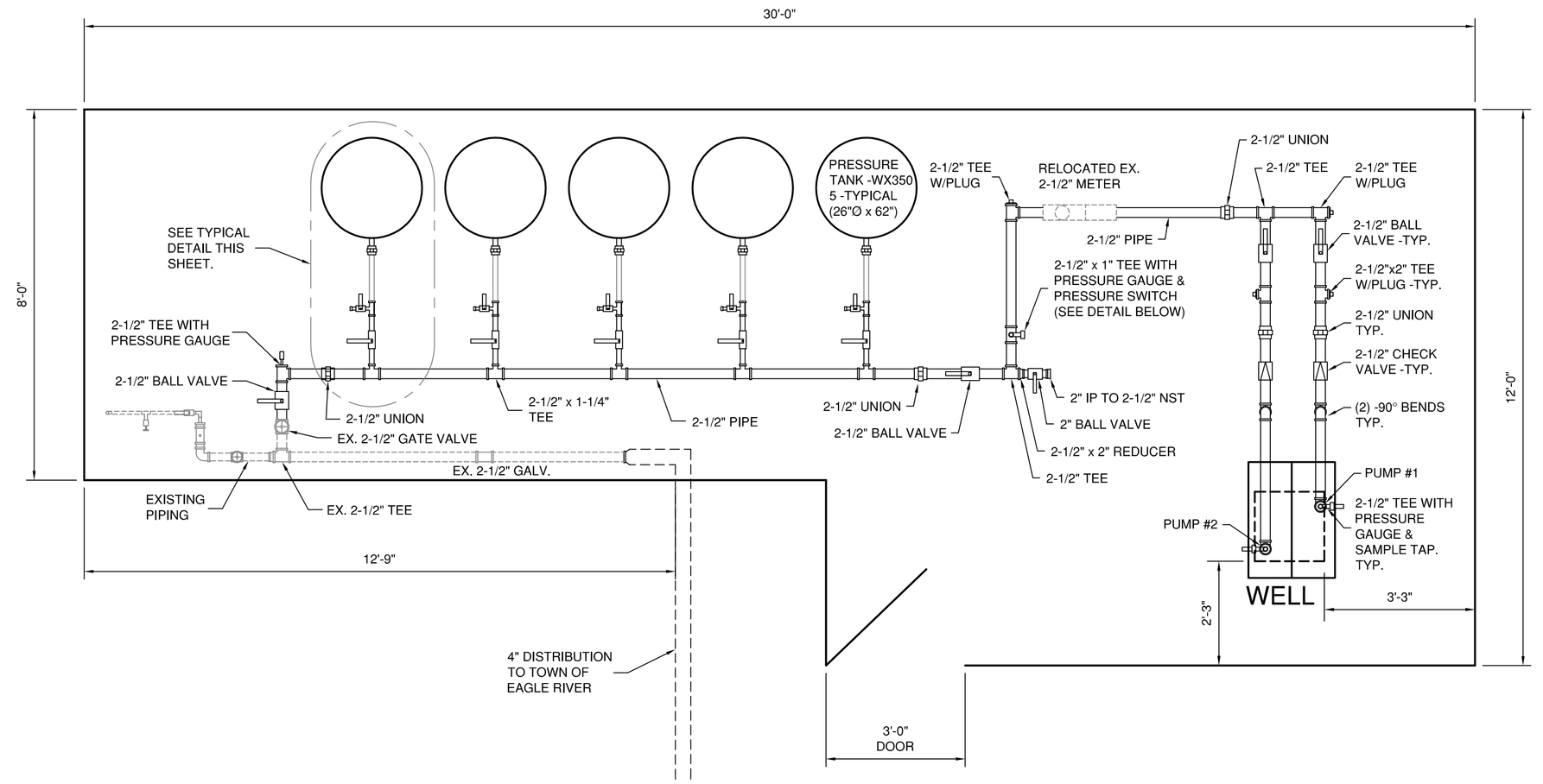
JOB NO. 524-03
3-22-23
SHEET NO. 1 OF 1



INTAKE DETAIL

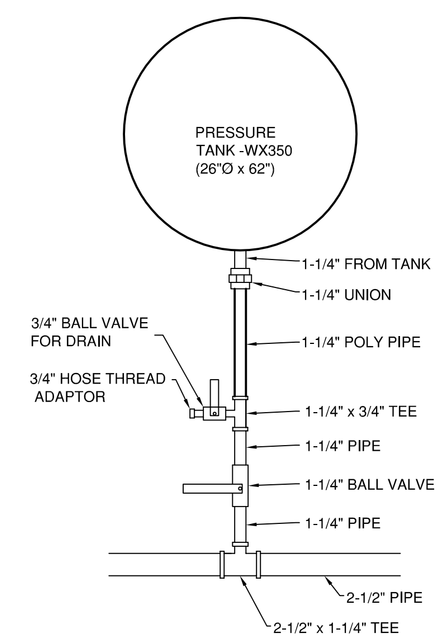
SCALE: 1/4" = 1'-0"

