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Point-of-Entry Treatment System for Killingworth Elementary School (KES)

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Prepared for:
Town of Killingworth
Killingworth, CT

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1.0 INTRODUCTION

Per- and Polyfluoroalkyl Substances (PFAS) have been detected at concentrations above Connecticut's Department of Public Health's (CT-DPH) Drinking Water Action Levels (DWALs) at the Town of Killingworth's elementary school, residential homes, and municipal center at the following locations.

a) Two (2) Killingworth Elementary School (KES) potable bedrock water supply wells (KES#1 and KES#2).
b) A potable bedrock water supply well (referred to as the Fire Department well) which services the Killingworth Municipal Buildings (KMC). These buildings include the Killingworth Fire Department (KFD), Town Hall, Dog Pound, and the "Town Barn / Emergency Operation Center".
c) The potable bedrock water supply well that services the Department of Public Works (DPW), and
d) Several residential homes bedrock water supply wells, in the vicinity of the KES and the KMC.

Figure 1 depicts the study area, whereas **Figure 2** provides the locations of the KES, KMC buildings and the reference bedrock wells, (a, b, and c above). This report only addresses the treatment of the contamination at the KES facility.

The PFAS contamination was initially detected during a CT-DPH lead regional bedrock potable water supply sampling event at residential homes, KES, KMC and DPW. This sampling event was initiated because PFAS was detected at the Connecticut Water Company's (CWC) Beachwood Community water supply wells located approximately 1,000-feet north of KES, where Aqueous Film Forming Foam (AFFF) was reportedly used to extinguish a fire.

The test results identified elevated PFAS concentrations at residential homes, CWC, KES, KFD and DPW bedrock wells. The greatest concentrations were measured at the KFD potable bedrock water supply well and downgradient of the DPW potable water supply well. The source of the PFAS at the KFD well was likely from fire training activities which were conducted at the KFD adjacent to the KFD well. The contamination may then have been transported/migrated through bedrock fractures (enhanced by pumping) to the surrounding wells which might be interconnected through bedrock fractures.

1.1 PREVIOUS PFAS TREATMENT REPORTS

An October 2023 report was prepared by GZA GeoEnvironmental, Inc. (GZA) describing proposed Point-of-Entry Treatment (POET) systems to be installed to treat the impacted groundwater from KES#1, KES#2, KFD and the DPW potable water supply wells. However, based upon a January 9, 2024 letter from CT-DPH and the need to complete the POET at KES during a period when the school is not in session (summer 2024), the original October 2023 report has been divided into two separate reports. This report addressing the POET system for KES whereas a second separate report will address the proposed POET at the KMC and DPW. This report is subject to the limitations in **Appendix A**.

The CT-DPH comments have been incorporated into this revised design. A copy of CT-DPH's comments is included in **Appendix B**.

While not included in the original October 2023 report but included in the March 2022 Engineering Alternative Analysis prepared by GZA, the daily water demand at KES is based upon the following information:

- Using CT-DEEP guidance for designing a large-scale septic leaching field, the estimated effluent would be 3,300 gallons per day at KES. This was based upon a total student/staff population of 300, including a kitchen. Septic effluent is typically used to estimate a daily water demand.
- Data provided by Killingworth indicate that the typical average daily flow ranges from 1,500 to 2,000 gallons per day, (data provided after a water storage tank distributed into the school). However, the school is using bottled water which is not accounted for in this average.
- KES has a 7,000-gallon fiberglass reinforced, underground storage/holding tank. Based upon the design and average demands, the storage tank would provide approximately 2.0 to 4.7 days of storage.
- Assuming the higher daily flow of 3,300 gallons per day, the minimum combined pumping rate from the both wells would be approximately 2.3 gallons per minute, assuming the pumps operating 100-percent of the time or 4.6 gallons per minute with the pumps operating 50 percent of the time.

The following lists the major components of the POET system to be incorporated into this modified KES design.

- The POET system will be installed within the mechanical boiler room (MBR), located in the lower northwestern portion of the school.
- Regulators will be used to restrict flow to 8-gallons per minute from each well (KES#1 and KES#2).
- Installation of lead and lag granular activated carbon (GAC) units with pre- and post-sediment filters. The design will assume a 10-minute empty bed contact time (EBCT).
- All components will be NSF/ANSI 61 certified.
- Ultraviolet (UV) sterilization will be installed after treatment. It is our opinion that io is required to prevent bacteria growth within the GAC units during periods when the school is closed or there is a reduced demand for water.
- The pH adjustment (calcite) treatment system currently located adjacent to KES#1 will be relocated to the MBR and the size of the unit increased. The pH control is to control a historic lead pipe issue, as opposed to PFAS.
- Extending a new water line from the MBR to the existing 7,000-gallon, underground storage tank (UST) within the school courtyard (adjacent to KES#1).
- Installation of a new larger (62-gallon) pneumatic tank for KES#2 in the MBR.
- Maintaining all existing electrical relays/switches.
- Maintaining the existing water distribution equipment from the storage tank to the school's fixtures.
- Purging and testing existing water lines, prior to occupant use.
- The existing 7,000-gallon storage UST will be re-evaluated. Because the tank is fiberglass, PFAS may have adsorbed onto the surface of the tank. To assess the concentration of PFAS from the tank after the shutdown of KES #1 that had elevated concentrations above DWALs (note that KES#2 concentration were below the DWAL), GZA proposes the following prior to construction.
    - Resample KES #2 influent water from the well to determine current concentrations with KES #1 off.
    - Assess the potential of re-lining the 7,000 UST. However, given its age, this may not be the most feasible and economical solution.
    - Assess the replacement of the UST. However, due to supply chain issues, a new tank may take 3 to 4 months for delivery.

  Therefore, GZA recommends that the final solution to the 7,000-gallon storage tank be phased with the most likely solution being the replacement of the UST after the POET system is installed. The new tank installation will require coordination with the school to avoid disturbing school activities.

1.2 REGULATORY CRITERIA

The CT-DPH has developed Drinking Water Action Levels (DWAL) to compare laboratory sampling results to determine if a contaminant would exceed an applicable criterion. The following presents the changes in the DWAL since 2016.

- In December 2016, the CT-DPH issued a PFAS action level for the sum of five (5) PFAS analytes (PFOA, PFOS, PFNA, PFHxS and PFHpA) equal to greater than 70 nano-grams per liter ng/L (or parts per trillion).
- In June 2022, CT-DPH revised the DWAL for (4) PFAS compounds based upon individual concentrations [PFOA (16 ng/L), PFOS (10 ng/L), PFNA (12 ng/L), and PFHxS (49)].
- In late June 2023, CT-DPH added an additional six (6) PFAS compounds to the four (4) individual DWALs based upon individual concentrations [(PFHxA (240 ng/L), GenX (10 ng/L), PFBS (760 ng/L), PFBA (1,800), F-35B major (2 ng/L), and F-35B minor (5 ng/L)]. The POET system was designed to meet the June 2023 DWALs. The names of the PFAS acronyms and the sampling results are presented in **Table 1.0**, which references the June 2023 DWALs.

Once an exceedance of the DWAL was detected at residential homes, KES, DPW and the KMC, bottled water was supplied for consumption. However, at KES, bottled water was already being provided to address a lead exceedance which is being corrected by adjusting the pH through the calcite system.

The DWAL are currently the criteria in Connecticut; however, the U.S. Environmental Protection Agency (EPA) has proposed lower Maximum Contaminant Levels (MCLs) for PFOS and PFOA at 4 ng/L (individually) and four (4) other compounds using a “hazard index” calculation. The EPA announced on April 10, 2024 that they have established an MCL (legally enforceable), for public water supplies. It is assumed that CT-DPH will have to modify their current DWAL to meet the minimum federal criterion. Because of these rapidly changes in the regulations, the design incorporates sufficient redundancy to account for the new EPA criteria.

In addition to the treatment of PFAS, there has been a lead issue from existing pipes. Low pH conditions in the groundwater from the existing wells can cause lead to leach from the existing water lines at KES into the water. To prevent leaching of the lead, a calcite water treatment system has been installed to adjust the pH level (increase) to prevent lead from leaching from the pipes. This calcite treatment system will be incorporated into the PFAS design. No other contaminants have been identified requiring treatment.

Data collected (**Table 1.0**) from KES #1 and KES#2 have identified exceedances of DWAL only at KES#1 and from the blending of KES #1 and KES#2. Currently, KES#1 has been shut down and water is only being provided from KES#2 (without treatment). However, a reassessment of the influent water quality at KES #2 will be required to evaluate if the concentrations are above the EPA promulgated MCLs.

2.0 POET SYSTEM

The POET system will incorporate granular activated carbon (GAC) to treat the PFAS impacted groundwater from the two (2) groundwater water supply wells at KES. GAC is a demonstrated and effective groundwater treatment technique for PFAS. GAC effectively adsorbs the PFAS because the carbon is highly porous material providing large surface area for these contaminants to adsorb onto. Hundreds of similar POET systems have been installed for PFAS absorption at municipalities, regional and community water supply wells, commercial buildings, industry, schools, homes, and other facilities. Typically, these systems are designed to provide 100-percent redundancy. This redundancy will permit one well to go offline for repairs/maintenance while the second well will continue to provide treated water. Once repairs/maintenance are completed the system is then placed back online. This design will be scalable to accommodate changes in future drinking water regulatory levels.

The nominal Empty Bed Contact Time (EBCT) for the POET system for the KES wells will be a minimum of 10 minutes. GZA has estimated that approximately 11 cubic feet (CF) of GAC will be required to meet the 10-EBCT. The design will incorporate:

- Two lead 30" x 72" (25.3 CF per tank) fiberglass tanks in parallel (total of 50.6 CF).
- Two lag 30" x 72" (25.3 CF per tank) fiberglass tanks in parallel (total of 50.6 CF).
- The media will be Filtersorb 600 AW, a granular activated carbon.

The design is based upon the Culligan cut sheets in **Appendix C**. The contact time is controlled by restricting the maximum flow to 8-gallons per minute (gpm) from each of the two (2) wells through these units.

It is recommended that the installation of the POET system be overseen by GZA to document that the system has been installed per the design. In addition, GZA should be included as part of the contractor bid process and review of bids to be compared to the requirements of the design.

2.1 KES POET SYSTEM DESCRIPTION

KES has two (2) bedrock potable water supply wells (KES#1 and KES#2). KES#1 well is in a mechanical/boiler room generally below the administrative offices, whereas the KES#2 well is in the field at the northwestern portion of the property, west of the parking lot. Water from the KES#2 well is piped across the field to a pneumatic tank within the main mechanical/boiler room (MBR). The MBR is located on the lower level, within the northwestern corner of the school. **Figure 3** depicts the well locations, the mechanical rooms and underground storage tank.

The current system controlling the groundwater from the two (2) wells is through existing electrical controls at KES#1 and a pneumatic tank at KES#2. To reduce costs, the electrical controls at KES#1 will be integrated into the design but the pneumatic tank will be replaced. Once the groundwater is pumped from the wells, it is directed to a 7,000-gallon underground storage tank (UST), prior to being pumped into the school through two (2) variable speed pumps (VSP). These variable speed pumps are designed to meet the water demand of the school and no changes are proposed.

According to Hungerfords Pump Service (Hungerfords), who services these wells, the storage tank has electrodes to turn on/off the submersible pumps in KES#1 and KES#2 and control the filling of the tank. The electrodes energize relays to the motor starters that activates the KES#1 and KES#2 pumps and energizes another relay that opens a ball valve from KES#2. When the level of water in the tank reaches a certain set-point, an upper electrode in the tank deactivates the pump from KES#1 pump and closes the ball valve on the piping from the KES#2 well. The KES#2 pump keeps pumping against the closed valve until a pressure switch in the pneumatic tank deactivates the pump.

The storage tank is located near KES#1, under the courtyard playscape (**Figure 3**). Because the KES#1 well is adjacent to the storage tank UST (basement boiler room, below the administrative office), groundwater is directly conveyed to the storage tank, after pH adjustment (calcite). Groundwater from KES#2 is conveyed to a pneumatic tank in the main mechanical/boiler room (MBR), located on the lower level in the northwestern corner of the school and then directed through a pipe, within the ceiling of the school to the KES#1 boiler room. Water from

KES #2 is combined (blended) with the raw water from KES #1 and is directed through the calcite treatment prior to exiting the boiler room to the storage tank.

The UST, VSP and existing plumbing will be retained. However, some modifications will be required because PFAS acts like a surfactant and can be retained on surfaces such as pipes and tanks. The modifications will include potentially re-lining (or replacing) the existing UST, replacing the existing pneumatic tank, flushing the VSP and water lines with clean water and testing representative taps (bathrooms, kitchen, classroom sinks and water bubblers). Only once the sampling results are below the DWAL will the POET system become active.

Water from sinks, and toilets is discharged to the existing subsurface disposal system leaching field. No changes are proposed during the flushing and once the POET system is fully operational. Upon completion, the discharge to the leaching field will no longer include PFAS concentration above a DWAL criteria.

