TETRA TECH

Memorandum

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Project: City of Molalla: PFAS Treatment & Alternatives **Project Number:** 200-12419-25001

This study was funded by the Bipartisan Infrastructure Law awarded by the Environmental Protection Agency (EPA) through Business Oregon and The Oregon Health Authority's (OHA) Drinking Water State Revolving Fund."

The City of Molalla has had at least one positive test for PFAS in the last several years. Although PFAS treatment is not currently required, PFAS treatment options and alternatives to treatment are evaluated as follows:

- Tetra Tech reviewed water quality data provided by the City of Molalla (City) for their Water Treatment Plant (WTP) to determine if treatment is required to meet current and future proposed PFAS regulations known at this time.
- Tetra Tech evaluated the three main PFAS treatment alternatives: Granulated Activated Carbon (GAC), Ion Exchange (IX), and Reverse Osmosis/Nanofiltration. This evaluation includes preliminary capitol costs, O&M costs, and an implementation schedule.
- Tetra Tech identified alternatives to providing PFAS treatment including connecting to alternative water supply systems, the purchase of other water rights and/or well development and provides preliminary capitol and O&M costs.
- Tetra Tech compared the alternatives.

The following sections outline our findings.

EXISTING WATER TREATMENT PLANT

The existing WTP obtains water through an intake on the Molalla River. Water is conveyed directly to the WTP via a raw water pump station, which pumps on average 1.23 MGD and a maximum 2 MGD. The pump station is equipped with three pumps, two 1400 gpm pumps and one 800 gpm pump. The 800 gpm pump is rarely used. The City will either run with one pump through the WTP at a production rate of 1400 gpm; or two pumps at 2800 gpm.

To meet the average daily demand of 1.23 MGD, a single pump will operate about 60% of the time; or two pumps will operate 30% of the time. To meet the maximum daily demand of 2 MGD, two pumps will operate for about 50% of the time.

The existing conditions are summarized in Table 1.

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Table 1. Water Treatment Plant Flow Data

Criteria	WTP Data
Production Rate (Maximum)	2,800 gpm
Production Rate (Minimum)	1,400 gpm
Production Rate (Average)	1,400 gpm
Operational Schedule	Varies
Daily Volume (Average)	1.23 MGD

REVIEW OF WATER QUALITY

Tetra Tech reviewed the water quality provided by the City. WTP was found to have PFAS compounds in the water samples. The samples were taken in 2023, on three separate months – January, April and July. For each sample, 30 analytes were tested. Of the 90 sample results, only one contaminant had a result measure above the Modified Reporting Limit (MRL). PFAS analyte 6:2 Flourotelomer Sulfonate (6:2 FTS) was detected in the raw water per a singular lab study in January 2023, then was below the MRL for the rest of the year. The remainder of the 89 sample results were below the MRL (i.e., non-detect). Table 2 contains the results for the two most common PFAS contaminants (PFOS and PFOA) along with results of the four (4) other contaminates the EPA has proposed Maximum Contaminant Level Goals (MCLG) and Maximum Contaminate Levels (MCL).

Table 2. Water Treatment Plant Water Quality Data

Contaminant	WTP Data (ng/L)
PFOA	ND
PFOS	ND
PFBS	ND
Gen X	ND
PFNA	ND
PFHxS	ND
PFPeA	ND
PFHxA	ND

Note: ND is Nondetectable below the laboratory reporting limit.

Other inorganic contaminants that can affect Granular Activated Carbon (GAC) or Ion Exchange (IX) treatment processes include the following:

- Nitrate
- Sulfate
- Alkalinity
- Iron

- Manganese
- Turbidity
- Suspended Solids
- Total Organic Carbon

Additional testing may be required to determine the effect these contaminants have on GAC or IX systems.

Nitrate, sulfate, and TOC can compete for GAC and IX resin adsorption, reducing the bed life. Iron, manganese, high turbidity, and high suspended solids can cause clogging and channeling in resins and medias. Complete water quality data from the past 3 to 5 years should be reviewed to finalize any recommendations based on feed water quality.

REGULATORY REQUIREMENTS

The Oregon Health Authority sets water quality standards for drinking water systems. Currently the state has 2 years to adopt the EPA regulations for PFAS contaminants that were set in 2024. These advisory levels are shown in Table 3.