SHAFT & INTAKE TUNNEL IS COPIED FROM A DRAWING LABELED "VILLAGE OF EAGLE RIVER, MICHIGAN, PUMP PLANT AND INTAKE". PREPAPED BY A.H. FLOCTER, DATED APRIL 1938



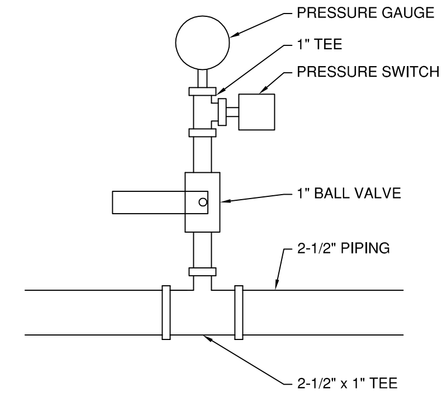
PIPING PLAN

SCALE: 1/2"=1'-0"



TYPICAL PRESSURE TANK PIPING

SCALE: 1"=1'-0"



PRESSURE SWITCH DETAIL

SCALE: 2"=1'-0"

FIGURE 2

DRAWN:
DESIGN:

SCALE: VERT. AS SHOWN
HORIZ.

REVISIONS	MARK	ADDENDUM/CHANGE ORDER	DATE	MARK	ADDENDUM/CHANGE ORDER	DATE	MARK	ADDENDUM/CHANGE ORDER	DATE

EAGLE RIVER
KEWEENAW COUNTY
EAGLE RIVER, MI 49924

TRAVERSE ENGINEERING SERVICES, P.C.
ENGINEERS - SURVEYORS - GEOLOGISTS
HANCOCK, MICHIGAN

EAGLE RIVER WELLHOUSE
WATER SYSTEM IMPROVEMENTS

EXISTING WATER SOURCE

JOB NO. 524-03
2-27-23
SHEET NO. 1 OF 1

LAKE SUPERIOR

EXISTING WELLHOUSE

3/4" SERVICE LINE

CITY OF HOUGHTON C.C.D.: L.16, PG. 853

DANIEL & JOAN STECK C.D.: 20110234

FIVE MILE POINT ROAD

MATCH LINE SEE BELOW

LAKE SUPERIOR

FRONT STREET

1-1/2"

2"

3/4" SERVICE LINE

3"

3" ABAN.

SECOND STREET

3/4"

1-1/2" PLASTIC

PLAT OF EAGLE RIVER EAST

0 50 100 200 FEET

LEGEND

EXISTING 4" WATER MAIN
EXISTING 3" WATER MAIN
EXISTING 2" WATER MAIN
EXISTING 3/4" SERV. LINE

MATCH LINE SEE TOP LEFT

1200 FT FLANGED EVERY 200 FT

4"

4" VALVE

4" TO CONDO'S

WEST LINE OF RANGE 31W SEC 19 - SEC 18

3"

3/4"

C/L M-26 (R.O.W. VARIES)

S 1/4 COR.

THIRD STREET

WEST MAIN

3/4" SERVICE LINE

EAGLE RIVER

1" 1-1/2"

3"

2"

FOURTH STREET

HWY M-26

1-1/2"

1"

ELM STREET

WEST MAIN STREET

EAST MAIN STREET

PINE STREET

MAPLE STREET

FIFTH STREET

FIGURE 3

DRAWN:
DESIGN: RDS

SCALE: VERT. N.T.S (11x17)
HORIZ. 1" = 100' (24x36)

REVISIONS	MARK	ADDENDUM/CHANGE ORDER	DATE	MARK	ADDENDUM/CHANGE ORDER	DATE	MARK	ADDENDUM/CHANGE ORDER	DATE

EAGLE RIVER
KEWEENAW COUNTY, MICHIGAN

TRAVERSE ENGINEERING SERVICES, P.C.
701 HANCOCK STREET, HANCOCK MICHIGAN
ENGINEERS - SURVEYORS - GEOLOGISTS
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EAGLE RIVER

EXISTING WATER SYSTEM

JOB NO. 524-03
3-22-23
SHEET NO. 1 OF 1

LAKE SUPERIOR

EXISTING WELLHOUSE

TWP. OF HOUGHTON Q.C.D.: L.16, PG. 853

PROPOSED 100,000 GALLON RESERVOIR

DANIEL & JOAN STECK C.D.: 20110234

FIVE MILE POINT ROAD

MATCH LINE SEE BELOW

MATCH LINE SEE TOP LEFT

LAKE SUPERIOR

FRONT STREET

SECOND STREET

THIRD STREET

FOURTH STREET

FIFTH STREET

WEST LINE OF RANGE 31W SEC 19 - SEC 18

EAGLE RIVER

WEST MAIN STREET

EAST MAIN STREET

ELM STREET

PINE STREET

MAPLE STREET

WEST MAIN

HWY M-26

PLAT OF EAGLE RIVER EAST

C/L M-26 (R.O.W. VARIES)

S 1/4 COR.