The proposed changes will include:

- The pneumatic tank within the MBR for well KES#2 will be replaced with a new larger 62-gallon unit (i.e., Amtrol WX0251, or equivalent, **Appendix C**).
- The interior of the existing underground storage tank (exterior courtyard) will be relined. Replacement of this tank was considered; however, because of its location adjacent to the building, additional costs (shoring) would be incurred.
    - Should the interior walls of the tank be considered too old or unsuitable to be re-lined, a new tank will be considered. However, there is a long lead time (3 to 4 months) on new tanks.
    - GZA is also proposing to resample the influent from KES#2 to establish existing conditions after the shut-down of KES#1.
- New piping for the treated water from the MBR will be installed adjacent to the existing KES#2 feed pipe (through the interior ceiling of the school) to the KES#1 mechanical / boiler room. This new pipe from the MBR will be placed above the ceiling tiles through the school then through an existing PVC chase pipe that was previously installed beneath the playscape area into the KES#1 mechanical / boiler room where the new line will be connected to the existing piping that feeds the storage tank.
- Water from KES#1 will be redirected and conveyed through the existing KES#2 water pipe (currently impacted by PFAS) back to the MBR which runs through the school for treatment.
- The POET system for each of the two KES wells will consist of the following:
    - Globe valves to control the flow from the well through the GAC at a flow rate of 8 gpm.
    - Pre-filter:
        - Removes sand and sediment from the well water.
    - Two lead GAC units:
        - Two 30” x 72” fiberglass GAC tanks in parallel (each 25.3 CF).
    - Two lag GAC units:
        - Two 30” x 725” fiberglass GAC tanks in parallel (each 25.3 CF).
    - Post-filter:
        - Removes GAC dust and sediment from treated water.
    - Flow meter:
        - Monitors flow rates and the volume of water treated/used.
    - UV Treatment:
        - Remove potential bacteria and odor control.
    - The treated PFAS groundwater from KES#1 and KES#2 will flow through individual 16” x 65” calcite treatment units (**Appendix C**) for pH control. Currently, the pH calcite treatment is in the KES#1

mechanical room. To consolidate all treatment systems, the pH calcite treatment will be relocated to MBR and re-sized.

- Sampling ports will be installed.
  - On the influent pipes from KES#1 and KES#2, prior to treatment.
    - These sampling taps will be smooth nosed and prior to any check valves.
  - In between the lead and lag GAC units.
  - After the lag unit and prior to pH adjustment.
  - A sampling port will be installed prior to entry into the storage tank.
  - A sampling port will be installed after the storage tank at the variable speed pumps.

The POET system for KES will be designed in parallel. That is groundwater water from KES#1 and KES#2 will be treated independent of each other. This will allow for maintenance on one well or treatment system while the second well/treatment can remain active providing provide water to the school, avoiding shutdowns given the storage capacity of the storage tank. Post POET treated water will then be conveyed through a new water line installed above the school's ceiling tiles to the KES#1 mechanical room where the water will enter the storage tank.

As described by Hungerfords, control of the submersible pump within KES#1 will continue to be controlled by the electrodes in the storage tank. Similarly, activation of the submersible pump within KES#2 and operation of the ball valve on the pipe from KES#2 will be controlled by the existing electrodes in the storage tank. However, deactivation of the submersible pump in KES-#2 will be controlled by a new larger pneumatic tank within the MBR.

Studies have shown that fiberglass may absorb PFAS and is not easily removed to concentrations below the ultra-low regulatory criteria by CT-DPH or future EPA criterion. Because the storage tank contained PFAS- impacted groundwater, the proposed phased storage tank remedy includes:

- Re-sampling KES #2 and the water from the storage tank. If the water is below the DWAL and the new MCLs recently promulgated, then no modification would be required.
- If concentrations exceed the DWAL and the MCLs, then a reassessment of the tank would be required, including a cost benefit analysis of relining the interior surface of the tank or replacing the tank to prevent PFAS from leaching from the tank walls into the school.
- Because of the age of the storage tank, it is likely that the cost of relining would not be economical. Therefore, under a separate phase of the overall construction program, a new tank would be installed. A separate phase is required due to the long lead time (3 to 4 month to obtain a tank).

Regardless, if the existing tank is relined/reuse or a new tank is installed as requested CT-DPH, the single vent/overflow pipe at the top of tank will be modified into two separate pipes (one for overflow and the other as a vent).

To reduce the potential from cross-contamination, the existing KES#2 water line above the ceiling tiles will be used to convey the water from the contaminated KES#1 well to the MBR where the groundwater will be treated. At this time, no other water conveyance piping after the storage tank will be replaced, including the variable speed pumps and interior school plumbing. However, prior to full scale operation, the water lines at KES will be flushed and tested in accordance with Section 4.3.1. to demonstrated compliance with the DWAL. If elevated concentrations are detected after the storage tank, further testing will be completed to isolate the cause. All purged water will be directed to the SSDS as currently configured. Once sampling data confirms concentrations are below the DWAL, the POET system will become active.

The layout of the system is depicted on the following figures:

Figure 3 – KES Site Plan
Figure 4 – KES#2 Mechanical Room Enlarged Plan
Figure 5 – KES Treatment System Flow Schematic
Figure 6 – KES#1 Boiler Room Enlarged Plan

2.2 OPERATION OVERVIEW

The POET system is designed to operate using the existing controls, pumps and is designed to operate continuously. However, should a well go down, there is redundancy in the KES treatment system permitting one well to operate at a time. Sampling ports will be installed to monitor performance prior to the POET systems (influent), between the lead and lag GAC units (mid-point), and after the lag GAC unit and after either the pH or the sodium treatment.

GZA understands the Town of Killingworth will work with a water treatment contractor (contractor selected based upon competitive bid) to have the POET system installed and maintained in accordance with Section 3. Because these GAC units will require media replacement, the Town should also consider contracting with a treatment company such as Culligan who can vacuum out the GAC, repack the treatment units and backwash the units to remove fines prior to replacing the units back on-line.

2.3 POET SYSTEM STARTUP

The Town will subcontract with a contractor to install the POET system, in accordance with this design and as shown on the schematics. All work will be in accordance with applicable building, electrical, and plumbing codes. The selected GAC units are Calgon 30" x 72" units (or equivalent, if approved by GZA). As an example, GZA included in **Appendix D** Calgon's Water Filter Specifications (as reference).

The Town's contractor will have to provide hydrotesting results of the system installation prior to the Town's accepting the system. If testing fails, the contractor is responsible for any fixes that may be required.

3.0 OPERATION AND MAINTENANCE (O&M)

The O&M of the POET system will be conducted by the Town of Killingworth's contractor, whereas the monitoring will be completed by the Town's consultant. Routine POET maintenance is well understood given their long-established use, but the frequency of maintenance is dependent on influent concentrations, water usage and other groundwater geochemistry. In general, maintenance will be based upon the results of the analytical performance monitoring data, as discussed in Section 4.0, and is designed to be protective of human health and to minimize interruptions. In addition, CT-DPH and CT-DEEP suggests that the GAC units be replaced every three years, if not replaced as part of the treatment O&M.

To simplify maintenance, the Culligan 30" x 72" units are non-backing washing units. Thus, spare units can be maintained for replacement. GZA recommends that KES maintain 4 spare replacement units should breakthrough be identified.

3.1 POET SYSTEM SHUTDOWN

Should there be a detection of PFAS at concentrations greater than 50 percent of the DWAL between the lead and lag units, GAC replacement will be required. Prior to replacement, the system (either associated with KES#1 or KES#2) will be shut down and pressure released from the system. At no time will both systems be shut down simultaneously.

The lead GAC unit will be removed for disposal, the lag unit will be moved into the lead position (physically) and a new lag unit installed. Once the new GAC is installed, the startup procedure as outlined in Section 3.4.1. will proceed to check for leaks.

The spent carbon will either be transported to Calgon (if selected) or another vendor. While the lead unit may use reactivated GAC (GZA recommends the use of virgin carbon in a school setting), at no time will the lag unit use reactivated GAC, only virgin carbon will be used prior to entering the school. Spent GAC will either be destroyed, re-generated/re-activated for re-use at a different location or will be disposed of in an approved landfill facility.

3.2 PRESSURE/FLOW ISSUES

The proposed POET system will limit the influent flow from both wells to 8-gpm each. While the flow from each well will be regulated at 8-gpm, the total flow to the KES storage tank will be 16-gpm. This will allow for the 10-minute EBCT specified in the CT-DPH comments. The pump curves for the existing pumps in KES#1 and KES#2 indicate that the existing pumps should be sufficient based upon the total head curves. However, if the pumps are not as reported (under- or oversized) or if the pumps are older, pump replacement may be required.

Prior to the start-up of the POET system, the Town will subcontract with a pump contractor to pull, inspect, and clean the existing well pumps. GZA understands that the pump in KES #1 is a Flint & Walling 4" submersible pump (1 ½ HP model 4F10S 15), whereas the pump in KES#2 is a Grundfos 4" submersible pump (0.75 HP Model 5S07-18). Depending on the condition of these pumps, they may need to be replaced. At the same time, the wells will be inspected, and total depth verified. Prior to reinstalling the pumps, the well will be chlorinated and purged to meet CT-DPH requirements. The chlorinated well water will be directed to the SSDS because chlorine can also be adsorbed onto the carbon. No purge water will flow through the POET until levels are below DWAL.

The differential pressures across the POET system will be documented at the time of sampling (frequency may change with time). The Town's contractor will monitor for pressure drops or pressure increases, at any point in the system (sediment filter, GAC filter, etc.). Contractor will make changes to the system (change out of filters or GAC) based upon system performance.

It is recommended that flows and pressures be evaluated at start-up, after one month to establish background conditions and then quarterly. This may be reduced once data has been generated.

3.3 SCHEDULE OF ACTIVITIES

The CT-DPH has pointed out that the well casing associated with KES#1 is in poor condition (rusty and flaking). The Town's selected contractor will sand, seal and if needed, reline the upper portion of the casing.

Routine maintenance will be conducted at the following schedule:

- Pre- and post-filter replacement – quarterly at KES (unless more frequent replacement is required). All filters will be disposed property, assuming PFAS contaminated.
- A site inspection will be completed during filter replacement to assess the condition of the POET system components.
- GAC canister replacement – based on performance monitoring. GAC replacement will be required when PFAS concentrations at the mid-point sampling port is above 50 percent of the DWAL. GZA working with Culligan have estimated that this might be 6 to 18 months.
- The bulb and sleeve will have to be replaced at least annually.

This schedule of activities can be modified as data is collected after one-year of operation. The initial sampling schedule is proposed to be protective of public health considering that a school is involved.

3.4 WATER USAGE MONITORING

The flow meter reading will be recorded during the maintenance and performance monitoring events. Data from these meter readings will be used to determine the total flow from each well passing through the POET.

3.5 GAC UNIT CHANGE OUT

The frequency of change out of the GAC units will be based upon the analytical results. Breakthrough will be defined if any of the PFAS concentrations are detected at 50 percent of the DWAL (example PFOS => 5.0 ng/L or if EPA adopts an MCL then PFOS and/or PFOA => 2 ng/L). GAC change out may also be required should there be relevant changes in pressures before or after the units.

Carbon change out is accomplished by removing the lead carbon unit(s) and moving the lag unit(s) into the lead position and installing a new unit(s) in the lag position(s). In general:

- Shut down the system and bleed off pressure.
- Disconnect and remove the lead unit.
- Disconnect the lag unit and install in the lead position.
- Install a replacement GAC (NSF-certified) unit in the lag position.

Consistent with the American Water Works Association Standard 8604, the new media must soak in water for 24 to 48 hours before operation. The pre-soak can be completed by the Town's contractor before the system is shut down. This way the GAC units can be delivered and immediately placed into service.

4.0 POET SYSTEM MONITORING

This POET monitoring program was developed to verify system performance, determine when O&M activities need to be performed (change outs), and to communicate conditions to both the Town of Killingworth and the School Board. The monitoring program includes a sampling and analysis plan, data management, and reporting.

4.1 SAMPLING AND ANALYSIS PLAN

This section provides a sampling and analysis plan (SAP) for monitoring the KES POET system. The SAP covers:

- Objectives of Sampling.
- Sampling Schedule.
- Purge Water.
- Data Management.
- Analytical Methods and Parameters.
- Preparation and Sample Collection.
- Sample Shipping.
- Reporting.

The sampling summarized herein will be performed by the Town of Killingworth's consultant.

4.1.1 Objective

The goal of the SAP is to verify that the POET system is operated and maintained in a manner that reduces the concentrations of the currently 10-regulated PFAS compounds at levels below the DWAL and maintain the pH with the calcite system.

4.2 ANALYTICAL METHODS AND PARAMETERS

The samples collected from the KES system will be delivered to a Connecticut Certified Laboratory under Chain of Custody protocol. The PFAS will be analyzed using U.S. Environmental Protection Agency (EPA) Method 533. **Table 2.0** contains the list of the 25-analytes, and their abbreviations and **Table 1.0** lists the DWALs. Because there are geochemical parameters that can interfere with treatment (pH, hardness, iron (Method 200.7) and total suspended solids (TSS)), these parameters will also be tested, annually.

4.3 SAMPLING SCHEDULE

Prior to the installation of the POET system, a baseline sample will be collected for the analytical parameters listed in Section 4.2 from KES#1 and KES#2. These baseline data will be used to assess the influent concentrations into the POET. GZA recommends that the samples be collected prior to removal of the pumps and the chlorination of the wells (Section 3.2). Startup monitoring is intended to assess system integrity immediately following installation (Section 4.3.1.). Performance monitoring is intended to establish O&M schedules necessary to achieve the water quality objectives based on site-specific operating conditions (Section 4.3.2.). Routine monitoring is designed to monitor system performance on an ongoing basis once site-specific O&M parameters are defined (Section 4.3.3.).

Once the POET system is installed, samples will be collected during start-up, as part of the performance monitoring, and during routine monitoring.