Table 3. EPA PFAS Advisory Levels

Contaminant	State Action Level (ng/L)
PFOA	4
PFOS	4
PFNA	10
PFHxS	10
GenX	10
Mixtures containing two or more: PFHxS, PFNA, HFPO-DA, and PFBS	1 (unitless) Hazard Index

On April 10, 2024, EPA announced the final National Primary Drinking Water Regulation (NPDWR) to establish legally enforceable level, call Maximum Contaminate Levels (MCLs), for six PFAS in drinking water. PFOA and PFOS as individual contaminants and PFHxS, PFNA, PFBS, and HFPO-DA (commonly referred to as GenX Chemicals) as a PFAS mixture. EPA is also proposing health based, non-enforceable Maximum Contaminant Level Goals (MCLGs) for these six PFAS.

On May 14, 2025, EPA announced its intent to rescind the regulations and reconsider the regulatory determinations for PFHxS, HFPO-DA (commonly known as Gen X), and the Hazard Index mixture of these three plus PFBS. The revised ruling sets the MCL and MCLGs only for PFOA and PFOS.

The contaminant levels are shown in Table 4.

Table 4. EPA NPDWR Levels

Contaminant	Final MCLG (ng/L)	Final MCL (ng/L)
PFOA	0.0	4.0
PFOS	0.0	4.0

Notes:

The proposed MCL will be an enforceable standard. The Hazard index is calculated as follows:

HI = (GenX/10) + (PFBS/2,000) + (PFNA/10) + (PFHxS/9)

The proposed rule would also require public water systems to:

- Monitor for these PFAS
- Notify the public of the levels of these PFAS
- Reduce the levels of these PFAS in drinking water if they exceed the proposed standards.

TREATMENT ALTERNATIVES

PFOS and PFOA can be removed from water in various ways. The three most common methods include:

- Granular Activated Carbon (GAC)
- Ion Exchange (IX) using single use resin
- Reverse Osmosis (RO) / Nanofiltration (NF)

Table 5 contains the advantages and the disadvantages of each option.

Table 5. Comparison of Treatment Methods

Technology	Advantages	Disadvantages
GAC	• Proven for PFOS & PFOA Removal • Removes other VOCs and Organics • Lower Energy Costs • Lower Media Costs/CF • Media can be regenerated • Can tolerate small amounts of suspended solids	• Long EBCT (≥10 min.) • More or Larger Vessels Required as compared with IX • Backwash Facilities Required • Not as Effective on short chain PFAS
IX	• Proven for PFOS & PFOA Removal • More Effective on short chain PFAS • Short EBCT (2-3 min.) • Fewer or Smaller Vessels Required as compared with GAC • No Backwash Facilities Required	• Requires suspended solids pre-treatment filters to protect expensive IX resin • Does not remove VOCs or Organics • Higher Energy Costs • Higher Media Cost/CF • Media must be incinerated or disposed of • Regulators may require pilot testing prior to approval
NF/RO	• Proven to remove a wide range of PFAS compounds • Removes many other dissolved contaminates • Physical Barrier for Undetected PFAS	• High Capital Cost • Higher Energy Cost • High Operational Costs • More Complex Technology to Operate • Concentrate Disposal is a major concern

PRELIMINARY TREATMENT SIZING

The most common forms of PFAS treatment are GAC and IX media treatment. The use of NF or RO while affective at PFAS removal, are not cost effective in this type of application, further it produces a 20% waste stream which would have problematic disposal concerns in this application.

GAC and IX system sizing is based on the minimum Empty Bed Contact Time (EBCT) required to successfully adsorb a particular pollutant and the allowable superficial velocity, or hydraulic loading rate of the vessel. Tetra Tech provided preliminary sizing below for GAC and IX based on the raw water pump production rate of 2,800 gpm, and water quality received.