0 50 100 200 FEET

LEGEND

- PROPOSED 8" WATER MAIN
- PROPOSED 6" WATER MAIN
- PROPOSED HYDRANT
- PROPOSED GATE VALVE

FIGURE 4

DRAWN:
DESIGN: RDS

SCALE: VERT. N.T.S (11x17)
HORIZ. 1" = 100' (24x36)

REVISIONS

MARK	ADDENDUM/CHANGE ORDER	DATE	MARK	ADDENDUM/CHANGE ORDER	DATE	MARK	ADDENDUM/CHANGE ORDER	DATE

EAGLE RIVER
KEWEENAW COUNTY, MICHIGAN

TRAVERSE ENGINEERING SERVICES, P.C.
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EAGLE RIVER

PROPOSED WATER SYSTEM

JOB NO. 524-03
3-22-23
SHEET NO. 1 OF 1

APPENDIX B

TABLE 1

EAGLE RIVER WATER SYSTEM UNDERGROUND SERVICE LINE AND VALVE PROPERTIES

LAST NAME	FIRST NAME	PHYSICAL ADDRESS	Galvanized Service Line	Syle K Copper Service Line	Plastic Service Line	Old Valve Brass	New Valve Brass
GUMEE	GITCHE	5189 GARDEN CITY ROAD			YES	YES	
HACKMAN	MELODY	GARDEN CITY ROAD		YES			
ISCHER	ROBERT	5128 GARDEN CITY ROAD		YES		YES	
FERGE	LES	4TH STREET		YES		YES	
COUNTY	KEWEENAW	5059 4TH STREET	YES			YES	
HUANG		5102 4TH STREET	YES			YES	
HUOVINEN	JIM	5088 4TH STREET		YES		YES	
O'TOOLE	DANIEL	4TH STREET		YES		YES	
MILLER	ERIC	DAM STREET	YES			YES	
NEIDERER	EDITH	M-26	YES			YES	
DEAL	SHARON	M-26		YES			YES
HALL	TOM	4967 M-26	YES			YES	
HOPPER	JONANTHAN	4959 M-26	YES			YES	
STECK	DANIEL	M-26	YES				YES
HILL	BEVERLY	ELM STREET	YES			YES	
STREDER	MARIAN	ELM STREET	YES			YES	
HARTER	CHERYL	ELM STREET	YES				YES
JESSUP	ELIZABETH	ELM STREET	YES			YES	
GLIHA	GREG	WEST MAIN	YES			YES	
JAEGER	BRIAN	4957 WEST MAIN	YES			YES	
MIHELCICH	PAUL	WEST MAIN	YES			YES	
MARSH	TODD	WEST MAIN	YES				YES
MELICAN	MATTHEW	WEST MAIN			YES	YES	
OBRIAN	NORA	WEST MAIN	YES				YES
KELLY	SARAH	WEST MAIN		YES			YES
MANNISTO	GLEN	WEST MAIN	YES	YES		YES	YES
LONG	MARY	5025 WEST MAIN (GRAY HOUSE	YES			YES	
LONG	MARY	5025 WEST MAIN (WHITE HOUSE	YES			YES	
COLE	EDGAR	OLD LIGHTHOUSE	YES			YES	
ZAREMBA	JOSEPH	CONDOS #1		YES			4" VALVE