Maintenance logs will be developed and filled out during any site visit to document the POET activities. These activities may include inspections, GAC change-out and/or sampling. Copies of the logs will be maintained on-site and included within regulatory reports.

4.3.1 Startup Monitoring

After quality control inspections are complete, but before startup samples are collected, the following flushing and sampling procedures will be initiated.

a) Approximately 200 gallons will be processed through the GAC system by the contractor to demonstrate that the system is working properly and without leaks. These 200-gallons of treated water will be directed to a floor drain in the mechanical room which discharges to the SSDS.
    a. After 200-gallons, a representative sample will be collected from both the KES#1 and KES#2 GAC units.
    b. No water will be directed to the storage tank until these results are received and evaluated.
    c. The sampling results will be compared to the DWAL. If below, treated water will then be directed to the storage tank, if not, the steps above will be repeated until concentrations are below the DWAL.

b) The KES internal pipes will be flushed with treated POET water from the storage tank. The Town has provided a list of sinks and water coolers in the school in the Table below. The number of samples to be collected from sinks/water coolers is based upon a percentage listed in the Table.
    a. All samples will be analyzed using EPA's PFAS Drinking Water Method 533.
    b. One duplicate and one MS/MSD sample will be collected per 20 samples for QA/QC.
    c. It is anticipated that the 20 - 30 samples could be collected in one day (using multiple samplers). However, because the samples will be collected in different rooms and locations in the school, 5 field blanks will be collected (1 from classrooms, 1 from the Kitchen, 1 from boy's bathrooms, 1 from girls' bathroom and 1 from the MBR).

Number of Sinks	Locations	Percentage to be Sampled	Number of Samples
38	Classrooms	20 %	8
8	Water Coolers	100 %	8
1	Office	100 %	1
1	Nurse Bathroom	100 %	1
1	Library	100 %	1
1	Staff Room	100 %	1
6	Kitchen	50 %	3
*	5-boys' bathrooms	50 %	2
*	5-girls' bathrooms	50 %	2
*	4- staff bathrooms	50 %	2
*	3- classroom bathrooms	50 %	1
4	Slop sinks	0 %	0
		Total Number of Samples	30
		Total QA/QC Samples	4
		Field Blanks	5
		Total Number of Sample for Method 533 Analyses	39

(*) - Note there are a total of 30 sinks in bathrooms (boys, girls, staff, classroom, and nurse's office)

c) Prior to collecting the representative samples, bathroom toilets will be flushed once to purge stagnant water through the lines and the designated sampling spigots will be opened for at least 30-minutes.

d) In addition to the PFAS analyses, lead will be analyzed using ICP Method. Lead samples will be collected immediately once the spigot is opened.

e) If a location sampled exceeds a DWAL, that location will be retested.

All water during the pipe/line flushing will be directed to the SSDS. The SSDS has received PFAS discharge for years and this procedure will not alter the groundwater quality from years of impacts. However, once the POET system is in place, clean, non-PFAS (less than DWAL) water will be directed to the SSDS. The removal of the PFAS source into the SSDS will likely dilute the existing PFAS groundwater concentration (if present) over time, potentially improving the groundwater conditions, if impacted.

At start-up, the sampling schedule will consist of the following locations:

- Well water influent (I), prior to the lead GAC (beyond the baseline sampling).
- Mid-Point (MP) between lead and lag GAC.
- Post lag (PL) GAC.
- Effluent (E) from POET after pH adjustment, to evaluate pH, only.

4.3.2 <u>Performance Monitoring</u>

Performance monitoring will be performed initially monthly to determine when breakthrough occurs through the lead GAC Unit. Once this is determined (based upon the analytical data and total volume passing), the frequency of sampling may be reduced to quarterly. If concentrations of PFAS, at the mid-point sample, are at 50-percent of the DWAL during the monthly sampling events, then monthly sampling will be retained. These initial performance monitoring activities will be used to assess the frequency of change outs.
Performance monitoring sampling schedule will be collected at:

- Well water influent (I), prior to the lead GAC (quarterly). May be reduced after 24-months.
- Mid-Point (MP) between lead and lag GAC (monthly). May be reduced after 6-months.
- Post lag (PL) GAC (quarterly).
- Effluent (E) from POET after pH adjustment (quarterly), to evaluate pH, only.

4.3.3 <u>Routine Maintenance Monitoring</u>

When performance monitoring detects a breakthrough at 50-percent of the DWAL for PFAS after the lead GAC unit (mid-point sample), additional routine monitoring will be required. These samples will be collected 4-hours after the new lead GAC unit (the old lag unit) is installed as follows:

- After the lead GAC unit to make sure the sorbed PFAS in the lag unit moved into the lead position is sufficient to treat the influent concentration of PFAS.
- After the new lag GAC unit is installed.

If elevated concentrations are reported (at 50-percent of DWAL) after the lead GAC unit within the mid-point sample (older lag unit), then the lead (the old lag) GAC unit will be replaced.

Because of the lead time to obtain replacement Lead and Lag GAC units, it is recommended that the O&M subcontractor for the POET maintain replacement lag units, within the MBR. Thus, at the time of installation, the subcontractor should provide two new lag units in addition to the units required to install the POET system. This way should a breakthrough be detected above 50% of the DWAL, then GAC can be replaced following the soak period as specified by the manufacturer.

4.4 PREPARATION FOR SAMPLING

A monitoring checklist will be completed for water sample collection, which also includes information on project contacts and required equipment and supplies. All laboratory equipment and supplies, including bottle ware, should be PFAS free. The Town's consultant will provide the required safety equipment including PFAS free gloves to prevent cross-contamination. The laboratory will also provide sampling bottles for the analysis identified in Section 4.2.

Prior to sampling, the field staff collecting the PFAS sample must adhere to strict PFAS sampling protocols to prevent cross contamination given the low DWAL concentrations. In addition, the area surrounding the POET should be kept free of PFAS containing materials. The Town's consultant will observe the area near the sampling locations prior to any sampling and note observed sources of potential cross-contamination.

4.4.1 Bottle Ware

Bottle ware will be used to transport samples for laboratory analyses and will be provided by the laboratory performing the analyses. The bottles will be prepared by the laboratory according to the analytical method and certified as clean. The bottles will not be opened until immediately before sample collection.

4.4.2 Field QA/QC

During sampling events, quality assurance/quality control samples will be collected as specified in Section 4.3.1(b). These will include field blanks, duplicate samples, and MS/MSD samples. The purpose of field blanks is to assess potential cross-contamination at the sample point.

4.4.3 Sample Naming and Labels

Sample numbers will consist of identification numbers that include the unique location identification (ID) and the sample port location. The sampling ID would be the same regardless of the analytical analyses. The analysis would be specified on the Change-of-Custody. GZA notes that lead will be included as part of the schools' requirements to maintain lead below the DWAL as part of their ongoing assessment of lead in pipes. Lead is not associated with the influent groundwater from the potable water supply wells.

- The first ID will be the unique location (KES).
- Next will be the well identification (KES#1 or KES#2).
- The sampling port will be identified as (I) influent well water prior to the lead GAC unit, (MP) mid-point sample between the lead and lag GAC units, (PL) post lag GAC unit, and (E) effluent sample after either pH controls, for pH only.
- Two-digit sampling date when the sample was collected (e.g., February 1, 2024 – 02/01/24).
- An example of a sample collected at the mid-point at KES from well KES#2, on September 24, 2023.
    - KES-KES#2- MP-09/23/23.

Labels will be affixed to each sample container. The labels will be sufficiently durable to remain legible even when wet and contain the following information using PFAS equipment (no write-in-the-rain book, sharpies, etc.):

- Location ID.
- Sampling port location as described above.

- Analysis type and if the sample is a QA/QC sample.
- Name or initials of collector.
- Date and time of collection.

4.4.4 Sample Preparation

A monitoring checklist will be completed for water sample collection, which also includes information on project contacts and required equipment and supplies. All equipment and supplies, including bottle ware, should be PFAS free of analytes and potential interferants.

4.4.5 Sample Collection

Field personnel will assess whether the treatment system has undergone regular use by checking the volume of water processed through the treatment system since the last visit. These data will be recorded in a field operation & maintenance book. The field personnel will then check the system for leaks, pressures, and any damage to the system. If leaks are identified, they will be reported immediately to the Town and or Superintendent.

Samples will be collected using a “Clean Hands” and “Dirty hands” protocol. Only the clean hands will collect the sample, whereas the dirty hands person will prepare the sample container, and document activities. These procedures are outlined in the Standard Operating Procedure located in **Appendix E.**

All sample bottles will be provided by a Connecticut certified laboratory. The laboratory will pre-preserve the bottles with ammonium acetate as required by EPA Method 533. Other bottles will be provided as indicated in Section 4.2, by the laboratory,

4.4.6 Sample Preservation and Handling

After collection, samples will be placed into an insulated cooler containing double-bagged wet ice immediately after sample collection, under a Chain-of-Custody. Reusable ice packs are not permitted for PFAS samples. To avoid the potential for cross-contamination, PFAS samples will be placed into their owner cooler, whereas all other parameters will be shipped in separate containers. Upon receipt of the samples, authorized laboratory personnel will store and/or prepare the samples for analysis.

4.4.7 Chain-of-Custody (COC)

Custody of samples, sample collection details (e.g., date, time, ID, requested analyses), shipment information, laboratory receipt, and laboratory custody until completion of analyses will be documented on a COC form. The COC will include the signature of the individuals collecting, shipping, and receiving each sample. Each sample will be entered on the COC. The COC will accompany each set of samples shipped to the laboratory. Each time sample custody changes, the receiving and relinquishing parties will sign, date, and add the time to the COC.

Upon receipt at the laboratory, the contents of the cooler will be compared with the COC. Any discrepancies will be noted on the COC or the laboratory’s sample receipt form. If discrepancies occur, the samples in question will be segregated from normal sample storage and the field personnel notified for clarification. COC records will be maintained as part of the project records.

4.5 PURGE WATER

As part of the sampling procedures, sufficient water will be purged from each sampling port to prevent stagnant water in contact with the GAC units to overestimate performance. To avoid sampling water than that has been in contact with the GAC longer than the empty bed contact time, the system will be purged based upon the number of GAC unit size. However, lead will be sampled immediately at spigot locations.

- PFAS Purge volume for each GAC units = three bed volumes

To achieve these volumes prior to sampling, the system should be operated to purge the water through the systems. To determine if sufficient volume has been purged, either the flow meter or a bucket will be used to measure and record the volume purged. Once the purge volume has been achieved, the sample will be collected during active flow conditions to provide a representative sample. All purge water will be directed to the floor drain which is directed to the SSDS.

4.6 SAMPLE SHIPPING

PFAS sample bottles will be placed into the cooler (see 4.4.6.) and packed with double-bagged wet ice immediately following collection. Packing material will be used as necessary. A temperature blank will be placed in the cooler prior to shipment. The cooler shall be addressed to the appropriate laboratory and dispatched to ensure timely arrival.

4.6.1 Custody Seals

In cases where samples are to be shipped to the laboratory by a commercial carrier (e.g., FedEx®), a custody seal will be placed on the sample shipping container to ensure the samples have not been disturbed during transport. One seal will be placed on the front of the cooler, across the opening. The seals will be signed and dated by the sampling personnel.

4.7 DATA MANAGEMENT

The objectives of data management include:

- Review of data quality, also known as data validation; and
- Data processing or tracking and organizing the data using a database management system to facilitate reporting and prevent processing errors.

4.7.1 Data Quality Review

The data quality review will be conducted in accordance with CTDEEP's Quality Assurance and Quality Control (QA/QC) following the Reasonable Confidence Protocols (RCPs). These QA/QC procedures will provide a level of confidence in the quality of the acquired data. A brief overview of procedures for data validation includes:

- Holding Times: Compare the time and date the sample was collected (on the COC) to the date analyzed in the laboratory report. Verify the dates are within the recommended holding times for the methods.

- Blank Data: Verify through blank sample data results that no significant contamination issues exist from sampling activities, sample transport, storage at the sampling site, or laboratory analyses (where applicable).
- Overall Data Assessment: Examine the data package as a whole and compare it to (1) the COC to verify completeness, (2) the historical data to verify representativeness, and (3) previous data.

Qualification of the data may result if the evaluation criteria are not met. Data qualification(s) will be presented in the sampling report.

4.7.2 Data Processing/Management

The laboratory data report might be provided in various formats including, a PDF, an Excel® spreadsheet format or other electronic data deliverable (EDD) as specified by the Town's consultant. Electronic deliverables are preferred to reduce potential transcription errors. These data will be incorporated into data reports based upon the sampling event and transmitted to the Town of Killingworth.

4.8 REPORTING

Upon receipt of the data, the Town's consultant will interpret the results to determine if there are any DWAL exceedances between the lead/lag GAC units or post lag unit. If there is an PFAS exceedance, the following notification will take place.

- If concentrations exceed 50-percent of the DWAL after the lead GAC unit but not after the lag GAC unit.
  - Notification to the First Selectman and Superintendent of Schools indicating that a change out will be required.
- An exceedance after the lag GAC unit.
  - Notification to CT-DPH and the First Selectman.
  - First Selectman will notify the Superintendent of Schools.
  - Superintendent of Schools will notify the Principal of Killingworth Elementary School.
  - Bottled water would be provided until the GAC units have been changed out.
- A second notice will be provided once the GAC units have been changed out and the concentration have been reported below the CT-DPH DWALs.
- Lead exceedances will be managed by the school and is considered separate from the PFAS treatment.