Granular Activated Carbon

GAC treatment for PFAS is configured in 2-vessel trains, with one train acting as the lead and the second train acting as the lag (i.e., the vessels operate in series). The standard train (2 vessels) GAC treatment systems are widely commercially available in 3 sizes for this size of a plant: 10-ft diameter with 700 cubic feet of GAC media per vessel, 12-ft diameter with 700 cubic feet of GAC media per vessel, or 12-ft diameter with 1,400 cubic feet of GAC media per vessel. The Molalla Water Treatment Plant could be configured with six (6) trains with a total of twelve (12) vessels for either 10-ft diameter units or the “short” 12-ft diameter units, or with three (3) trains with a total of six (6) vessels of the 12-ft diameter “tall” units. In addition, GAC systems should consider the need for a large backwash waste tank (up to 50,000 gallons), or the ability to discharge up to 1,000 gpm of backwash waste to sewer during a media replacement.

Table 6. GAC Treatment Sizing Alternatives for Water Treatment Plant

Parameter	Alternative A: 10-ft Vessel 700 ft³ GAC	Alternative B: 12-ft Vessel 700 ft³ GAC	Alternative C: 12-ft Vessel 1,400 ft³ GAC
Design Flow Rate (gpm)	2,800	2,800	2,800
PFAS Treatment Concept: Number of GAC Trains Flow per Train (gpm) EBCT (min) Superficial Flow (gpm/sf)	 6 500 10.71 5.9	 6 500 10.71 4.1	 3 1,000 10.71 8.3
GAC Media per Vessel (ft^3)	700	700	1,400
Vessel Diameter (ft)	10	12	12
System Height (ft)	19' – 11"	15' – 4"	23' – 0"
Vessel Surface Area (sf)	78.5	113	113
Allowable Superficial Flow (gpm/sf)	4.0 – 10.0		
Design Minimum EBCT (min)	10		

Ion Exchange

IX treatment for PFAS removal is configured in 2-vessel trains, with one train acting as the lead and the second train acting as the lag (i.e., the vessels operate in series). The standard train (2 vessels) IX treatment systems are widely commercially available in 2 sizes for this size of a plant: 10-ft diameter with an allowable treatment flow rate of 500 to 1,400 gpm per train, or 12-ft diameter with an allowable treatment flow rate of 700 gpm to 2,000 gpm. Ion exchange resin has a high headloss per ft of bed depth, and for this reason many facilities cap their treatment capacity based on a maximum resin depth of 3.7-ft per vessel. Therefore, for PFAS treatment most plants have limited their IX systems to 1,600 gpm maximum for 12-ft vessels.

The Molalla Water Treatment Plant could be configured with three (3) trains with a total of six (6) vessels for the 10-ft diameter units, or with two (2) trains with a total of four (4) vessels for the 12-ft diameter units. Before selecting, a head loss analysis is recommended to consider which approach is more reasonable. In addition, most of the IX plants for PFAS removal limit capacities to 1,600 gpm, which may result in some hesitation by the Health Department to accept a higher hydraulic loading rate without further testing.

An IX system needs to also consider the installation of 5-micron pre-treatment cartridge or bag filters ahead of the IX vessels.

Table 7. IX Treatment Sizing Alternatives for Water Treatment Plant

Parameter	Alternative A: 10-ft Vessel 294 ft^3 IX	Alternative B: 12-ft Vessel 550 ft^3 IX
Design Flow Rate (gpm)	2,800	2,800
<u>PFAS Treatment Concept:</u> Number of IX Trains Flow per Train (gpm) EBCT (min) Superficial Flow (gpm/sf)	 3 1,000 3.40 11.9	 2 1,600 2.27 12.4
IX Resin per Vessel (ft^3)	424	424
Vessel Diameter (ft)	10	12
System Height (ft)	19' – 11"	15 – 4"
Vessel Surface Area (sf)	79	113
Allowable Superficial Flow (gpm/sf)	6 - 14	
Design Minimum EBCT (min)	1.5	

Budgetary Cost Information

In comparing the proposed treatment options for the PFAS at Molalla Water Treatment Plant, Tetra Tech has prepared similar cost estimates for plants of a similar size. The following numbers can be used for budgetary cost information as the City continues to investigate its options. Typically, the capital costs for the GAC systems are more expensive as there is typically more equipment. The capital and O&M costs are based on 2025 US Dollars.

