

Scope of Work for PFAS Treatment System Cost Estimate and Preliminary Design

Background

The City of Redmond (City) owns and operates a water treatment and distribution network to deliver finished drinking water to its customers. The City gets a little less than 2/3 of its water supply from the Cascade Water Alliance (CWA) via Seattle Public Utilities' Tolt System, with the remainder provided via five municipal groundwater wells. PFOS has been detected in Wells 1, 2, 3 and 5 (4 is offline) via quarterly testing initiated in Fall 2024, with the results in Wells 1 and 2 exceeding the EPA MCL of 4 ppt (levels range between 4.86 and 5.08 ppt). Quarterly testing also identified low level detections of the short-chain PFBS in all wells (initially only Wells 1 and 2, but more recently all wells showed detections of PFBS). These levels range from 2.09 to 4.54 ppt, with only the more recent detections in Wells 1 and 2 being above the 3 ppt practical quantitation limit (PQL) for PFBS.

To comply with the U.S. Environmental Protection Agency's (EPA) regulations, particularly the new Maximum Contaminant Levels (MCLs) for certain PFAS compounds, the City has retained Hazen and Sawyer (Hazen) to provide engineering services to perform a feasibility study and conceptual design for a system to treat the PFAS levels observed in Wells 1 and 2. The feasibility analysis and conceptual design will consider alternative treatment processes to address the observed PFAS concentrations and will evaluate their overall effectiveness, cost to construct and operate and the feasibility of implementing the technologies (considering factors such as residuals management, ease of permitting, space requirements, etc.). To support this City in this effort, Hazen will perform the following tasks:

- Task 1 – Project Administration
- Task 2 – Feasibility Analysis and Conceptual Design

General Scope

The general scope of services for this project is to provide the City with engineering services to assess the feasibility of treating PFAS at municipal wells 1 and 2 and to develop a conceptual design for the recommended treatment alternative. In providing these services, Hazen will:

- Utilize One Water Engineering for bench-top evaluation of treatment process efficacy (via Rapid Small-Scale Column Tests, or RSSCTs).
- Provide engineering services for assessing feasibility of different treatment technologies and providing a conceptual design for the recommended treatment approach.

General Assumptions

The following general assumptions are common to each task and subtask under this Scope of Services, unless stated otherwise:

- The City will provide Hazen one set of consolidated and reconciled City comments on submittals from Hazen. City review times are estimated as no more than 10 business days from the date of transmittal of each deliverable from Hazen to the City.
- Final submittals identified in the following task and subtask descriptions will be electronic in PDF format transmitted via email or Hazen file transfer application.
- Hazen has a reasonable right to rely on the accuracy of information, data and documents provided by the City without independent verification by Hazen.
- No surveying services are required for this project.
- Geotechnical investigation work is not required for this level of analysis.
- The opinions of probable project or construction cost (OPCC) provided by Hazen are made based on information available to Hazen at the time of development and based on Hazen's experience and qualifications and represents its judgment as an experienced and qualified professional engineer. However, Hazen has no control over the cost of labor, materials, equipment, or services furnished by others, or the contractor(s') methods of determining prices, or competitive bidding or market conditions, Hazen therefore does not guarantee that proposals, bids or actual project or construction cost will not vary from opinions of probable cost Hazen prepares. Each OPCC prepared for this project will have a range of accuracy based upon Association for the Advancement of Cost Estimating (AACE) International Recommended Practice No. 18R-97, as defined in this scope for each deliverable.

Task 1 – Project Administration

Task 1.1 – Project Management

Objective

The purpose of this task is to manage scope, schedule, and budget throughout the completion of all tasks. Budget in this task will allow for project oversight and management by the Project Manager. Tasks include monthly invoicing, progress and schedule updates, management of project team, a written management plan, and general coordination with the City of Redmond and the larger project team to deliver this scope of services.

Hazen Services

- Prepare the Project Management Plan (PMP) outlining project scope, overall Work Breakdown Structure (WBS), team organization, preliminary project schedule, and project communications protocol.
- Prepare the project Quality Assurance and Quality Control (QA/QC) Plan to outline the QA/QC procedures for this project.