Lead sampling and notifications are not subject to this PFAS notification. CT-DPH has a separate defined lead notification requirement.

4.8.1 Periodic Reporting

Documentation will be reported either quarterly or after sampling events.

- When samples are collected, the laboratory data report will be reviewed to determine if concentrations exceed the DWAL within 24 to 48 hours of receipt and verbally (or e-mail) reported to both the First Selectman and Superintendent of schools. Any exceedance past the lag GAC will also be reported to CT-DPH.
- All performance and routine maintenance will be summarized in a quarterly report. This report will include all analytical data that may have been collected that period.

- Annually, the data will be reviewed to report trends (i.e., frequency of change outs, changes in the influent concentrations and changes in pressures across the GAC units). This data will be used to assess the subsequent years cost.

TABLES

Table 1.0 Analytical Results
Town of Killingworth

Sample Locations	CT-DPH DWAL Criteria	Units	Area 1		Area 2				
			Public Works	Fire Department	KES Well #1	KES Well #2	KES "BLENDED"	KES-BLENDED Reanalysis	KES-Blended Re-Sample
PFAS Compounds	**Sampling date**		**1/20/2022**	**1/20/2022**	**2/2/2022**	**1/20/2022**	**2/2/2022**	**2/2/2022**	**3/25/2022**
Regulated PFAS Compounds									
Perfluorohexane sulfonic acid (PFHxS)	49.0	ng/L	620.0	610.0	32.0	6.5	22.0	27.0	13.0
Perfluoro-n-hexanoic acid (PFHxA)	240.0	ng/L	160.0	120.0	10.0	5.2	7.8	9.5	6.1
Perfluoro-n-nonanoic acid (PFNA)	12.0	ng/L	9.1	13.0	0.9	ND	ND	0.8	ND
Perfluoro-n-octanoic acid (PFOA)	16.0	ng/L	56.0	67.0	9.5	4.8	7.2	9.1	5.1
Perfluorooctane sulfonic acid (PFOS)	10.0	ng/L	1,000.0	1,400.0	45.0	9.0	30.0	38.0	16.0
Hexafluoropropylene oxide dimer acid (HFPO-DA; GenX)	19.0	ng/L	ND	ND	ND	ND	ND	ND	ND
Perfluorobutane sulfonic acid (PFBS)	760.0	ng/L	99.0	73.0	4.9	2.4	3.9	4.7	4.8
Perfluorobutanoic acid (PFBA)	1,800.0	ng/L	NA	NA	NA	NA	NA	NA	NA
6:2 chloropolyfluoroether sulfonic acid (6:2 Cl-PFESA, 9Cl-PF3ONS, F-53B najor)	2.0	ng/L	NA	NA	NA	NA	NA	NA	NA
8:2 chloropolyfluoroether sulfonic acid (8:2 Cl-PFESA, 11Cl-PF3OUdS,F-53B minor)	5.0	ng/L	NA	NA	NA	NA	NA	NA	NA
Non- Regulated PFAS Compounds									
9-chlorohexadecafluoro-3-oxanone-1-sulfonic acid (9Cl-PF3ONS)	NE	ng/L	ND	ND	ND	ND	ND	ND	ND
11-chloroeicosafluoro-3-oxaundecane-1-sulfonic acid (11Cl-PF3OUdS	NE	ng/L	ND	ND	ND	ND	ND	ND	ND
Perfluoro-n-heptanoic acid (PFHpA)	NE	ng/L	35.0	43.0	4.3	2.0	3.2	4.0	2.1
4,8-dioxa-3H-perfluorononanoic acid (ADONA)	NE	ng/L	ND	ND	ND	ND	ND	ND	ND
N-ethylperfluoro-1-octanesulfonamidoacetic acid (EtFOSAA)	NE	ng/L	ND	ND	ND	ND	ND	ND	ND
N-methylperfluoro-1-octanesulfonamidoacetic acid (MeFOSAA)	NE	ng/L	ND	ND	ND	ND	ND	ND	ND
Perfluoro-n-decanoic acid (PFDA)	NE	ng/L	1.7	3.8	ND	ND	ND	ND	ND
Perfluoro-n-dodecanoic acid (PFDoA)	NE	ng/L	ND	ND	ND	ND	ND	ND	ND
Perfluoro-n-heptanoic acid (PFHpA)	NE	ng/L	35.0	43.0	4.3	2.0	3.2	4.0	2.1
Perfluoro-n-tetradecanoic acid (PFTeDA)	NE	ng/L	ND	ND	ND	ND	ND	ND	ND
Perfluoro-n-tridecanoic acid (PFTrDA)	NE	ng/L	ND	ND	ND	ND	ND	ND	ND
Perfluoro-n-undecanoic acid (PFUdA)	NE	ng/L	ND	ND	ND	ND	ND	ND	ND
Sodium and Chloride									
Sodium	28.0	mg/L	92.0	90.0	28.0	15.0	NA	NA	NA
Chloride	250.0	mg/L	21.0	240.0	130.0	48.0	NA	NA	NA

Values in red exceed the CT DPH Drinking Water Action Level (DWAL) Criteria or above a notification requirement (sodium)

Table 2.0
List of EPA Method 533 PFAS 25-Compounds
and (abbreviations)

Compounds	Abbreviation
11-Chloroeicosafluoro-3-oxaundecane-1-sulfonic acid	(11Cl-PF3OUdS)
9-Chlorohexadecafluoro-3-oxanonane-1-sulfonic acid	(9Cl-PF3ONS)
4,8-Dioxa-3H-perfluorononanoic acid	(ADONA)
Hexafluoropropylene oxide dimer acid	(HFPO-DA)
Nonafluoro-3,6-dioxaheptanoic acid	(NFDHA)
Perfluorobutanoic acid	(PFBA)
Perfluorobutanesulfonic acid	(PFBS)
1H,1H, 2H, 2H-Perfluorodecane sulfonic acid	(8:2FTS)
Perfluorodecanoic acid	(PFDA)
Perfluorododecanoic acid	(PFDoA)
Perfluoro(2-ethoxyethane)sulfonic acid	(PFEESA)
Perfluoroheptanesulfonic acid	(PFHpS)
Perfluoroheptanoic acid	(PFHpA)
1H,1H, 2H, 2H-Perfluorohexane sulfonic acid	(4:2FTS)
Perfluorohexanesulfonic acid	(PFHxS)
Perfluorohexanoic acid	(PFHxA)
Perfluoro-3-methoxypropanoic acid	(PFMPA)
Perfluoro-4-methoxybutanoic acid	(PFMBA)
Perfluorononanoic acid	(PFNA)
1H,1H, 2H, 2H-Perfluorooctane sulfonic acid	(6:2FTS)
Perfluorooctanesulfonic acid	(PFOS)
Perfluorooctanoic acid	(PFOA)
Perfluoropentanoic acid	(PFPeA)
Perfluoropentanesulfonic acid	(PFPeS)
Perfluoroundecanoic acid	(PFUnA)

FIGURES

TOWN OF KILLINGWORTH
WELLHEAD TREATMENT
KILLINGWORTH, CONNECTICUT

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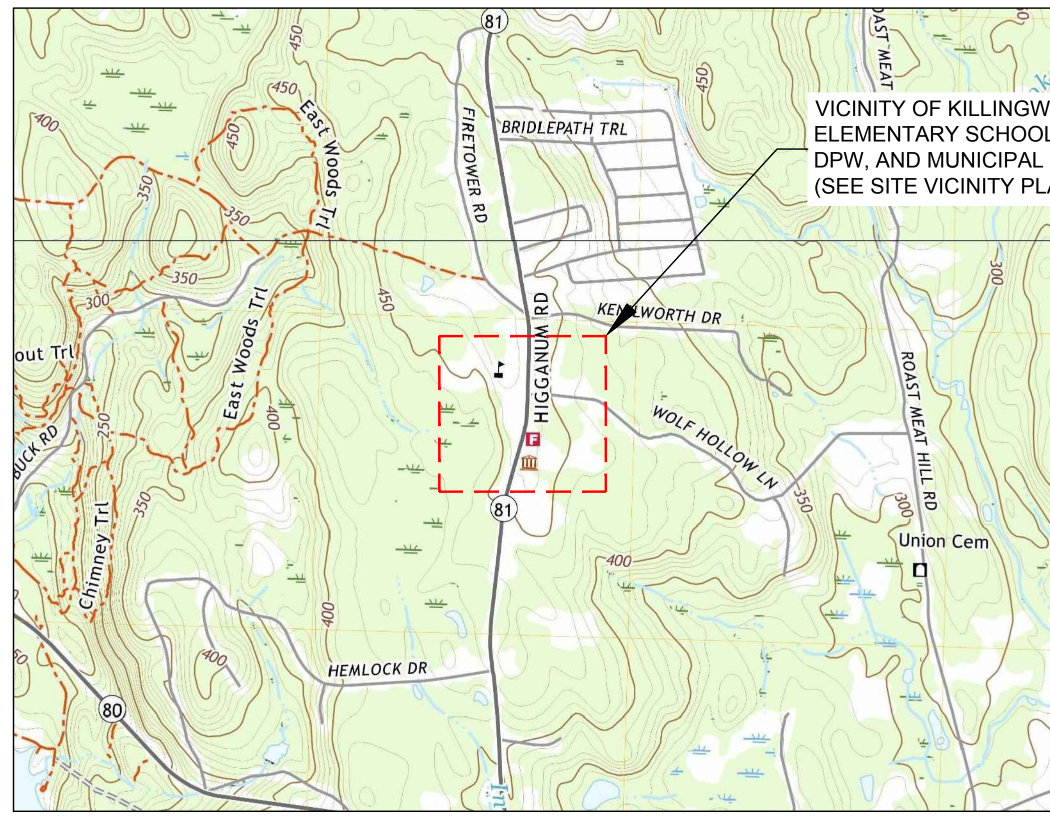
FIGURE 3	KES SITE PLAN
FIGURE 4	KES #2 MECHANICAL ROOM ENLARGED PLAN
FIGURE 5	KES TREATMENT SYSTEM FLOW SCHEMATIC
FIGURE 6	KES #1 BOILER ROOM ENLARGED PLAN



PROJECT LOCUS MAP

SOURCE: USGS TOPOGRAPHIC MAPS OF CLINTON, CT (2021) AND HADDAM, CT (2021)

0 250' 500' 1000' 1500'

SCALE IN FEET

NO.	ISSUE/DESCRIPTION	BY	DATE

WELL HEAD TREATMENT
KILLINGWORTH, CONNECTICUT

LOCATION PLAN AND FIGURE INDEX

PREPARED BY:
GZA GeoEnvironmental, Inc.
Engineers and Scientists
www.gza.com

PREPARED FOR:
TOWN OF KILLINGWORTH
323 ROUTE 81
KILLINGWORTH, CONNECTICUT

PROJ MGR: RJD	REVIEWED BY: RD/MW	CHECKED BY: RD/MW	FIGURE
DESIGNED BY: MAW	DRAWN BY: KJB	SCALE: AS SHOWN	1
DATE: MARCH 2024	PROJECT NO. 05.0046908.02	REVISION NO.	SHEET NO. 1 OF 10

LEGEND

POTABLE WATER WELL

NOTES:

1. 2019 AERIAL PHOTO OBTAINED FROM CT ECO ONLINE DATABASE.