The costs for a typical 2,800 gallon GAC treatment system are:

- Capital Cost of $8.2 Million
- O&M Cost of $0.4 Million

The costs for a typical 2,800 gallon IX treatment system are:

- Capital Cost of $6.7 Million
- O&M Cost of $0.5 Million

PFAS Treatment Location:

There are several locations at the existing Water Treatment Plant (WTP) where PFAS treatment could be located. The exact location would need to be determined in a predesign report should the City need to add the treatment. The PFAS treatment would be plumbed such that it connects to the system after the existing treatment train.

Inside the treatment building there is a location at the south end where the old filters were removed. The PFAS treatment system could potentially be located there, but the required space would need to be verified in a predesign report. The pipe would also need to be aligned such that the PFAS treatment system is plumbed in after the filters.

Outside the treatment building there are two locations where the PFAS treatment system could be located: Immediately north of the WTP building, and to the east of the building at the north end. Again, a predesign report would determine which location is the best fit. See Figure 1 for PFAS Treatment Locations at the City's Water Treatment Plant.

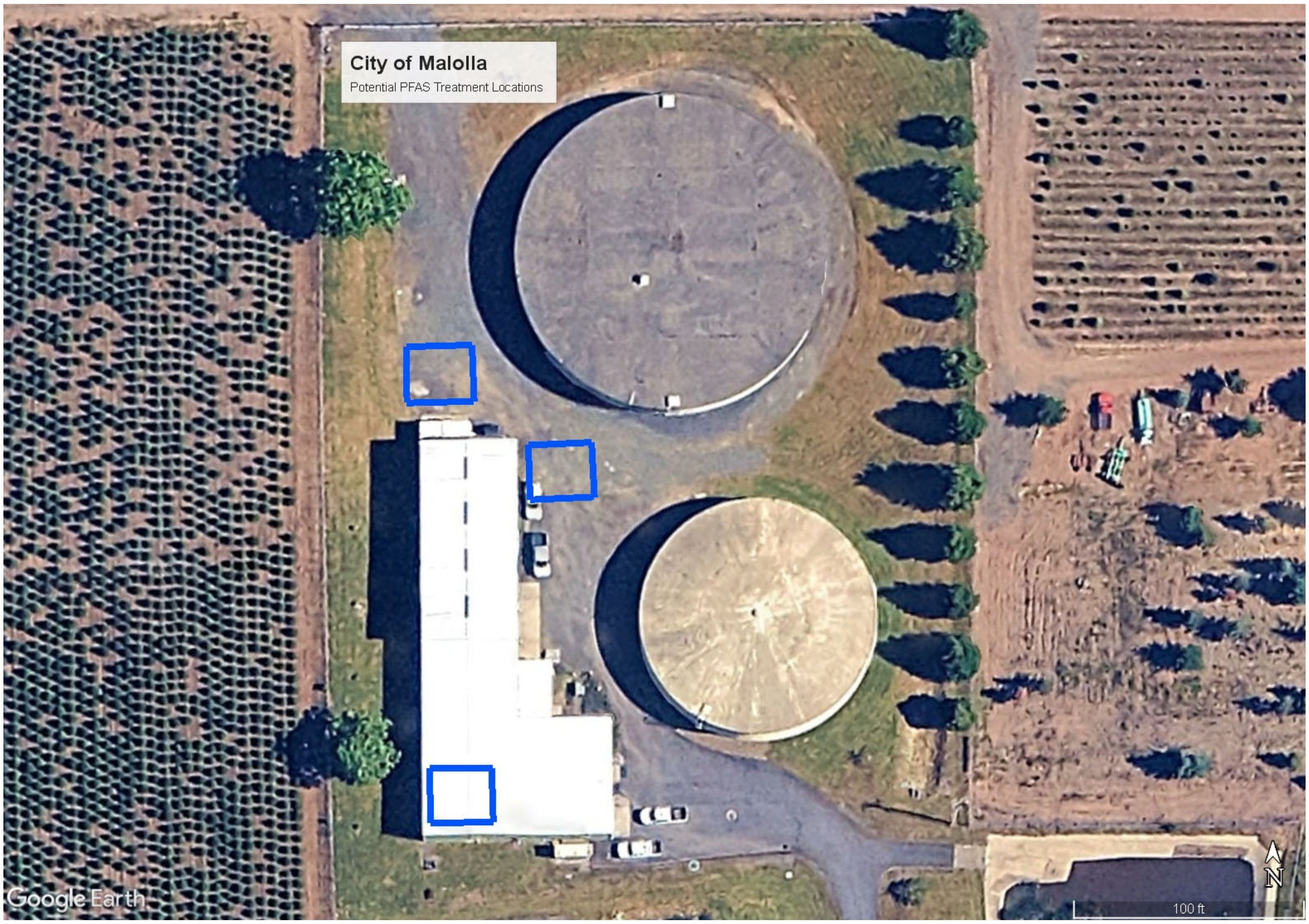

Figure 1: Potential PPFAS Treatment Locations

PFAS TREAMENT SUMMARY

After reviewing the water quality data and evaluating the latest SALs and the EPA final NPDWR Levels we found the following:

- PFAS analyte 6:2 Flourotelomer Sulfonate (6:2 FTS) was found in Molalla Water Treatment Plant. This was the only contaminant that had a result measure above the Modified Reporting Limit (MRL). It was detected in the raw water per a singular lab study in January 2023. For the rest of the year 2023, the results were below the MRL.
- These results indicate the City of Molalla is not currently required to install treatment system to remove PFAS.
- Additional water quality testing should be completed to test contaminants that can affect GAC and IX treatment processes.

- Final determination of the recommended treatment process and costs will be dependent on these factors.

ATERNATIVES TO PFAS TREAMENT

Based upon water test results to date, the City does not need to pursue PFAS treatment at this time. However, if regulations change or if the monitoring of the City water consistently shows the presence of PFAS, PFAS treatment or an alternative would be needed. A preliminary review of alternatives to PFAS treatment is presented below.

The Molalla River is the raw water source for the City's system. If PFAS becomes an issue, and the City does not want to treat for PFAS, the City would need to obtain a replacement water source with sufficient supply to meet the City's demand. The projected water demand for the City of Molalla is 4 mgd. (20-year projection)