- Conduct quality assurance reviews regularly throughout the project to discuss technical approach, team resources, other available or required firm resources, and project management approach.
- Coordinate with and manage the project team and subconsultant.
- Prepare monthly invoices in accordance with the contract terms and conditions.
- Prepare a monthly status report, describing the following:
 - Services completed during the invoice month
 - Services planned for the following month
 - Needs for additional information
 - Scope/Schedule/Budget status
 - Project schedule update and financial status summary
- Attend a bi-weekly project management check-in meeting via Microsoft Teams with the City Project Manager to review scope, schedule, and budget. This meeting will provide a means for communication of potential issues and project challenges.

City Responsibilities

- Participate in project management meetings.
- Timely processing and payment of project invoices.
- Review and process contract change requests and amendments, if required.

Assumptions

- Task 1.1 duration is 10 months for the feasibility assessment and conceptual design services.
- Project schedule is as shown at the end of this Scope of Services.
- One (1) 30-minute project management and design update meeting will be held biweekly for the duration of the project, for a total of 20 meetings. These meetings will be conducted via phone or teleconference. An allowance for an additional five 30-minute meetings will be included in the fee estimate for this task.
- Invoices will be standard Hazen format in electronic format (Portable Document Format [PDF] file).

Deliverables

- Project management meeting agenda (PDF file).
- Monthly progress report and invoice (PDF file).

Task 1.2 – Project Initiation and Data Review

Objective

Conduct and participate in a project kick-off meeting with City staff and provide for an opportunity to participate in a site visit with City staff to collect and identify existing conditions and project site data for conceptual design considerations including limitations and restrictions that will apply to the project. Obtain and review data necessary to perform the feasibility assessment and conceptual design.

Hazen Services

- Prepare for and conduct the project kick-off meeting with City staff.
 - The kick-off meeting will introduce project team members, identify roles and responsibilities, define communication organization, review project background, review scope of services, present a baseline project schedule, and identify critical issues related to the project (i.e., defining overall project goals).
 - The kick-off meeting will also establish the overall goals for the process evaluation and technology selection effort.
- Prepare and submit a data request list to the City, which will include facility record drawings, information regarding surrounding utilities (water, sewer and storm), property information, PFAS monitoring data and other groundwater quality data. It should be noted that some of these data have been provided to Hazen during the scoping process but are listed here for clarity.
- Review the collected data to inform overall project understanding and to support the feasibility assessment and conceptual design efforts.

City Responsibilities

- Facilitate and participate in the project kick-off meeting.
- Provide access to the Wells 1 and 2 treatment facility site for Hazen staff to conduct a field investigation.
- Provide requested data to Hazen in a timely manner.

Assumptions

- The project kick-off meeting is limited to a single 1-hour period.
- The project kick-off meeting will be attended by up to three (3) Hazen staff, who will then proceed to perform the site visit / field investigation.

Deliverables

- Project kick-off meeting agenda and notes (PDF file).
- Data request list (PDF file).

Task 2 – Technology Evaluation and Recommendation

Under this task, Hazen will evaluate multiple treatment technologies for suitability to address observed PFAS in municipal wells 1 and 2. Each technology will be evaluated based on treatment efficiency and overall effectiveness, operational complexity, high-level capital cost to implement, compatibility with other treatments used at the wells, and approximate lifecycle costs, among other factors. Bench-scale treatability testing will be performed for selected technologies to better assess their operational performance. The result of this task will be a recommended technology for use in conceptual design development.

Task 2.1 – Bench-Scale Adsorbent Testing

Objective

Evaluate the applicability of adsorbents to remove PFAS from the City of Redmond's blended municipal well 1 and 2 source water.

Subconsultant Services – Testing Services

Hazen will contract with a testing laboratory to perform bench-scale adsorbent testing with applicable methods to determine the effectiveness of selected adsorbents with water sourced from municipal wells 1 and 2.

- Prepare a bench-testing plan to outline objectives, procedures and analytical requirements for each test performed.
- Receive and store water sourced from municipal wells 1 and 2.
- Confirm presence of PFAS in sampled water and discuss / implement spiking of PFAS for improved test resolution.
- Perform bench-scale testing with alternative adsorbent materials and applicable methods.
- Provide a data analysis and summary report to document processes, results, summary and recommendations.