N

0 75 150 300

SCALE IN FEET

NO.	ISSUE/DESCRIPTION	BY	DATE

WELL HEAD TREATMENT
KILLINGWORTH, CONNECTICUT

SITE VICINITY PLAN - ELEMENTARY SCHOOL, FIRE DEPARTMENT, DEPARTMENT OF PUBLIC WORKS, AND MUNICIPAL BUILDINGS

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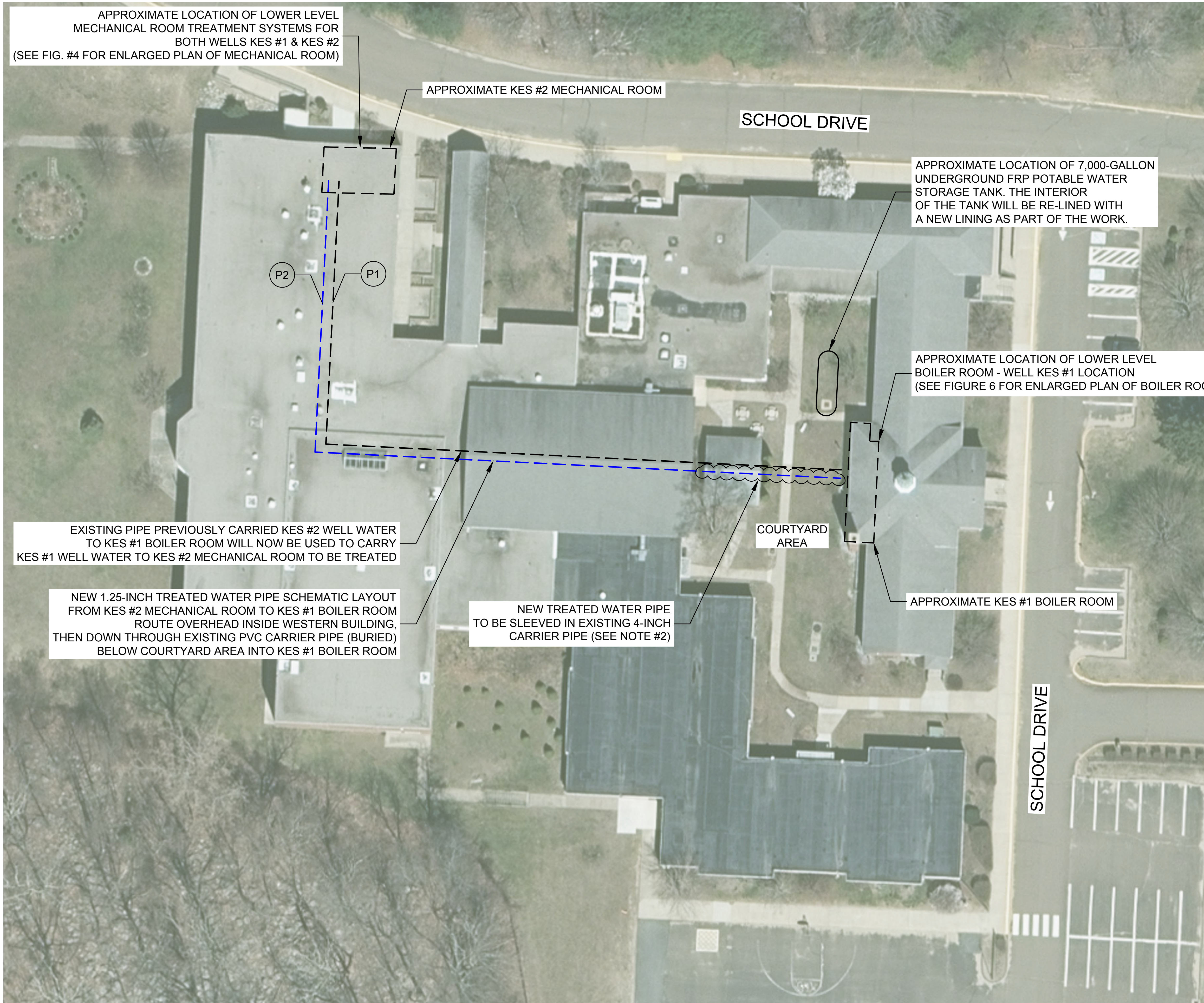
PROJ MGR: RJD	REVIEWED BY: RD/MW	CHECKED BY: RD/MW	FIGURE
DESIGNED BY: MAW	DRAWN BY: KJB	SCALE: AS SHOWN	2
DATE: MARCH 2024	PROJECT NO. 05.0046908.02	REVISION NO.	SHEET NO. 2 OF 10

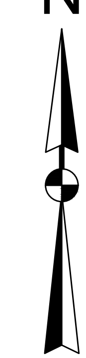


LEGEND

- — — — — CONTAMINATED WATER LINE
- — — — — (blue) TREATED WATER LINE
- (P1) CONTAMINATED WATER FROM KES #1
- (P2) TREATED WATER

NOTES:

1. 2019 AERIAL PHOTO OBTAINED FROM CT ECO ONLINE DATABASE.
2. NO FITTINGS OR JOINTS WILL BE INSTALLED IN THE PIPING SLEEVED THROUGH THE EXISTING 4-INCH CARRIER PIPE.



NO.	ISSUE/DESCRIPTION	BY	DATE

WELL HEAD TREATMENT
KILLINGWORTH, CONNECTICUT

KES SITE PLAN

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PREPARED FOR:
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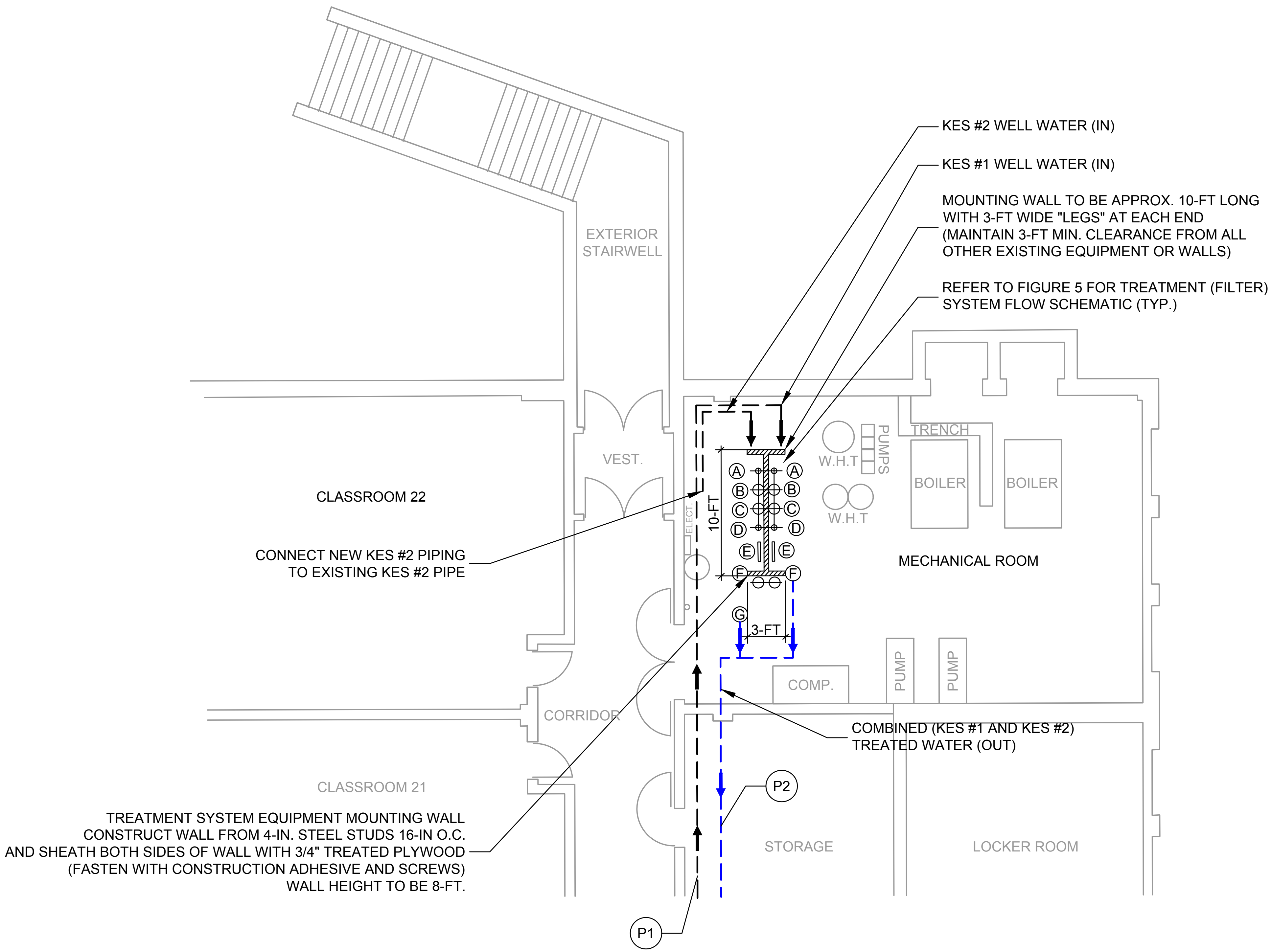
KILLINGWORTH, CONNECTICUT

PROJ MGR: RJD	REVIEWED BY: RD/MW	CHECKED BY: RD/MW	FIGURE
DESIGNED BY: MAW	DRAWN BY: KJB	SCALE: AS SHOWN	3
DATE: MARCH 2024	PROJECT NO. 05.0046908.02	REVISION NO.	SHEET NO. 3 OF 10



(PARTIAL) ENLARGED LOWER LEVEL FLOOR PLAN - KES #2 MECHANICAL ROOM

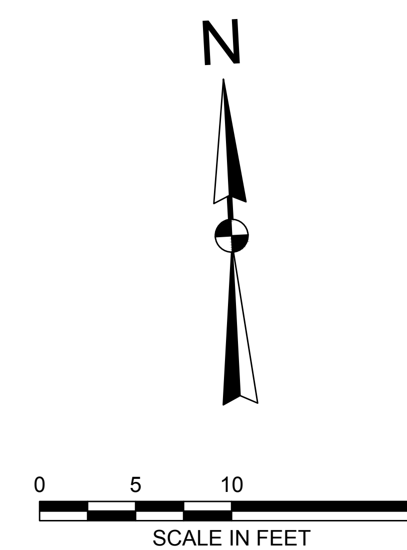
SCALE: 1" = 10'

LEGEND

- (P1) CONTAMINATED WATER PIPING FROM KES #1
- (P2) NEW TREATED COMBINED WATER PIPING FROM KES #1 AND KES #2 TO KES #1 BOILER ROOM

EQUIPMENT LIST

- (A) ENPRESS 50-5 MICRON FILTER
- (B) CULLIGAN CTM-CF-30
- (C) CULLIGAN CTM-CF-30
- (D) ENPRESS 50-5 MICRON FILTER
- (E) VIQUA PRO 30
- (F) CLACK CORPORATION 16X65 HDPE MINERAL TANK
- (G) AMTROL MODEL WX 251 PRESSURE TANK



NO.	ISSUE/DESCRIPTION	BY	DATE

WELL HEAD TREATMENT
KILLINGWORTH, CONNECTICUT

KES #2 MECHANICAL ROOM ENLARGED PLAN

PREPARED BY:
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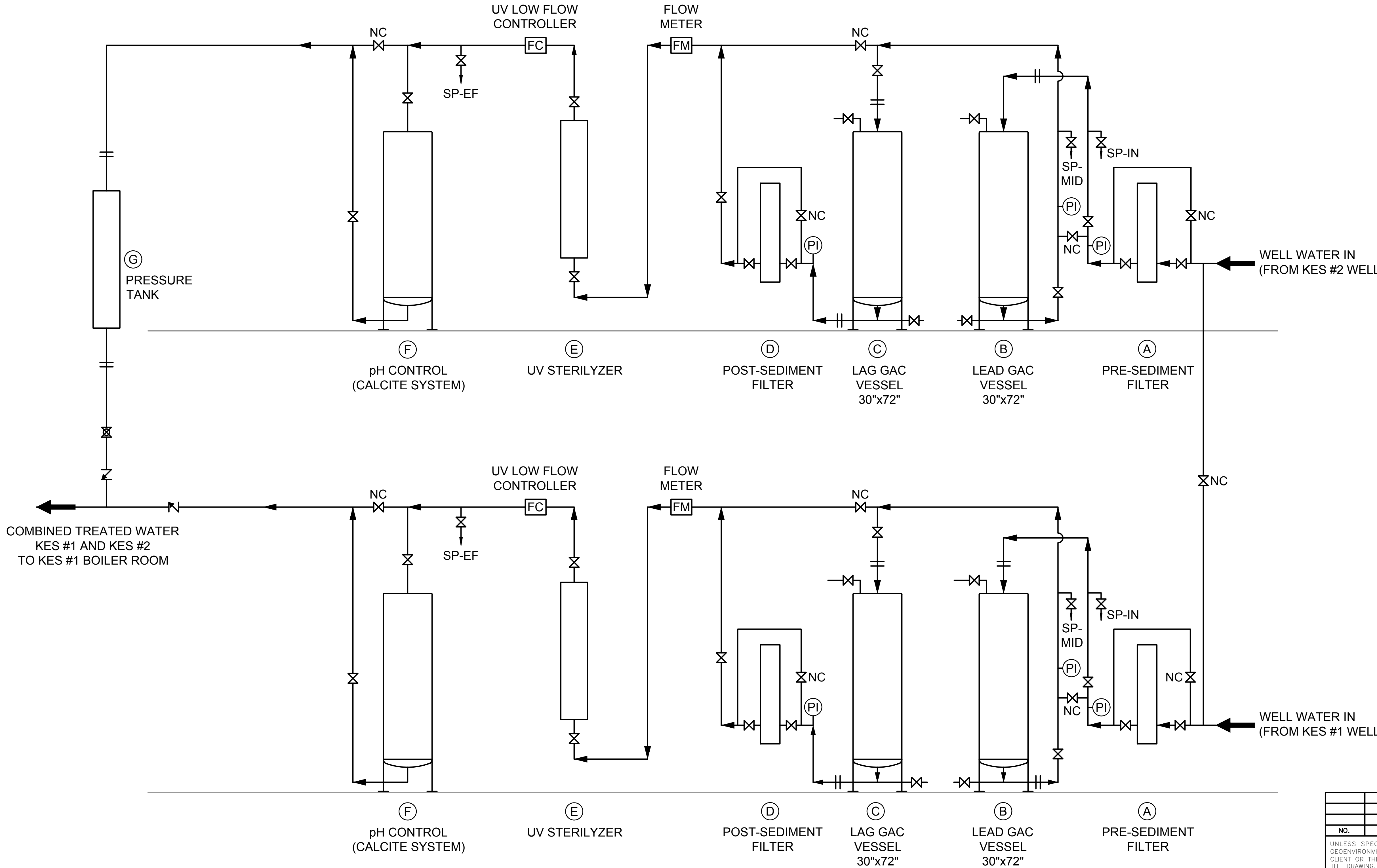
PREPARED FOR:
TOWN OF KILLINGWORTH
323 ROUTE 81
KILLINGWORTH, CONNECTICUT

PROJ MGR: RJD	REVIEWED BY: RD/MW	CHECKED BY: RD/MW	FIGURE
DESIGNED BY: MAW	DRAWN BY: KJB	SCALE: AS SHOWN	4
DATE: MARCH 2024	PROJECT NO. 05.0046908.02	REVISION NO.	SHEET NO. 4 OF 10



EQUIPMENT LIST

(A)	ENPRESS 50-5 MICRON FILTER
(B)	CULLIGAN CTM-CF-30
(C)	CULLIGAN CTM-CF-30
(D)	ENPRESS 50-5 MICRON FILTER
(E)	VIQUA PRO 30
(F)	CLACK CORPORATION 16X65 HDPE MINERAL TANK
(G)	AMTROL MODEL WX 251 PRESSURE TANK

LEGEND

SP-XX	SAMPLE PORT
	GLOBE VALVE
	RELAY CONTROLLED BALL VALVE
FC	FLOW CONTROLLER
FM	FLOW METER
PI	PRESSURE INDICATOR
‖	UNION
	CHECK VALVE
◄	DIRECTION OF FLOW
NC	NORMALLY CLOSED

FILTER SYSTEM SCHEMATIC

NO SCALE

NOTES:

1. ALL TREATMENT SYSTEM PIPING TO BE 1-INCH DIAMETER PEX (TYPICAL).
2. ALL VALVES ARE NORMALLY OPEN UNLESS OTHERWISE INDICATED.
3. TREATMENT SYSTEM FOR BOTH KES #1 AND KES #2 WELL WATER LOCATED IN LOWER LEVEL MECHANIC ROOM. SEE FIGURE 4.
4. THE ULTRAVIOLET STERILYZER SHALL BE PROVIDED WITH A GROUND FAULT PROTECTION CIRCUIT.
5. THE UV FLOW CONTROLLER WILL ALSO RESTRICT THE FLOWS FROM KES #1 AND KES #2 TO 8-GALLONS PER MINUTE.