This eliminates water source replacement alternatives such as aquifer storage and recovery (ASR) or the purchase of additional water rights from the Molalla River.

- The ASR approach is putting the City's current water and putting it into the ground and then pumping it back out. This method is implemented to stretch the existing water source by making it available in summer months when it is required. However, this method would use the same water source and would not eliminate the requirement for PFAS treatment.
- Purchasing additional water rights on the Molalla River is obtaining more of the same water and would also not eliminate the requirement for PFAS treatment.

Potential Alternatives:

- Drill new wells in the vicinity of Molalla.
- Purchase existing wells and water rights in the vicinity of Molalla.
- Connect to a different water supply that is free of PFAS. There are two adjacent water systems that may be large enough to supply the City of Molalla: (See Figure 2)
    - The City of Oregon City
    - The City of Woodburn

A preliminary evaluation of each of these alternatives is presented including preliminary improvements, capitol costs, and operations and maintenance costs. (O&M)

Drilling New Wells:

A preliminary evaluation of drilling new wells near Molalla was conducted by Summit Water Resources, LLC in September of 2024. This is a summary of what they found. Wells in the area are estimated to produce from 300 to 1,000 gpm. Based upon this the City would require 4 to 5 wells.

It is unclear where these wells could be drilled, and it is likely that there would be land purchase and piping line costs. It is also unclear if treatment would be required. Many wells do not require treatment, some require disinfections, and some require additional treatment. The Summit report did not evaluate the water quality and what if any treatment would be required, nor where the wells could be drilled.

The Summit report did assess the potential for obtaining water rights. Due to the new regulations regarding water rights, it is unlikely that the City would be able to obtain new water rights for year round use. The most feasible option would be to purchase water rights and transfer them to the new wells. Approximately 98% of the wells and water rights in the area are for irrigation or nursery use. These are often restricted to use from March through October. It is unlikely these could be modified to authorize year-round municipal use.

Due to the water right issues, this is not considered a feasible alternative to replace the Molalla water source. The cost for this alternative will not be developed.