TABLE 1

LAST NAME	FIRST NAME	PHYSICAL ADDRESS	Galvanized	Syle K Copper	Plastic	Old Valve	New Valve
			Service Line	Service Line	Service Line	Brass	Brass
HARTSHOME	TIM	CONDOS #2		YES			ON MAIN
PUHEK	RICHARD	5042 WEST MAIN UNIT #3		YES			LINE
MILLER	RICHARD	CONDOS #4		YES			YES
ARNOLD	THOMAS	CONDOS #5		YES			YES
PUHEK	RICHARD	CONDOS #6		YES			YES
TREGANOWAN	JACK	7428 EAST MAIN	YES			YES	
MCEVERS	MARK	7432 EAST MAIN	YES			YES	
GREGORICH	MRS. MILES	EAST MAIN	YES				YES
COLE	EDGAR	7438 EAST MAIN		YES			YES
ROVANO	JIM	EAST MAIN	YES				YES
COLE	EDGAR	EAST MAIN	YES			YES	
INN	FITZGERALD	5033 FRONT STREET	YES			YES	
BRYANT	CHRIS	PINE STREET	YES			YES	
BURKHART	TED	PINE STREET		YES		YES	
RANDALL	RENEE	PINE STREET	YES			YES	
KOLB	MICHAEL	SECOND STREET	YES			YES	
KLINE	JOHN	SECOND STREET		YES		YES	
CHRISTENSEN	DANE	SECOND STREET		YES		YES	
SULLIVAN	TED	SECOND STREET		YES			YES
ERICKSON	GARY	5090 SECOND STREET	YES				YES
JONES	CLINT	MAPLE STREET		YES			YES
SIMULA	GLEN	MAPLE STREET		YES			YES
JOHNSON	KATHY	MAPLE STREET		YES			YES
BAYS	GARY	SECOND STREET	YES				YES
TASKILA	KIM	M26		YES		YES	
OLSON	TIMOTHY	7434 PINE STREET		YES			YES
JOHNSON	MATT	PINE STREET	YES			YES	
STEFFERS	JACQUELINE	PINE STREET	YES				YES
MONTELIONE	ANTHONY	PINE STREET	YES			YES	
MIHELCICH	JEFF	5055 STATE STREET M-26	YES			YES	
KERSHNER	ROGER	FIVE MILE POINT ROAD		YES			YES
STECK	DAN	FIVE MILE POINT ROAD		YES			YES
COLE	EDGAR	LOG CABIN		YES			YES
RAVANO	JIM	SECOND STREET		YES			YES
HOUGHTON TWP		5059 FOURTH STREET		YES			YES

TABLE 2

EAGLE RIVER WATER SYSTEM

EXISTING WATER MAIN INVENTORY

August 31, 2022

SEGMENT	STREET	FROM	TO	MATERIAL	1"	1-1/2"	2"	3"	4"	VALVES	HYDRANTS
1	Easement	Pump House	Elm Street extended	Galv. Flanged					1,220		
2	Easement	Transmission Main	Condos	Ductile Iron					400		
3	Easement	Elm Street extended	West Main Street	Galvanized				450		1	
4	Easement	W. Main Street	East Main Street	Galvanized				250		2	1
5	Elm Street	Transmission Main	Fourth Street	Galvanized				500		1	1
6	Elm Street	Fourth Street	South POE	Galvanized		150					
7	W. Main Street	Elm Street	NE POE	Galvanized	330					1	
8	W. Main Street	Fourth Street	S. to River Crossing	Galvanized				150			
9	W. Main Street	S. River Crossing	S. POE	Galvanized	210						
10	W. Main Street	N. River Crossing	N. POE	Galvanized	200						
11	E. Main Street	N River Crossing	Second Street	Galvanized				310		1	
12	E. Main Street	Second Street	N. POE	Galvanized		260				1	
13	E. Main Street	N. River Crossing	Third Street	Galvanized				110		1	1
14	Second Street	E. Main Street	Pine Street	Galvanized				470			
15	Third Street	E. Main Street	Pine Street	Galvanized				470		1	
16	Third Street	Pine Street	Maple Street	Galvanized				470		2	2
17	Fourth Street	Pine Street	Maple Street	Galvanized				450		1	
18	Fourth Street	Maple Street	Cedar Street	Galvanized				450			2
19	Easement	W. Main Street	Pine Street	Galvanized				650		2	
20	Fourth Street	Pine Street	Maple Street	Galvanized				450		1	
21	Fourth Street	Maple Street	Cedar Street	Galvanized				470			2
22	Pine Street	Easement	N. to Fourth Street	Galvanized				140			
23	Pine Street	Fourth Street	Third Street	Galvanized				480		1	
24	Pine Street	Third Street	Second Street	Galvanized				480		2	1
25	Pine Street	Second Street	Front Street	Galvanized			410			1	
26	Maple Street	Third Street	Second Street	Plastic		520					
				TOTAL	740	930	410	6,750	1,620	19	10

TOTAL FOOTAGE ALL WATER MAIN 10,450 LFT

TABLE 3

EAGLE RIVER WATER SYSTEM

PUMPING RECORDS

YEAR	TOTAL GALLONS	YEARLY GAL/Day	MIN/MO. GALLONS	MIN/DAY GALLONS	MAX DAY GALLONS	MONTH	AVERAGE GPM	MIN DAY GALLONS	MONTH	AVERAGE GPM
2011	2,424,700	6,643								
2012	2,092,203	5,732								
2013	2,388,100	6,543								
2014	3,330,600	9,125								
2015	3,338,900	9,148								
2016	2,149,800	5,890								
2017	2,469,600	6,766								
2018	3,712,300	10,171	78,000	2,600	25,800	AUGUST	18	2,910	DECEMBER	2.0
2019	2,391,100	6,551	68,300	2,277	25,800	AUGUST	18	1,958	NOVEMBER	1.4
2020	3,480,000	9,534	55,735	1,858	18,970	AUGUST	13	2,105	DECEMBER	1.5
2021	2,667,700	7,309	72,287	2,410	16,411	AUGUST	11	2,096	FEBRUARY	1.5
2022	2,382,800	6,528	62,893	2,029	17,200	July	12	1,996	DECEMBER	1.4
	AVERAGE	8,176		2,793	20,836		14			