Hazen Services

- Conduct a bench-testing process kick-off meeting with City staff.
- Coordinate testing requirements with the subconsultant.
- Coordinate with carbon, ion-exchange and novel adsorbent manufacturers to obtain samples of adsorbents for testing.
- Obtain water samples of blended well 1 and 2 water from the City's tap.
- Package, prepare and ship samples to the subconsultant.
- Manage testing subconsultant contract.
- Coordinate and pay for analysis of water quality samples.
- Review and provide comments on bench testing plan.
- Review and provide comments on data analysis and summary report.
- Incorporate the results of the data analysis and summary report with media cost estimates and process recommendation as part of the technology review recommendation (Task 2.2 deliverable).

City Responsibilities

- Provide applicable historical testing results and reports.
- Participate in the bench-testing kick-off meeting.
- Review and provide comments on bench testing plan.
- Review and provide comments on data analysis and summary report.

Assumptions

- The sample water will be collected in 55-gallon drums at the location of the combined municipal well 1 and 2 tap and shipped to the testing agency by Hazen. Shipment of these drums will be on a pallet (three drums per pallet) wrapped together with each drum approximately 90% full. The shipment will be a class 50, less than load (LTL) shipment. Shipments will be coordinated through a shipping broker such as Freight Center or directly through a shipping company like TForce Freight. Drums and pallet for shipment be procured from Uline (Drum Part Number: [S-10757BLU](#), Pallet Part Number: [H-1211](#)). It is assumed that shipment will require liftgate at pickup and dropoff locations.
- Adsorbent testing will be performed with up to three (3) types of adsorbents:
 - Granular Activated Carbon (GAC)
 - Ion-Exchange (IX) Resin
 - Specialty Adsorbent, proprietary source
- Testing will be conducted on up to six media samples.
- Two raw water samples will be collected and analyzed for PFAS, TOC, UV254, alkalinity, hardness, iron, manganese, iron, manganese, sulfate, nitrate, chloride, chlorine, and pH.
- The effluent of each of the six media samples will be analyzed for PFAS (up to 10 samples per media sample), TOC (up to 10 samples per media sample), UV254 (up to 6 samples per media sample), and sulfate, nitrate, and chlorine (up to 3 samples per media sample).
- Adsorbent testing data analysis and summary report will consist of up to 50 pages.

Deliverables

- Adsorbent Testing Data Analysis and Summary Report (PDF file).

Task 2.2 – Technology Evaluation

Objective

Incorporating the results of the bench-scale testing, evaluate potential PFAS treatment technologies to treat the water from municipal wells 1 and 2. Factors to be considered in the evaluation include approximate, high-level capital and operating costs (and lifecycle cost); potential pre-treatment requirements to address background constituents (e.g., iron and manganese) as well as other contaminants that could impact fouling / treatment performance and media longevity; changes to chemical feed process to incorporate the additional treatment; hydraulic impacts of treatment on the existing system pumps; waste disposal requirements to handle startup flushes and periodic backwashing of media; site availability, including property availability, zoning, setbacks / maximum height requirements, etc.; and, permitting feasibility. The results of the evaluation will be a recommended treatment technology to be used in conceptual design development. The evaluation will be summarized in a section of the final feasibility and conceptual design report, discussed in Task 4.