NO.	ISSUE/DESCRIPTION	BY	DATE

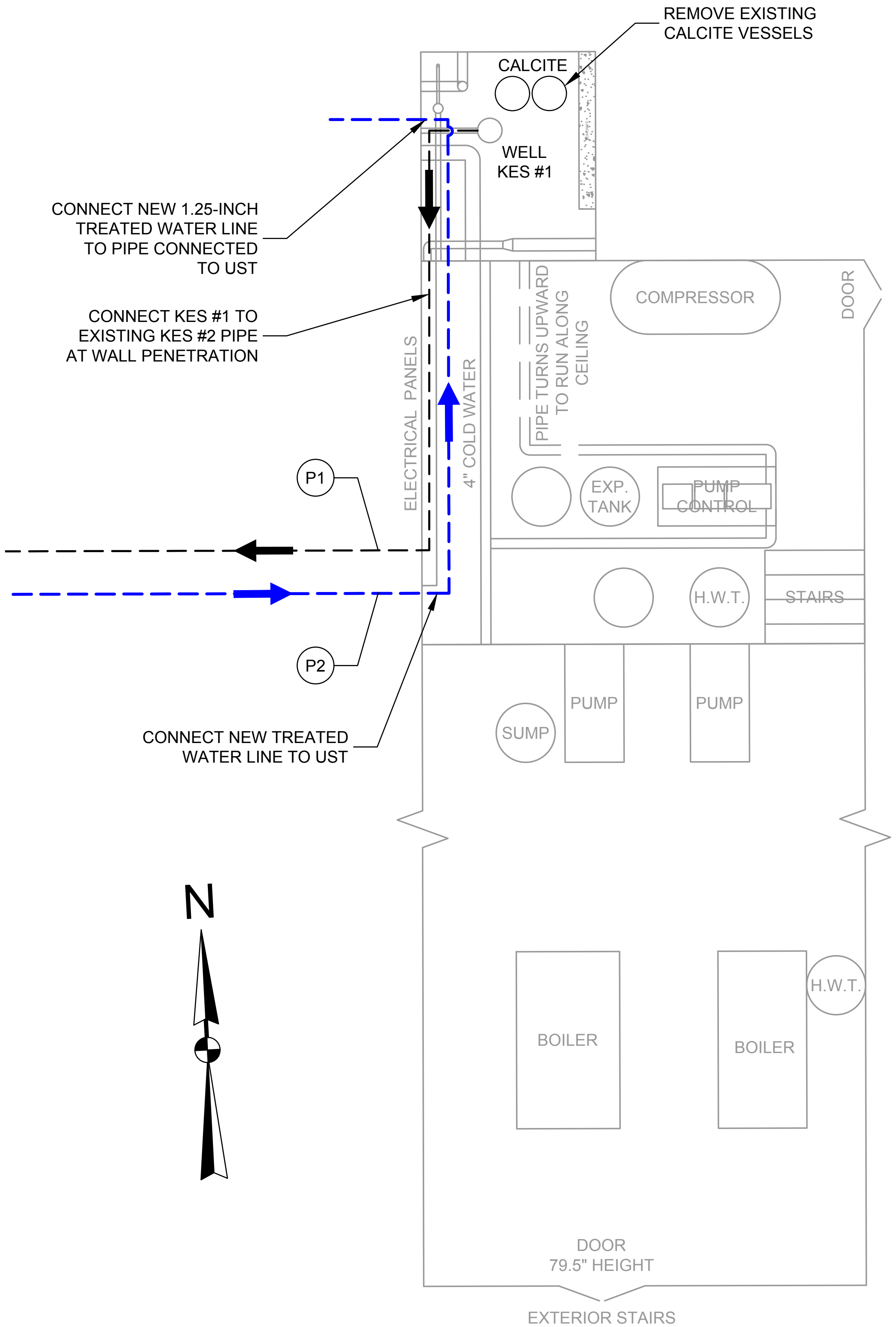
WELL HEAD TREATMENT
KILLINGWORTH, CONNECTICUT

KES TREATMENT SYSTEM FLOW SCHEMATIC

PREPARED BY:
GZA GeoEnvironmental, Inc.
Engineers and Scientists
www.gza.com

PREPARED FOR:
TOWN OF KILLINGWORTH
323 ROUTE 81
KILLINGWORTH, CONNECTICUT

PROJ MGR: RJD	REVIEWED BY: RD/MW	CHECKED BY: RD/MW	FIGURE
DESIGNED BY: MAW	DRAWN BY: KJB	SCALE: AS SHOWN	5
DATE: MARCH 2024	PROJECT NO. 05.0046908.02	REVISION NO.	SHEET NO. 5 OF 10



(PARTIAL) ENLARGED LOWER LEVEL PLAN OF KES #1 BOILER ROOM

SCALE: 1" = 5'

PHOTO AT WEST WALL OF KES #1 BOILER ROOM

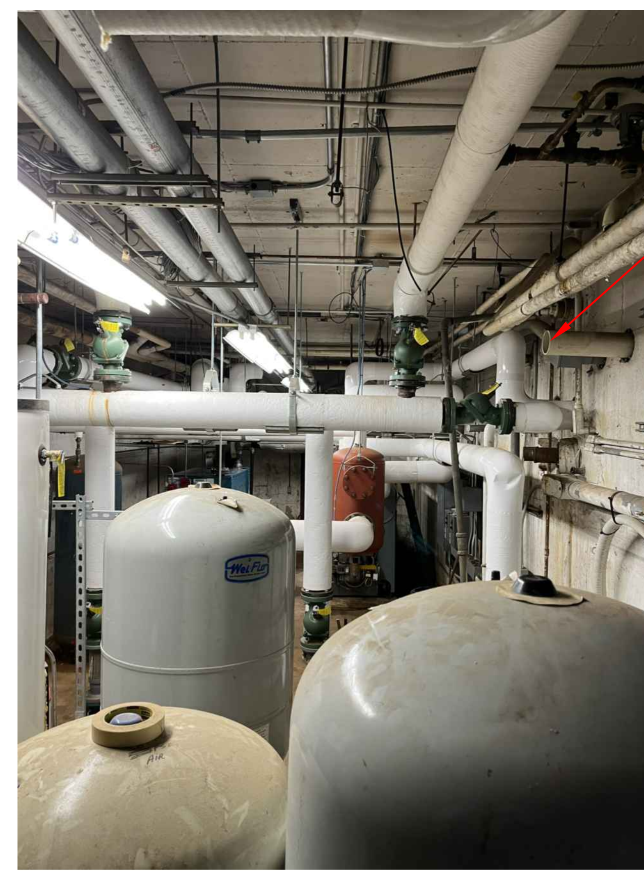


PHOTO LOOKING SOUTH AT WEST WALL OF KES #1 BOILER ROOM

P1 EXISTING (INCOMING) KES #2 PIPE TO BE USED AS (OUTGOING) PIPE FOR KES #1 WELL WATER TO TREATMENT SYSTEM LOCATED IN KES #2 LOWER LEVEL MECHANICAL ROOM (REFER TO FIGURE 4)

P2 EXISTING 4-INCH PVC CARRIER PIPE TO BE USED FOR ROUTING NEW 1.25-INCH TREATED WATER PIPE FROM TREATMENT SYSTEM LOCATED IN KES #2 LOWER LEVEL MECHANIC ROOM (REFER TO FIGURE 4) TO THIS AREA (KES #1 BOILER ROOM)

NO.	ISSUE/DESCRIPTION	BY	DATE

WELL HEAD TREATMENT
KILLINGWORTH, CONNECTICUT

KES #1 BOILER ROOM ENLARGED PLAN

PREPARED BY:
GZA GeoEnvironmental, Inc.
Engineers and Scientists
www.gza.com

PREPARED FOR:
TOWN OF KILLINGWORTH
323 ROUTE 81
KILLINGWORTH, CONNECTICUT

PROJ MGR: RJD	REVIEWED BY: RD/MW	CHECKED BY: RD/MW	FIGURE
DESIGNED BY: MAW	DRAWN BY: KJB	SCALE: AS SHOWN	6
DATE: MARCH 2024	PROJECT NO. 05.0046908.02	REVISION NO.	SHEET NO. 6 OF 10

APPENDIX A
LIMITATIONS

USE OF REPORT

1. GZA GeoEnvironmental, Inc. (GZA) prepared this Report on behalf of, and for the exclusive use of our Client for the stated purpose(s) and location(s) identified in the Proposal for Services and/or Report. Use of this Report, in whole or in part, at other locations, or for other purposes, may lead to inappropriate conclusions; and we do not accept any responsibility for the consequences of such use(s). Further, reliance by any party not expressly identified in the agreement, for any use, without our prior written permission, shall be at the party's sole risk, and without any liability to GZA.

STANDARD OF CARE

2. GZA's findings and conclusions are based on work conducted as part of the Scope of Services set forth in the Proposal for Services and/or Report and reflect our professional judgment. These findings and conclusions must be considered not as scientific or engineering certainties, but rather as our professional opinions concerning the limited data gathered during the course of our work. Conditions other than described in this report may be found at the subject location(s).

3. GZA's services were performed using the degree of skill and care ordinarily exercised by qualified professionals performing the same type of services, at the same time, under similar conditions, at the same or similar property. No warranty, express or implied, is made. Specifically, GZA does not and cannot represent that the Site contains no hazardous material, oil, or other latent condition beyond that observed by GZA during its study. Additionally, GZA makes no warranty that any response action or recommended action will achieve all of its objectives or that the findings of this study will be upheld by a local, state, or federal agency.

4. In conducting our work, GZA relied upon certain information made available by public agencies. Client and/or others. GZA did not attempt to independently verify the accuracy or completeness of that information. Inconsistencies in this information which we have noted, if any, are discussed in the Report.

SUBSURFACE CONDITIONS

5. The generalized soil profile(s) provided in our Report are based on widely-spaced subsurface explorations and are intended only to convey trends in subsurface conditions. The boundaries between strata are approximate and idealized, were developed utilizing interpolation/extrapolation methods, and were based on our assessment of subsurface conditions. The composition of strata, and the transitions between strata, may be more variable and more complex than indicated. For more specific information on soil conditions at a specific location refer to the exploration logs. The nature and extend of variations between these explorations may not become evident until further exploration or construction. If variations or other latent conditions then become evident, it will be necessary to reevaluate the conclusions and recommendations of this Report.

6. Water level readings have been made, as described in this Report, in the specified monitoring wells at the specified times and under the stated conditions. These data have been reviewed and interpretations have been made in this Report. Fluctuations in the level of the groundwater, however, occur due to temporal or spatial variations in areal recharge rates and heterogeneities, the presence of subsurface utilities, and/or natural or artificially induced perturbations. The observed water table and hydraulic heads may be other than indicated in the Report.

COMPLIANCE WITH CODES AND REGULATIONS

7. We used reasonable care in identifying and interpreting applicable codes and regulations necessary to execute our scope of work. These codes and regulations are subject to various, and possibly contradictory, interpretations. Interpretations and compliance with codes and regulations by other parties is beyond our control.

SCREENING AND ANALYTICAL TESTING

8. GZA collected environmental samples at the locations identified in the Report. These samples were analyzed for the specific parameters identified in the Report. Additional constituents, for which analyses were not conducted, may be present in soil, groundwater, surface water, sediment, and/or air. Future Site activities and uses may result in a requirement for additional testing.

9. Our interpretation of field screening and laboratory data is presented in the Report. Unless noted otherwise, we relied upon the laboratory's QA/QC program to validate these data.

10. Variations in the types and concentrations of contaminants observed at a given location or time may occur due to release mechanisms, disposal practices, changes in flow paths, and/or the influence of various physical, chemical, biological, or radiological processes. Subsequently observed concentrations may be other than indicated in the Report.

INTERPRETATION OF DATA

11. Our opinions are based on available information and data as described in the Report, and on our professional judgment. Additional observations made over time, and/or space, may not support he opinions provided in the Report.