MIMIMUM GALLONS PUMPED PER MONTH

	2018	2019	2020	2021	2022
JAN		107,182	91760	88,443	76,490
FRB		106,100		68,853	70,120
MAR		106,265			76,100
APR		100,160			
NOV	93,000	70,700	55,735	82,210	62,893
DEC	78,000	68,300	65,241	72,287	69,363
AVG/GPM	85,500	93,118	70,912	77,948	70,993
AVG/GPD	2,850	3,104	2,364	2,598	2,366
AVG/GPM	2.0	2.2	1.6	1.8	1.6

MAXIMUM GALLONS PUMPED PER MONTH

	2018	2019	2020	2021	2022
MAY	381,300				
JUNE	494,670	279,225	270,000	362,580	310,200
JULY	666,500	490,500	396,526	480,071	490,515
AUGUST	587,450	416,800	516,009	518,741	490,515
SEPTEMBER		254,000	341,250	325,650	296,000
AVG/MO	532,480	360,131	380,946	421,761	396,808
AVG/DAY	17,749	12,004	12,698	14,059	13,227
	12.3	8.3	8.8	9.8	9.2

March 21, 2023

TABLE 4

WATER USED BY CUSTOMERS OF
HOUGHTON TOWNSHIP WATER DEPARTMENT

September 30, 2021 - September 30, 2022

	NAME				GALLONS USED	OTHER	RES	GPD-RES	GPD-COM
1	Gitche Gumee Bible Camp				441,000	441,000			1,208
2	Fitzgerald				323,000	323,000			885
3	Erickson		YAR		82,000		82,000	225	
4	Treganowan		YAR		61,000		61,000	167	
5	Kershner				52,000				
6	Kline		YAR		49,000		49,000	134	
7	Huovinen		YAR		46,000		46,000	126	
8	County Buildings		YAR		42,000	42,000	42,000		115
9	Mihelcich, Paul		YAR		38,000		38,000	104	
10	Cole - old jail building				37,000				
11	Steck - mothers house				37,000				
12	Matt Johnson				35,000				
13	Kolb		YAR		30,000		30,000	82	
14	Fischer		YAR		28,000		28,000	77	
15	Hall		YAR		28,000		28,000	77	
16	Cole - Lighthouse				26,000				
17	Burkhart				26,000				
18	McEvers		YAR		25,000		25,000	68	
19	O'Toole				25,000				
20	Streder				23,000				
21	Long - main house		YAR		22,000		22,000	60	
22	Steck - lake front house		YAR		22,000		22,000	60	
23	Neiderer				21,000				
24	Huang				19,000				
25	Hill		YAR		18,000		18,000	49	
26	Marsh				16,000			1,230	
27	Deal				15,000			72	

TABLE 4

	NAME				GALLONS USED	OTHER	RES	GPD-RES	GPD-COM
28	Tim Olson				15,000				
29	Zaremba				14,000				
30	Jaeger				12,000				
31	Christensen				12,000				
32	Cole - old hotel				11,000				
33	Taskila				11,000				
34	Hackman				11,000				
35	Obrian				11,000				
36	Long - rental house				11,000				
37	Harter				10,000				
38	Simula				10,000				
39	Hartshome				10,000				
40	Montelione				9,000				
41	Paul Mihelcich - rental house				9,000				
42	Kelly				8,000				
43	Cole - Log cabin				8,000				
44	Ferge				7,000				
45	Arnold				7,000				
46	Kathy Johnson				5,000				
47	Bays				4,000				
48	Gregorich				4,000				
49	Miller				4,000				
50	Melican				4,000				
51	Mannisto				3,000				
52	Gliha				3,000				
53	Jessup				3,000				
54	Hopper - Jonathan				3,000				
55	Steffes				3,000				
56	Puhek				3,000				
57	Miller				3,000				
58	Puhek				3,000				
59	Rovano				2,000				

TABLE 4

	NAME				GALLONS USED	OTHER	RES	GPD-RES	GPD-COM
60	Jones				2,000				
61	Bryant				2,000				
62	Randall	Never turned on in 2022			0				
63	Rovano - Leblance	Never turned on in 2022			0				
64	Sullivan				2,000				
65	Township Hall				6,495	6,495			
			TOTAL SOLD		**1,832,495**	**806,000**			
			AVG GAL SOLD/DAY		5,021				
	YAR = YEAR AROUND RESIDENT								
		TOTAL PUMPED			**2,409,800**				
		AVG GAL PUMPED/DAY			**6,602**				
			DIFFERENCE gallons		**585,800**				