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Woodburn:

The City of Woodburn obtains water from multiple wells that are directed to three water treatment plants. The capacity of the three treatment plants, when originally constructed, was 8.7 mgd. A fourth treatment plan is shown for the future. The Water System Master Plan is being updated but is not complete, therefore, it is not clear how much extra capacity the City has in both raw water source and treatment.

However, based on existing treatment capacity it is unlikely that the City of Woodburn would be able to provide the 4 mgd required for the Molalla system. The following cost estimate is developed accordingly.

To obtain treated water from the City of Woodburn the flowing facilities would be required at a minimum:

- Approximately 12 miles of 18-inch conveyance pipe to transmit 4mgd at approximately 3.5 fps.
- A 4mgd pump station, including master meter and backflow prevention.
- Additional supply and treatment improvements in the City of Woodburn.
    - Assuming one new treatment plan and three new wells.
- Connection fee is assumed to be equal to the SDC of two 10-inch meters
- An intergovernmental agreement (IGA)

The estimates costs for procuring treated water from the City of Woodburn:

- Capital Cost of $60 Million
- Connection Fee of $70 Million
- O&M Cost of $0.2 Million

Oregon City:

Oregon City receives water from the South Forks Water Board which supplies water to both Oregon City and West Linn. The raw water comes from the Clackamas River, and the capacity of the system is estimated to be between 22 and 23 mgd, and many of its components of the system are near capacity including the treatment plant. It appears that there is sufficient water source, but improvements to the system would be required to provide 4 mgd to the City of Molalla.

To obtain treated water from the City of Oregon City the flowing facilities would be required at a minimum:

- Approximately 17 miles of 18-inch conveyance pipe to transmit 4mgd at approximately 3.5 fps.
- A 4mgd pump station, including master meter and backflow prevention.
- Additional supply and treatment improvements in the City of Oregon City.
    - Assuming treatment plant upgrades.
- Connection fee is assumed to be equal to the SDC of two 10-inch meters
- An intergovernmental agreement (IGA)

It is likely that the City would pay a premium for the water from the South Forks Water Board. It is typical to charge customers outside of the community up to 1.5 times what is charged in town. This is a negotiated cost that cannot be defined at this time.

The estimates costs for procuring treated water from the City of Oregon City:

- Capital Cost of $60 Million
- Connection Fee of 60 Million
- O&M Cost of $0.2 Million