ADDITIONAL INFORMATION

12. In the event that the Client or others authorized to use this report obtain additional information on environmental or hazardous waste issues at the Site not contained in this Report, such information shall be brought to GZA's attention forthwith. GZA will evaluate such information and, on the basis of this evaluation, may modify the conclusions stated in this Report.

ADDITIONAL SERVICES

13. GZA recommends that we be retained to provide services during any future investigations, design, implementation, activities, construction, and/or property development/redevelopment of the Site. This will allow us the opportunity to: i) observe conditions and compliance with our design concepts and opinions; ii) allow for changes in the event that conditions are other than anticipated; iii) provide modifications to our design; and iv) assess the consequences of changes in technologies and/or regulations.

APPENDIX B
CUTSHEETS

STATE OF CONNECTICUT
DEPARTMENT OF PUBLIC HEALTH

Manisha Juthani, MD
Commissioner

Ned Lamont
Governor
Susan Bysiewicz
Lt. Governor

Drinking Water Section

January 9, 2024

Mr. Eric Couture
First Selectman
Town of Killingworth
323 route 81
Killingworth, CT 06419

PWS Name:	Killingworth Town Hall & Killingworth Elementary School
Town:	Killingworth
PWSID:	CT0700204 & CT0709003
DWS Project No.:	SFY 23-70 & SFY 23-71
Project:	PFAS/Sodium Remediation

Subject: Drinking Water State Revolving Fund (DWSRF)
Design Review Comments – Request for Additional Information

Dear Mr. Eric Couture:

The Department of Public Health (DPH) has reviewed the document titled Point-of-Entry Treatment Systems for Killingworth Elementary School (KES) and the Town of Killingworth Municipal Center (KMC) dated October 2023, that was submitted for the Killingworth Town Campus & Elementary School PFAS and Sodium Remediation project by GZA GeoEnvironmental, Inc. on behalf of the Town of Killingworth. As a result of our review, please see the following comments and requests for additional information and respond to this office to proceed with the technical approval process for the above-mentioned project.

Comments from sanitary survey review:

1. KES – the atmospheric storage tank appears to have a combined vent and overflow and should be separated, if possible.
2. KES – the casing for Well #1 is rusty and flaking. It is recommended that the well casing be checked for integrity and at the least be sanded down and repainted.
3. KMC – the pressure gauge at the hydropneumatic tank was in disrepair and must be replaced.

Comments from design review:

4. The water from the line flushing that is planned to remove legacy PFAS in the distribution system should be handled and disposed of properly.
5. It appears that the EBCT for the GAC filter vessels at KES is stated to be 8-minutes through two GAC vessels and at the Town, 4-minutes through four vessels. A minimum of 10-minute EBCT is required in each vessel regardless of whether the vessels are operated in parallel. This design appears to be undersized and should be scaled appropriately to achieve non-detectable levels of PFAS. If there is no space for larger tanks, resin media may be a viable alternative treatment method with lower EBCTs depending on the product.
6. There appears to be bypass valves for the GAC treatment indicated in the drawings. All water supplied to consumers should be continuously treated by the PFAS treatment system. No bypass lines should be installed for servicing/routine maintenance. A parallel train may be utilized to provide potable water when one train is out of service.
7. What is the reasoning behind installing UV? The addition of UV treatment will increase the water system's monitoring requirements. Systems using non 4-log certified disinfection are required to conduct source water monitoring at the same frequency as RTCR sampling. Also, there has only been one period of occurrences of total coliform bacteria with the town hall PWS in 2015. Is UV necessary? Additionally, please share the reasoning of their location in the treatment trains. Would it possibly be more beneficial to install the UV disinfection before the GAC filters to address organism growth on the filters?
8. Refer to DPH UV Treatment Guidance. Please ensure that conditions in the guidelines regarding influent water quality, unit installations and monitoring are being met.
9. Raw water sample taps must be smooth nosed and installed on influent well water lines prior to the check valve on the well discharge line.
10. All treatment system components must be certified to the NSF/ANSI Standards for use with drinking water systems and media to the NSF/ANSI Standard 60. Please indicate if Culligan and RO components are certified to these standards.
11. KMC – DPW Well – The DPH has only ever regulated the Town Hall Well as part of the PWS CT0700204. If a PWS wants to add a well to the regulated public water system, it must go through the well approval process. This begins with 1) Well Site Suitability Application and 2) Well Quality and Quantity Application and ends with the well use approval. We should discuss the implications of connecting this well to the regulated public system.
12. Restricting the fire department well from 40 gpm to 8 gpm may cause unfavorable backpressure on the well pump depending on pump sizing. This should be evaluated prior to finalizing the design.
13. There is no MCL for sodium and the notification level for sodium was increased in the 2021 regulation change to RCSA19-13-B102 to require public notice if the sodium level is above 100 mg/L. RO can also treat PFAS. Why are both GAC and RO being installed for the town system? The RO treatment and remineralization tank may not be necessary.

14. The RO reject water is shown to go to a dedicated drywell. The drywell must be located outside of the sanitary radii of the wells and shall conform with the requirements of the comprehensive general permit. Additionally, the reject water discharge must meet the regulatory and technical standards indicated by the DPH Environmental Engineering Program.
15. Was circulation of the RO reject water considered?
16. How will spent sediment filters be disposed of? Used sediment filters may contain PFAS.
17. Will start up backwash procedures be utilized when GAC is changed to condition the new media?
18. Please provide the technical specifications for the “remineralization tanks”.

Comments from October 17, 23 meeting:

19. Please respond to the Preliminary Engineering Report comments sent on October 11, 2023 from the DWS Emerging Contaminant Unit.
20. Please submit DWS Public Water System General Application for Approval or Permit.
21. Please submit a Water Treatment Plant Classification Form.
22. Please submit a DWSRF Pre-Bid Checklist along with all supporting documentation.
23. Please provide an engineering best estimate of the project cost.

If you have any questions or need any assistance, please do not hesitate to contact me at Joseph.Buehler@ct.gov.

Sincerely,

Joseph Buehler, P.E.
Environmental Engineer
Drinking Water Section

Copy: Robert Albert, Regional School District 17
Richard Desrosiers, GZA
Mandy Smith, DWS
Austin McMann, DWS
Patricia Bisacky, DWS
Aaron Medford, DWS

APPENDIX C
NATHAN L. JACOBSON & ASSOCIATES, INC. DRAWING

AMTROL®

WELL-X-TROL®

Diaphragm Well Tanks: WX-100, 200 and 300 Series

150 PSIG Working Pressure

Construction

Shell	High Strength Steel
Diaphragm	Heavy Duty Butyl
Liner	Antimicrobial
System Connection	Stainless Steel
Finish	Tuf-Kote™ HG Blue
Water Circulator	Turbulator®
Air Valve	Projection Welded
Factory Precharge	38 PSIG (2.6 bar)

Performance

Maximum Operating Temperature	200°F (93°C)
Maximum Working Pressure	150 PSIG (10.3 bar)
Maximum Relief Valve Setting	125 PSIG (8.6 bar)
Warranty	7-Years

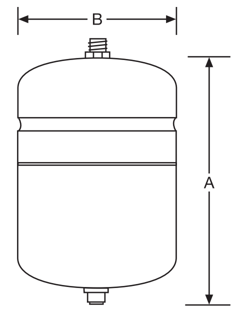
Application

- Controls pump cycling in residential well water systems.
- Can be installed indoors or outdoors.

In-Line Models

Model Number	Tank Volume		Max. Acceptance Factor	A Tank Height		B Tank Diameter		System Connection (NPTM)	Shipping Weight	
	Gal	Lit		In	mm	In	mm	In	Lbs	Kg
WX-101	2.0	8	0.45	13	330	8	203	¾	5	2
WX-102	4.4	17	0.55	15	381	11	279	¾	9	4
WX-103	6.7	25	0.40	20	508	11	279	¾	13	6
WX-104	10.3	39	1.00	18	457	15	381	1	20	9
WX-200	14.0	53	0.81	22	559	15	381	1	22	10

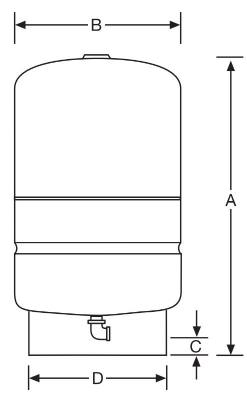
Available in gray. Use suffix G.



Stand Models

Model Number	Tank Volume		Max. Accept. Factor	A Tank Height		B Tank Diameter		C Sys. Conn. Centerline		D Stand Diameter		System Conn. (NPTF)	Shipping Weight	
	Gal	Lit		In	mm	In	mm	In	mm	In	mm	In	Lbs	Kg
WX-201	14.0	53	0.81	25	635	15	381	1 19/32	40	12	304	1	25	11
WX-202	20.0	76	0.57	32	813	15	381	1 19/32	40	12	304	1	32	15
WX-202XL	26.0	98	0.44	39	991	15	381	1 19/32	40	12	304	1	39	18
WX-203	32.0	121	0.35	47	1194	15	381	1 19/32	40	12	304	1	47	21
WX-205	34.0	129	1.00	30	762	22	559	1 15/16	49	20½	521	1¼	57	26
WX-250	44.0	167	0.77	36	914	22	559	1 15/16	49	20½	521	1¼	65	29
WX-251	62.0	235	0.55	47	1194	22	559	1 15/16	49	20½	521	1¼	87	39
WX-255	81.0	306	0.41	57	1448	22	559	1 15/16	49	20½	521	1¼	109	49
WX-302	86.0	326	0.54	47	1194	26	660	2 1/16	52	20½	521	1¼	106	48
WX-350	119.0	450	0.39	62	1575	26	660	2 1/16	52	20½	521	1¼	146	66

Avaliable in Blue only. Available in Tan and Gray. Use suffix T or G.



All dimensions and weights are approximate.

Job Name ______________________ Notes ______________________

Engineer ______________________ ______________________

Contractor ______________________ ______________________

P.O. No. ______________________ ______________________

Sales Rep. ______________________ ______________________

Model No. ______________________ ______________________

Antimicrobial. Turbulator.

NSF Certified to NSF/ANSI/CAN 61

ISO 9001:2015 CERTIFIED

LEAD FREE IAPMO R&T ®

Clack® Mineral Tanks

Clack Mineral Tanks are made of high density polyethylene (HDPE) plastic liner with composite fiberglass filament winding over the liner. Clack's design provides a continuous seamless inner liner with a glass filled polypropylene inlet for higher strength and pressure capabilities. Residential and commercial pressure tanks are available from 8" to 30" diameters.

FEATURES:

- For water softener and filtration applications
- Capacities from 6.7 to 189.1 gallons
- 10 year warranty for 8" - 13" vessels
- 5 year warranty for 14" - 30" vessels

MATERIAL OF CONSTRUCTION:

- Inner liner high density polyethylene
- Threaded inlet glass filled polypropylene

OPERATING PARAMETERS:

- Maximum operating pressure: 150 psi
- Maximum operating temperature: 120ºF

EXCEEDS NSF/ANSI 44 MINIMUM PERFORMANCE REQUIREMENTS:

- Safety factor: 4:1
- Minimum burst at 600 psi
- Tested to 100,000 cycles/0-150 psi

COLORS AVAILABLE:

ALMOND
BLACK
BLUE
GREY
NATURAL

NSF®

This product is Tested and Certified by NSF International against NSF/ANSI 44 for material and structural integrity requirements and NSF/ANSI/CAN Standard 61 for material requirements. Certified to NSF/ANSI/CAN 372.