March 21,2023

TABLE 5A

TRAVERSE ENGINEERING SERVICES, P.C.
701 Hancock Street
HANCOCK, MICHIGAN 49930

ENGINEERS ESTIMATE

DATE OF ESTIMATE : March 22, 2023

LOCATION: HOUGHTON TOWNSHIP, KEWEENAW COUNTY

TYPE OF WORK: WATER SYSTEM IMPROVEMENTS

PROJECT DESCRIPTION: EAGLE RIVER RESERVOIR AND PUMP HOUSE IMPROVEMENTS
PUMP HOUSE SITE

Item	Est. Quantity	Unit Used	Unit Price	Amount
1. Mobilization, Bonds and Insurance	1	LSUM	$100,000.00	$100,000.00
2. Clear and Grub and Rock Excavation	1	LSUM	$10,000.00	$10,000.00
3. Access Road and Turn-around	1	LSUM	$5,000.00	$5,000.00
4. Reinforced Concrete Reservoir	1	LSUM	$480,000.00	$480,000.00
5. Reservoir Piping	1	LSUM	$80,000.00	$80,000.00
6. Reservoir Electrical	1	LSUM	$45,000.00	$45,000.00
7. Controls	1	LSUM	$30,000.00	$30,000.00
8. Well House Connection	1	LSUM	$30,000.00	$30,000.00
9. Service Pumps anf Piping	1	LSUM	$30,000.00	$30,000.00
10. Pump House Improvements	1	LSUM	$143,500.00	$143,500.00
11. Standby Generator	1	LSUM	$50,000.00	$50,000.00
12. Safety Equipment	1	LSUM	$10,000.00	$10,000.00
	SUBTOTAL CONSTRUCTION			$1,013,500.00
CONTINGENCIES, LEGAL, ENGINEERING, ETC.				$375,000.00
	ESTIMATED TOTAL PROJECT COST			$1,388,500.00

FOLDER C

TABLE 5B

TRAVERSE ENGINEERING SERVICES, P.C.
701 Hancock Street
HANCOCK, MICHIGAN 49930

ENGINEERS ESTIMATE

DATE OF ESTIMATE : March 22, 2023

LOCATION: HOUGHTON TOWNSHIP, KEWEENAW COUNTY
TYPE OF WORK: WATER SYSTEM IMPROVEMENTS

PROJECT DESCRIPTION: EAGLE RIVER RESERVOIR AND PUMP HOUSE IMPROVEMENTS
GARDEN CITY ROAD SITE

Item	Est. Quantity	Unit Used	Unit Price	Amount
1. Mobilization, Bonds and Insurance	1	LSUM	$100,000.00	$100,000.00
2. Site Clear and Grub and Rock Excavation	1	LSUM	$45,500.00	$45,500.00
3. 12" Ductile Iron Water Main	2,000	LFT	$150.00	$300,000.00
4. 12" Gate Valve & Well	4	EACH	$8,000.00	$32,000.00
5. 4" DR 11 HDPE	2,000	LFT	$40.00	$80,000.00
6. 4" Gate Valve & Box	3	EACH	$1,000.00	$3,000.00
7. Water Main Rock Excavation	1,350	CYD	$120.00	$162,000.00
8. Hydrants	3	EACH	$5,500.00	$16,500.00
9. Access Road and Turn-around	1	LSUM	$10,000.00	$10,000.00
10. Reinforced Concrete Reservoir	1	LSUM	$480,000.00	$480,000.00
11. Reservoir Piping	1	LSUM	$80,000.00	$80,000.00
12. Reservoir Electrical	1	LSUM	$30,000.00	$30,000.00
13. Controls	1	LSUM	$45,000.00	$45,000.00
14. Control Valve Vaults on the Reservoir Fill Line	1	LSUM	$60,000.00	$60,000.00
15. Pump House Improvements	1	LSUM	$103,500.00	$103,500.00
16. Restoration	2	Acres	$4,000.00	$8,000.00
17. Land Purchase	1	LSUM	$5,000.00	$5,000.00
18. Safety Equipment	1	LSUM	$10,000.00	$10,000.00
	SUBTOTAL CONSTRUCTION			$1,570,500.00
CONTINGENCIES, LEGAL, ENGINEERING, ETC.				$580,000.00
	ESTIMATED TOTAL PROJECT COST			$2,150,500.00