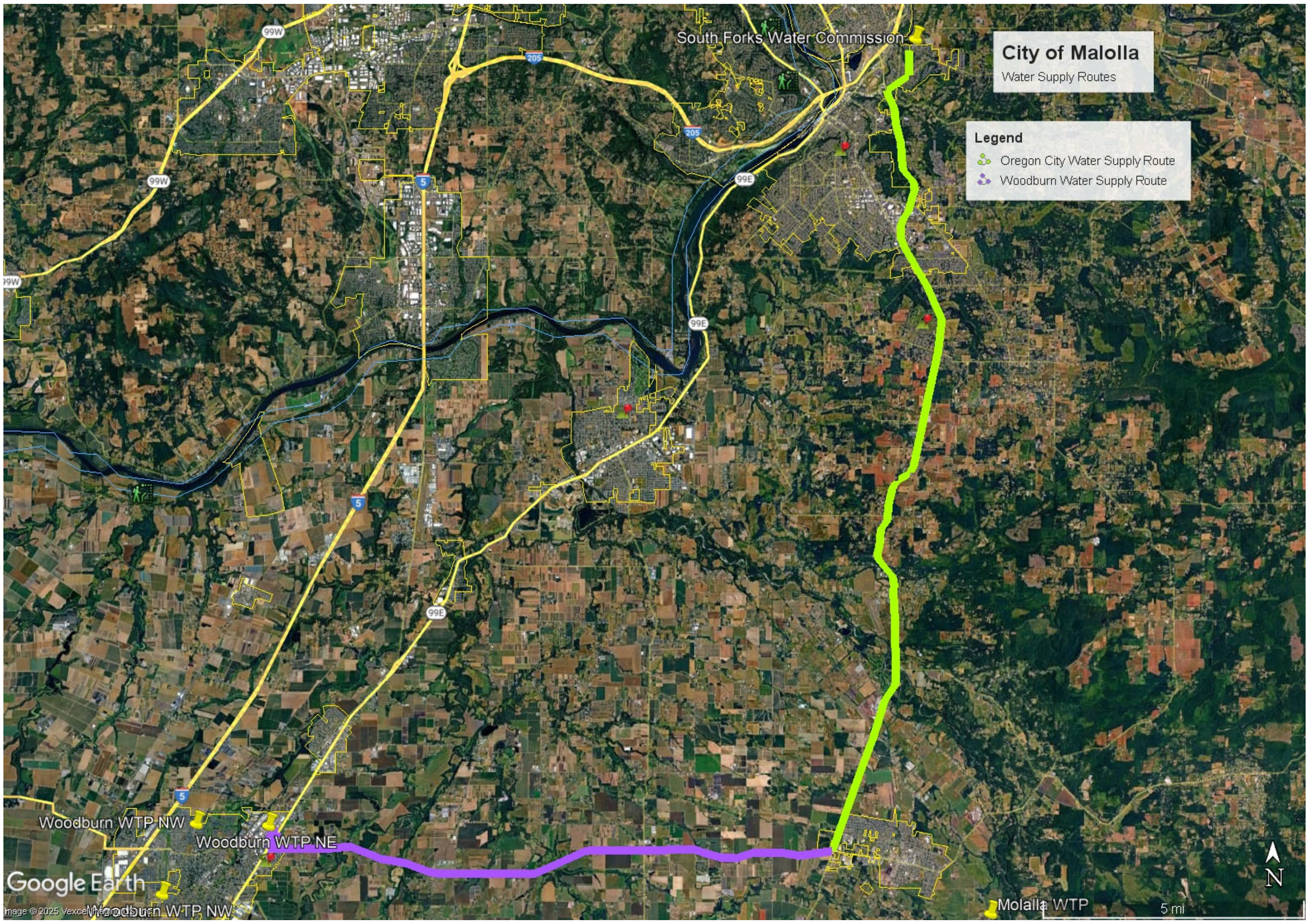

Figure 2: Alternative Water Sources

COMPARISON

Due to the Capitol Cost difference between PFAS treatment and the alternative water sources, it is evident that the PFAS treatment is the preferred alternative. However, a qualitative comparison is provided. The following is a comparison of the three alternatives identified: PFAS Treatment, Connection to the City of Woodburn, and Connection to the City of Oregon City.

The criteria are rated from 1 to 10, with 1 being not very good, and 10 being very good. Therefore, the highest score is the preferred alternative.

Table 8. Qualitative Comparison of Alternatives

Criteria	PFAS Treatment	Connect to the City of Woodburn	Connect to the City of Oregon City
Capitol Cost	10	1	1
O&M Costs	5	6	6
Feasibility	10	1	1
Permitting	6	3	3
Environmental	5	4	4
Social	6	5	5
Total	42	20	20

C***apitol Costs:***

The PFAS treatment is significantly less expensive. Connecting to either the City of Woodburn or Oregon City is prohibitively expensive.

O&M Costs:

The additional O&M cost for PFAS treatment is higher than the O&M cost for a pump station. The O&M costs for treatment would be paid for either directly or through monthly rates in any alternative. However, if a connection is made to another system and the current Molalla WTP is abandoned, then the direct testing, reporting, and operations would not be the responsibility of Molalla.

Feasibility:

Due to the cost of connecting to either Woodburn or Oregon City those options are not really feasible for Molalla.

Permitting:

The PFAS treatment would be done on City property, and it is likely that the only permit would be land use. The other two alternatives would require land purchase, land use permitting, ODOT permits, and potentially County right-of-way permits, City permits, and environmental permits.

Social:

The largest social impact would be disruption during construction. Due to the miles of pipeline along major roadways, there would be temporary disruptions to transportation.

PRELIMINARY SCHEDULE

A preliminary schedule has been identified for just the preferred alternative, PFAS treatment. This schedule is high level.

- Funding: 2 years
- Predesign & Pilot Testing: 1 year
- Design & Permitting: 1 year
- Construction: 1-2 years

SUMMARY

If PFAS becomes an issue for the City of Molalla water treatment plant, PFAS treatment modifications to the water treatment plant is the preferred alternative based on this preliminary comparison of alternatives.