Hazen Services

- Perform an evaluation of historical raw water quality to characterize raw water quality parameters and PFAS concentrations.
- Identify additional treatment needs to address background water quality constituents (e.g., iron and manganese) and develop preliminary sizing for those treatment systems.
- Establish the basis of design for up to four PFAS treatment approaches, including GAC, IX, novel adsorbents and reverse osmosis (RO) membranes.
 - It should be noted that the RO membrane sizing is being performed for thoroughness of the evaluation but will be limited to approximate capital cost and overall footprint. Based on the nature of the project, siting constraints and the types of PFAS observed and their concentrations, this technology is unlikely to be recommended so more qualitative responses to the remaining factors will be provided based on previous project experience (i.e., difficulty in RO concentrate disposal, O&M costs, etc.).
 - For the other three PFAS technologies the conceptual design will include loading rates, empty bed contact times (EBCTs), size and number of units, headloss, pretreatment needs, and waste flows (both startup and during media changeout). Facilities will be sized based on the reported 1,400 gpm combined flow rate from wells 1 and 2.
- Evaluate the existing disinfection and chemical feed systems at the well 1 and 2 facility to identify any required modifications, whether related to moving the point of chemical addition or additional feed requirements for pre-treatment facilities.
- Size the PFAS treatment building (both in plan and approximate elevation) and compare the sizes of structures needed for the different treatment technologies to the available space.
- Develop a preliminary hydraulic profile through the PFAS treatment trains to identify pressure requirements for new treatment vessels, piping and related equipment, and any identified pre-treatment systems. Coordinate with the City to obtain a system curve from the hydraulic model that the existing pumps see. Review the system curves for the existing pumps, coupled with the additional headloss from the proposed treatment trains, and identify potential impacts on their performance.
 - *If needed, Hazen will coordinate with the City to perform pump testing to assess the current pump operating curve compared to the published operating curve for the pumps.*
- Using the waste flows identified for each PFAS treatment process, coordinate with the City to understand limitations on disposal rate and potential contaminant concentrations (e.g., arsenic). Establish the volume and configuration of the residuals holding/equalization tank for each treatment process to accommodate sewer discharge flow restrictions and identify pumping / flow control valve requirements. This includes alternative means of addressing startup arsenic for GAC systems, including low rinse approaches and procuring alternative carbons with lower arsenic levels (e.g., acid rinsed media). Evaluate returning decant water from the residuals holding/equalization tank to the head of the treatment train.
- Develop a matrix that compares each technology based on:
 - Treatment performance / time to breakthrough for target PFAS
 - Anticipated media change out costs / O&M costs
 - Pre-treatment needs
 - Chemical feed modifications
 - Facility footprint and ease of siting the facility
 - Capital cost to construct

- Hydraulic impacts on existing pumps
- Residuals handling and disposal considerations
- Prepare for and lead a workshop with the City to review the analyses performed and discuss the comparison matrix such that the team can reach consensus on the preferred treatment technology to address the well 1 and 2 PFAS concentrations.

City Responsibilities

- Share additional requested data and respond to questions from the project team regarding the technology assessment tasks.
- Provide access to the Wells 1 and 2 treatment facility site for Hazen staff if additional visits are needed to gather additional information or address identified questions.
- Participate actively in the treatment process review workshop.

Assumptions

- Cost estimates will be Class 5.
- Facility sizing / layout figures will consist of “boxes” that establish overall footprint at this stage to allow differences in technologies to be assessed.
- One treatment option to address background water quality constituents will be developed at this stage for planning purposes.
- Data are available to permit the evaluation of the sewer capacity and pump hydraulics / system curve.
- The workshop will be attended virtually and will be two hours in duration.
- The bench-scale RSSCT evaluation will be sufficient to perform the PFAS treatment feasibility assessment and that the results will be acceptable to DOH without piloting. This is consistent with other recent PFAS projects performed by Hazen in Washington State.

Deliverables

- PFAS treatment technology comparison matrix (PDF)
- Treatment process review workshop agenda and notes (PDF file).

Task 2.3 – Optional Task: Municipal Well 4 Water Quality and Treatment Evaluation

Objective

Leverage the work performed under Tasks 2.1 and 2.2 coupled with available water quality data for Municipal Well 4 to identify if the results for Wells 1 and 2 could be used to guide future planning for Well 4.

Hazen Services

- Review historical water quality data for Well 4 along with anticipated production.

- Identify if the water quality from Well 4 suggests that the results from the evaluation for Wells 1 and 2 would be applicable to Well 4.
- Assuming the data suggests applicability, identify the preliminary treatment recommendations for Well 4 and an approximate cost to implement the recommended concept(s).

City Responsibilities

- Share available production and water quality data for Well 4 and representative monitoring wells in the vicinity of Well 4.
- Provide answers to questions raised by Hazen relative to Well 4 operations.

Assumptions

- It is assumed that Well 4 quality will be comparable to that from Wells 1 and 2 such that recommendations can be made and costs provided.
- No bench-scale testing, preliminary engineering or workshops will be performed relative to this evaluation.

Deliverables

- Summary email documenting the analysis, findings and recommendations for Well 4.

Task 3 – Conceptual Treatment System Design

Objective

Develop a conceptual design for the recommended / preferred PFAS treatment technology to facilitate the City's planning and budgeting for the proposed system. This includes conceptual design drawings, documenting site development considerations, costs, implementation schedule, and implementation risks. The outcome will be a technical report that summarizes the evaluation and effort and documents the above considerations.