FOLDER E

TABLE 6

HOUGHTON TOWNSHIP

PROPOSED EAGLE RIVER WATER MAIN

March 22, 2023

SEGMENT	STREET	FROM	TO	6"	8"	HYDRANTS	VALVES
1	Easement	Pump House	Elm Street Extended	20	1220	1	1
2	Easement	Elm Street	West Main Street		440	1	1
3	Elm Street	Easement	South of Fourth Street	180	520	2	3
4	West Main Street	Easement	Front Street		630	1	2
5	North River Crossing	One side	The other side		150		
6	Fourth Street (M-26)	West Main Street	West to West Main (Easement)	300	500	2	3
7	West Main Street	Fourth Street	South to the River Crossing		440	1	
8	South River Crossing	One side	The other side		180		2
9	Front Street	East Main Street	Maple Street	900		1	5
10	East Main Street	Front Street	Third Street	700		2	4
11	Pine Street	Front Street	Fourth Street	1,275		3	6
12	Maple Street	Front Street	Fourth Street	1,370		3	6
13	Second Street	East Main Street	Maple Street	920			3
14	Third Street	East Main Street	Maple Street	920		1	4
15	Fourth Street	East Main Street	Maple Street	880		3	5
16	Garden City Road	Maple Street	POE at the Bible Camp	750		2	2
17	West Main Street (Esmt)	M-26	Northerly POE @ W. Main St.	900		1	5
18	Easement (Pine & Fifth)	South side of River	East and North to Fourth Street	1,120		2	2
19	M-26	West Main Street crossing	Bore and Jack Casing				
20	M-26	Pine Street Crossing	Bore and Jack Casing				
21	M-26	Maple Street Crossing	Bore and Jack Casing				
			TOTALS	10,235	4,080	26	54

TOTAL FOOTAGE ALL WATER MAIN 14,315 LFT

TABLE 7

TRAVERSE ENGINEERING SERVICES, P.C.
701 Hancock Street
HANCOCK, MICHIGAN 49930

ENGINEERS ESTIMATE

DATE OF ESTIMATE : March 22, 2023

LOCATION: HOUGHTON TOWNSHIP, KEWEENAW COUNTY

TYPE OF WORK: WATER SYSTEM IMPROVEMENTS

PROJECT DESCRIPTION: EAGLE RIVER WATER MAIN AND APPURTENANCES

Item	Est. Quantity	Unit Used	Unit Price	Amount
1. Mobilization	1	LSUM	$150,000.00	$150,000.00
2. 8" Ductile Iron Water Main	4,080	LFT	$95.00	$387,600.00
3. 8" and 6" Gate Valve & Well	54	EACH	$8,000.00	$432,000.00
4. 6" Ductile Iron Water Main	10,235	LFT	$85.00	$869,975.00
5. 6" Gate Valve & Box	2	EACH	$2,600.00	$5,200.00
6. 4" Gate Valve & Box	3	EACH	$2,500.00	$7,500.00
7. Hydrants	26	EACH	$6,000.00	$156,000.00
8. 1" Corp and Tapping Saddle	65	EACH	$300.00	$19,500.00
9. 1" Curb Stop	65	EACH	$300.00	$19,500.00
10. 1" Copper Water Service	2,400	LFT	$60.00	$144,000.00
11. 1" Copper Water Service Connection	65	EACH	$1,500.00	$97,500.00
12. Temporary Water Service	1	LSUM	$30,000.00	$30,000.00
13. Rock Excavation	4,300	CYD	$125.00	$537,500.00
14. M-26 Bore and Jack 24" Casing	240	LFT	$500.00	$120,000.00
15. 6" and 8" Plug & Thrust	6	EACH	$800.00	$4,800.00
16. South River Crossing	1	LSUM	$100,000.00	$100,000.00
17. North River Crossing	1	LSUM	$100,000.00	$100,000.00
18. Pavement Repair	14,000	SYD	$45.00	$630,000.00
19. Restoration	9	Acres	$4,000.00	$36,000.00
20. Traffic Control	1	LSUM	$30,000.00	$30,000.00
	SUBTOTAL CONSTRUCTION			$3,877,075.00
CONTINGENCIES, LEGAL, ENGINEERING, ETC.				$1,434,500.00
	ESTIMATED TOTAL PROJECT COST			$5,311,575.00

FOLDER D

TABLE 8

HOUGHTON TOWNSHIP
EAGLE RIVER WATER SYSTEM IMPROVEMENTS
COST ESTIMATE

March 22, 2023

ADMINISTRATION			
Bond Counsel			$ 70,000
Legal			$ 14,000
Finiancial Advisor			$ 20,000
Legal Advertising			$ 5,000
Bid Advertising			$ 4,000
Treasury Costs			$ 10,000
SUBTOTAL ADMINISTRATION			$ 123,000
ENGINEERING SERVICES			
Preliminary Engineering			$ 8,000
Basic Engineering			$ 321,500
Additional Engineering Services			
Staking	$ 16,000		
Survey/Easements	$ 12,000		
Soil Borings	$ 18,000		
O & M Manual	$ 8,000		
Testing/Control	$ 8,000		
As-Built Drawings	$ 6,000		
Subtotal Additional Engineering	$ 68,000		$ 68,000
Construction Review			$ 362,000
SUBTOTAL ENGINEERING			$ 759,500
CONSTRUCTION			
Water Main and Appurtenances			$ 3,877,075
Ground Level Reservoir			$ 1,013,500
SUBTOTAL CONSTRUCTION			$ 4,890,575
CONTINGENCIES			$ 927,000

ESTIMATED TOTAL PROJECT COST $ 6,700,075

FOLDER F

TABLE 9

Houghton Township Water System Budget Projections

INCOME

	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
Water Sales	$21,330.30	$21,113.60	$20,113.60	$20,022.80	$20,601.40	$30,902.00	$41,203.00	$42,439.09	$43,712.26	$45,023.63	$46,374.34
Construction Fees	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
Hook-up Fees	$1,000.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
Delinquent Fees	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
Late Fees	$42.58	$18.91	$73.07	$47.83	$83.53	$50.00	$50.00	$50.00	$50.00	$50.00	$50.00
Interest-Checking	$38.08	$52.06	$57.88	$41.86	$49.20	$49.20	$98.40	$98.40	$98.40	$98.40	$98.40
Interest-CD	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
Other Income	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
Debt Repayment	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
Total Income	**$22,410.96**	**$21,184.57**	**$20,244.55**	**$20,112.49**	**$20,734.13**	**$31,001.20**	**$41,351.40**	**$42,587.49**	**$43,860.66**	**$45,172.03**	**$46,522.74**

EXPENSES

	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
Cost of Meters	$0.00	$0.00	$0.00	$0.00	$0.00	$200.00	$200.00	$200.00	$200.00	$200.00	$200.00
Utilities	$1,041.62	$796.75	$1,029.17	$930.70	$974.07	$974.07	$1,022.77	$1,073.91	$1,127.61	$1,183.99	$1,243.19
Water Tests	$1,398.00	$600.00	$1,283.00	$2,054.00	$1,415.00	$1,415.00	$1,485.75	$1,560.04	$1,638.04	$1,719.94	$1,805.94
Wages	$4,675.00	$5,377.50	$4,812.50	$4,118.75	$4,628.75	$4,628.75	$4,860.19	$5,103.20	$5,358.36	$5,626.27	$5,907.59
Repairs	$1,538.50	$3,660.89	$8,405.00	$2,170.00	$0.00	$5,000.00	$5,000.00	$5,000.00	$5,000.00	$5,000.00	$5,000.00
Vehicle Expense (Travel)	$255.00	$494.74	$0.00	$377.60	$224.45	$400.00	$420.00	$441.00	$460.00	$460.00	$460.00
Supplies	$299.63	$108.92	$724.52	$62.19	$779.09	$800.00	$840.00	$882.00	$926.10	$972.41	$1,021.03
Postage	$157.90	$165.00	$110.00	$171.00	$118.00	$175.00	$183.75	$192.94	$202.58	$212.71	$223.35
Office Expense (internet/wireless)	$0.00	$516.74	$649.00	$649.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
Telephone	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$1,450.00	$1,522.50	$1,598.63	$1,678.56
Payroll Taxes	$357.64	$411.36	$368.17	$315.08	$354.11	$354.11	$371.82	$390.41	$409.93	$430.42	$451.94
Prof. Svcs-Audit, Att.	$1,200.00	$500.00	$1,200.00	$550.00	$1,200.00	$550.00	$1,200.00	$600.00	$1,200.00	$1,200.00	$1,200.00
Prof. Svcs-Contract	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
Prof. Svcs-Engineering	$0.00	$0.00	$0.00	$0.00	$0.00	$34,500.00	$0.00	$0.00	$0.00	$0.00	$0.00
Insurance - General	$763.00	$763.00	$763.00	$763.00	$882.00	$882.00	$926.10	$972.41	$1,021.03	$1,072.08	$1,125.68
Insurance - Worker's Comp	$372.00	$377.00	$0.00	$377.00	$104.00	$104.00	$109.20	$114.66	$120.39	$126.41	$132.73
Capital Expense	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
Miscellaneous Expense	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
Water Operator License	$418.15	$994.69	$745.02	$670.13	$1,105.97	$1,105.97	$1,161.27	$1,219.33	$1,280.30	$1,344.31	$1,411.53
Repair and Replacement	$0.00	$0.00	$0.00	$0.00	$0.00	$11,000.00	$21,965.00	$21,965.00	$21,965.00	$21,965.00	$21,965.00
Debt Service	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
Depreciation	3155.92	$4,092.80	$936.89	$0.00	$936.89	$936.89	$983.73	$1,032.92	$1,084.57	$1,138.80	$1,195.74
Total Expenses	**$15,632.36**	**$18,859.39**	**$21,026.27**	**$13,208.45**	**$12,722.33**	**$63,025.79**	**$40,729.58**	**$42,197.81**	**$43,516.40**	**$44,250.97**	**$45,022.27**

March 22, 2023