Hazen Services

- Prepare conceptual design drawings for the proposed treatment facility. A basis of design table will be prepared documenting the proposed design criteria for the proposed facilities (sizes, loading rates, etc.). Drawings to support the conceptual design will consist of:
 - Process flow schematic depicting existing and proposed facilities
 - Proposed modifications to the existing facilities (via redline markup of existing PDF record drawings), to include potential changes to chemical feeds, piping and/or pumps
 - Plan view of the proposed PFAS treatment building depicting the major process elements
 - Site plan depicting the proposed facilities and connecting piping
- Prepare a summary of key conceptual design considerations for inclusion in the final report. This summary shall include:

- Site constraints and space needs including discussion of siting and site permitting related challenges with the proposed facilities, including property acquisition / easement needs, permit requirements and potential waiver needs, stormwater management needs, etc. Hazen will also investigate truck access requirements on the proposed site location for delivery of treatment media (as the City noted the site was somewhat constrained).
- Ancillary items such as identification of possible geotechnical / seismic risks, electrical power needs, noise, and architectural treatments for the proposed facilities.
- Cost analysis for both capital and operating costs. Capital costs will include construction costs and major markups (overhead and profit, contingency, and other “general conditions” items) as well as engineering, permitting and property acquisition costs. O&M costs will include approximate labor costs, energy costs, costs for residuals disposal and treatment media replacement costs, chemical costs and other recurring treatment costs. A life cycle cost estimate will also be performed.
- A summary of the major risks and mitigating activities, including those discussed above as well as regulatory changes, material shortages or manufacturing delays, etc.
- Prepare a preliminary project implementation schedule, to include:
 - Final design and permitting.
 - Regulatory deadlines (including the current EPA 2029 deadline and potential future changes).
 - The City of Redmond's Capital Improvement Program (CIP) process and budgeting cycles.
 - Current and anticipated lead times for critical materials and equipment.
 - Availability of qualified contractors for design and construction.
 - Property acquisition if required for project footprint.
- Prepare for and lead a Preliminary Design Review Workshop.
- Prepare for and lead a Project Cost, Schedule and Risk Workshop

City Responsibilities

- Provide requested reference documents and information on a timely basis.
- Coordinate with the serving electric utility company if the existing utility service needs to be upgraded to understand the nature of the effort, costs and schedule.
- Participate in project coordination meetings and workshops.

Assumptions

- The City can provide data related to labor costs for staff, sewer disposal costs, chemical costs and costs for property acquisition (if needed).
- Two 1-hour project coordination meetings will be held during the conceptual design effort, each of which will be attended virtually.
- Each workshop will be two hours in duration and will be attended virtually.
- Preliminary project cost estimate will be a Class 5 estimate

Deliverables

- Conceptual design drawings (PDF)

- Project coordination meeting agendas and notes (PDF)
- Workshop agendas and notes (PDF)

Task 4 – Feasibility Analysis and Conceptual Design Report

Objective

Develop a written report summarizing the efforts expended in the preceding Tasks 2 and 3.

Hazen Services

- Prepare a written report summarizing the feasibility analysis and conceptual design tasks, pulling from previously prepared sections, figures, tables and drawings as necessary.
- Respond to review comments from the City.

City Responsibilities

- Provide review comments on the draft report.

Assumptions

- The City will provide one round of consolidated review comments on the draft report.

Deliverables

- Draft and final Feasibility Analysis and Conceptual Design Report (PDF)

PROJECT SCHEDULE

Work will begin as soon as written Notice to Proceed is issued by the City of Redmond (email is sufficient). The anticipated start date is approximately March 3 (the February 17 Council approval date plus 2 weeks). The anticipated project schedule is as follows (specific dates are preliminary to be coordinated with the City after kickoff):

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|---|-------------------------------|
| • Engineer Notice to Proceed | March 3, 2026 |
| • Project Kickoff Meeting | week of March 16, 2026 |
| ○ Site Visit and Sampling | March 17, 2026 |
| • Process Recommendation Workshop | August 18, 2026 |
| • Preliminary Design Review Workshop | September 21, 2026 |
| • Project Cost, Schedule and Risk Workshop | October 21, 2026 |
| • Submission of draft Feasibility Report | December 2026 |