MADE IN THE USA

MINERAL TANK SPECIFICATIONS:

Tank Size (Inches)	Opening Diameter (Inch/mm)	Height with Base (Inch/mm)	Capacity Gallons	Capacity Liters	Capacity Cubic Feet	Empty Tank Weight With Base (Lbs/Kg)	Quantity per Bulk Pack/ Carton
8x35*	2.5/63.5	34.9/886	6.7	25.5	0.90	8.1/3.7	18
8x44	2.5/63.5	44.2/1123	8.6	32.5	1.15	9.8/4.4	18
9x18*	2.5/63.5	18.4/467	3.9	14.8	.52	5.1/2.3	9
9x35*	2.5/63.5	34.8/884	8.2	31.0	1.09	9.5/4.3	16
9x48	2.5/63.5	48.3/1227	11.5	43.7	1.54	12.5/5.7	16
10x18*	2.5/63.5	18.4/468	4.75	18.0	.64	6.3/2.9	8
10x35*	2.5/63.5	35.0/889	10.2	38.8	1.37	10.4/4.7	16
10x40	2.5/63.5	40.6/1031	12.0	45.5	1.61	11.7/5.3	16
10x44	2.5/63.5	44.3/1125	13.2	50.1	1.77	12.4/5.6	16
10x47	2.5/63.5	47.2/1199	14.2	53.8	1.90	13.1/5.9	16
10x54	2.5/63.5	54.4/1382	16.0	60.6	2.14	15.0/6.8	16
12x35*	2.5/63.5	35.4/900	14.60	55.3	1.95	15.4/7.0	9
12x52	2.5/63.5	52.8/1341	23	86.6	3.1	19.7/8.9	9
13x54	2.5/63.5	55/1397	28	105.4	3.7	22.5/10.2	9
14x65	2.5/63.5	65.6/1666	39.4	149.2	5.27	37.5/17	1
14x65	4/101.6	65.6/1666	39.4	149.2	5.27	37.5/17	1
16x53	2.5/63.5	54/1371	41.0	155.2	5.48	41/18.6	1
16x65	4/101.6	65.6/1666	51.2	193.8	6.85	42.75/19.4	1
18x65	4/101.6	67.7/1720	73.5	278.1	9.83	52.5/23.8	1
21x62	4/101.6	67.8/1722	89.6	339.1	11.98	75.75/34.4	1
24x72	4/101.6	73.6/1869	120	464.1	16.39	98.25/44.6	1
30x72	4/101.6	72.2/1884	189.1	715.8	25.28	116/52.6	1

***Available with or without base.**
Note: All data is for reference only and is subject to change without notice.

Clack Corporation
4462 DURAFORM LANE • WINDSOR, WISCONSIN 53598-9716 USA
PHONE (608) 846-3010 FAX (608) 846-2586 SALES/CUSTOMER SERVICE FAX (800) 755-3010

Form No. 2902 • 8/26/2021

APPENDIX D
CULLIGAN’S OWNER MANUAL (INCLUDED FOR REFERENCE/INFORMATIONAL PURPOSES ONLY)

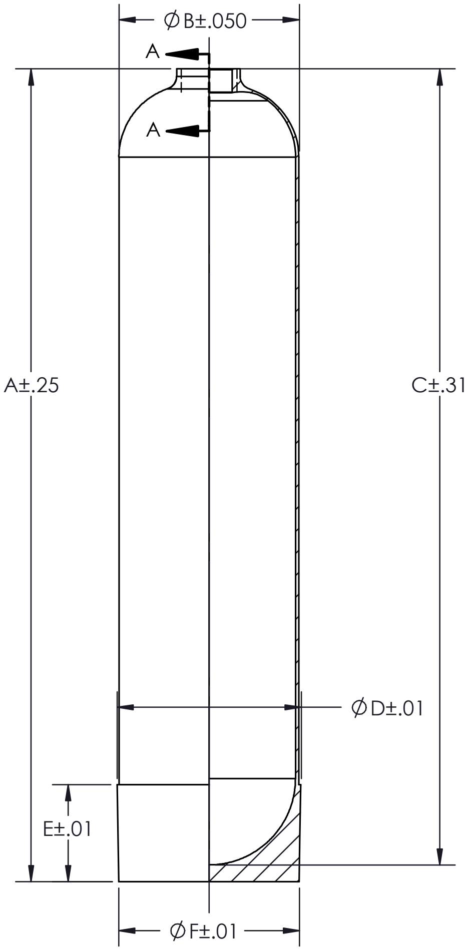
1. FRP PEDI TANKS:

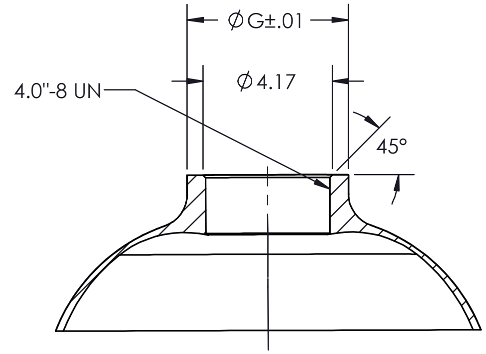
Culligan Branded PEDI tanks. With Heavy duty rubber base and rubber protection bumper. The protection bumper wraps over the dome/side wall transition providing superior dome protection during handling. The polyethylene liner is surface treated to ensure complete adhesion of the resin/ glass matrix with HDPE liner. The liner is also wounded with an extra helical winding layer provides robust construction for protection against frequent loading and unloading of the tank during transportation.

CATALOG NUMBER	DESCRIPTION	TANK SIZE (IN)	MEDIA LOAD (FT^3)	IN/OUT OPEN'G (IN)	TANK OPEN'G
MS444114	FRP PE Tank 9x42, w/ tank adaptor, internals, fill port	9"x44"	1.4	¾" NPT	2 ½"
MS444117	FRP PE Tank 12x42, w/ tank adaptor, internals, fill port	12"x44"	2.4	1" NPT	4 ½"
MS444120	FRP PE Tank 14x47 w/ tank adaptor, internals, fill port	14"x48"	3.5	1" NPT	4 ½"
MS029326	FRP PE Tank 14x65 w/ tank adaptor, internals, fill port	14"x65"	5.2	1" NPT	4 ½"
MS029349	FRP PE Tank 16x65 w/ tank adaptor, internals, fill port	16"x65"	6.8	1" NPT	4 ½"

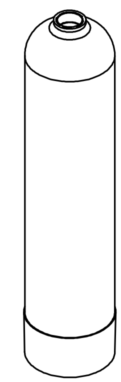
- 150 psi max. Pressure; 120° F max. Temperature.
- Resin or media loading is not included, see resins and carbon section below for choices
- These tanks are available through the Marketplace program, they ship from stock, FOB Libertyville, IL
- Order the above on C-Port

CULLIGAN PN	PENTAIR REF DWG	TANK SIZE	TANK VOLUME	DOME VOLUME	TANK WEIGHT W/BASE	A	B	C	D	E	F	G
01019577	CHSK-5229	16X53	40.0 GAL	2.7 GAL	26.0 LB	54.996	16.00	52.242	16.30	8.56	16.01	5.44
01019578	CHSK-5308	14X47	27.5 GAL	1.7 GAL	21 LB	47.027	14.42	45.266	14.81	7.81	14.54	5.44
01019579	CHSK-5201	16X65	49.0 GAL	2.7 GAL	34.0 LB	66.206	16.00	63.957	16.30	8.56	16.01	5.44
A2365029	CHSK-5200	14X65	38.0 GAL	1.7 GAL	32.0 LB	65.40	14.50	64.11	14.81	7.81	14.54	5.20





SECTION A-A
SCALE 1 : 4



MAX OPERATING PRESSURE	150 PSIG	[1034 kPa]
MAX OPERATING TEMPERATURE	120°F	[49°C]

NOTES:
1. NOT SUITABLE FOR PNEUMATIC PRESSURE APPLICATIONS
2. TANK ELONGATES UP TO .25 [6.4] AT MAXIMUM OPERATING PRESSURE. FLEXIBLE CONNECTIONS ARE RECOMMENDED TO PREVENT DAMAGE TO THE TANK OR PIPING.
3. TANK IS RATED FOR AN INTERNAL NEGATIVE PRESSURE OF 5.0 [127] OF Hg VACUUM. HIGHER VACUUM VALUES MUST BE PREVENTED WITH AN ADEQUATE VACUUM BREAKER
4. MINIMUM CLEARANCE OF 48.0 [1219.2] ON TOP REQUIRED FOR PIPING AND MANEUVERING.
5. PENTAIR ONLY - TANK LINER MAY USE UP TO 75% REGRIND PROCESSED INTO BLOW MOLD LINER. THIS PERCENTAGE OF REGRIND COINCIDES WITH PENTAIR SUBMITTAL TO WQA FOR NSF 44 AND NSF 61 CERTIFICATION
6. THIS DRAWING IS TO BE USED AS REFERENCE ONLY. SEE PENTAIR DRAWINGS FOR APPROVED DIMENSIONS

REVISION DESCRIPTION	DCO#	BY	DATE
Initial Release	210354	RL	01-25-22

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MATERIAL: -

SIZE	DRAWN BY
B	RL
SCALE	APPROVED BY
1:10	RL
SHEET	APPROVED DATE
1 OF 1	01-25-22

TOLERANCES, UNLESS OTHERWISE SPECIFIED

LAST DIGIT	TOLERANCE (inches)	TOLERANCE (millimeters)
0.	± 0.030	± 0.76
0.0	± 0.015	± 0.38
0.00	± 0.010	± 0.25
0.000	± 0.005	± 0.13
ANGULAR	± 0.5°	± 0.5°

PART DESCRIPTION: **Tank,FG,4",A/S Port**

FILE NAME: **DRW-2206**

REV: **A**

APPENDIX E
PFAS SAMPLING SOP

PURPOSE

The purpose of this Standard Operating Procedure (SOP) is to provide guidance for collecting samples for per- and poly-fluorinated alkyl substances (PFAS) analysis. *Please note that PFAS are emerging contaminants; therefore, this SOP will be modified as new information becomes available.*

Because of the potential presence of PFAS in common consumer products and in equipment typically used to collect groundwater samples and the low detection limits associated with laboratory PFAS analysis, special handling and care must be taken when collecting samples for PFAS analysis.

This SOP outlines general practices for collecting PFAS samples and provides a summary of non-acceptable field and sampling materials (likely to contain PFAS) and acceptable alternatives.

BACKGROUND

Based on U.S. Environmental Protection Agency (USEPA) guidance[1], "per- and polyfluoroalkyl substances (PFAS)" is the preferred term to refer to this class of chemicals, although the general public and others may also refer to them as "perfluorinated chemicals (PFCs)" or "perfluorinated compounds (PFCs)."

PFAS are a family of man-made compounds that do not naturally occur in the environment. They have a large number of industrial uses and are found in many commercial products because of their properties to resist heat, oil, grease, and water. Once released to the environment, PFAS are persistent and do not readily biodegrade or break down. There are areas within the United States where widespread PFAS impacts to drinking water supplies have been identified.

The USEPA issued drinking water lifetime health advisories for two PFAS, perfluorooctanoic acid (PFOA) and perfluorooctane sulfonate (PFOS) on May 19, 2016. The State of Michigan has adopted three groundwater standards (effective January 2018): 70 parts per trillion (ppt) for PFOA, 70 ppt for perfluorooctane sulfonic acid (PFOS), and 70 ppt for PFOA and PFOS combined, where the chemicals are found together.

RESOURCES

Frequently asked questions, fact sheets and additional information concerning PFAS can be found on the EPA website[2]. The Northeast Waste Management Officials' Association (NEWMOA) provided a five-part webinar training[3] series in 2016. The National Groundwater Association (NGWA) published a PFAS guidance document *Groundwater and PFAS: State of Knowledge and Practice* in 2017. Other training events and information are available online. The Interstate Technology & Regulatory Council (ITRC)[4] is also in the process of preparing educational materials, which will also be available online when completed.

GENERAL GUIDANCE

<u>SITE CONTROL</u>

Due to the ease by which cross-contamination may occur when collecting samples for PFAS analysis, strict site control must be maintained. During daily setup, the field team shall clearly demarcate an exclusion zone (area with approximately 30 feet of sampling location). The exclusion zone shall be marked with stakes, cones, flags, caution tape, or equivalent visual cues. Visitors to the sampling area (including other contractors, managers, regulators, residents, and the public) must stay outside of the exclusion zone while sampling and investigation activities are on-going. If an individual requests access to the exclusion zone, they must receive training on the components of this SOP that are pertinent to the activities occurring at the time of

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[1] https://www.epa.gov/pfas/what-are-pfcs-and-how-do-they-relate-and-polyfluoroalkyl-substances-pfass
[2] https://www.epa.gov/pfas/what-are-pfcs-and-how-do-they-relate-and-polyfluoroalkyl-substances-pfass
[3] http://www.newmoa.org/cleanup/workshops.cfm
[4] http://www.itrcweb.org

their access and they will be subject to GZA's health and safety plan. Documentation of all non-GZA personnel within the exclusion zone shall be provided in the daily field summary as well as on the field sample data sheet.

PERSONAL PROTECTIVE EQUIPMENT

Disposable nitrile gloves must be worn at all times within the exclusion zone. Further, a new pair of nitrile gloves shall be donned prior to the following activities at each sample location:

1. Decontamination of re-usable sampling equipment.
2. Contact with sample bottles or water containers.
3. Insertion of anything into the well (e.g., tubing, pump, bailer, water level meter).
4. Insertion of silicon tubing into the peristaltic pump.
5. Sample collection upon completion of monitoring well purging.
6. Handling of any quality assurance/quality control samples including field blanks and equipment blanks.

New gloves shall also be donned after the handling of any non-dedicated sampling equipment, contact with non-decontaminated surfaces, or when judged necessary by field personnel.

Typically 3 pairs of gloves are required when collecting PFAS samples at a location. Gloves may be worn in layers so that gloves are removed between tasks revealing a set of clean gloves below:

- One pair of gloves is used for sample preparation (exclusion zone setup, transporting coolers to the sample site, preparing field documentation);
- A new pair is donned for labeling sample bottles; and
- A new pair is donned for the sample collection. The use of a different colored glove (e.g., bright orange) for the collection of PFAS samples can help provide a visual reminder to prevent cross-contamination.

Note that field blanks and equipment blanks require a clean set of gloves to avoid cross-contamination with the field samples. Once PFAS samples are collected, then bottles for other analytes may be filled if required.

SAMPLE COLLECTION METHOD/SEQUENCE

Bottleware for PFAS samples is provided by the laboratory and should arrive onsite or at the staging area in coolers separate from other (non-PFAS sample) bottleware. Additionally, PFAS bottleware should arrive packaged in Ziploc® brand or equivalent LDPE resealable bags. These bags are used to re-package the PFAS samples following collection. Samples are returned to the laboratory in separate coolers to reduce the likelihood of cross-contamination.

Single-Person Sampling Methodology

When samples are being collected for groundwater or solid only (not drinking water samples), one person may collect the samples rather than a two-person team. A two-person team should be used to collect any samples from residential water supplies or other drinking water sources. The following procedure shall be implemented to reduce the likelihood of cross-contamination:

1. The sampler must put on a clean pair of gloves during equipment set-up, purging, and data monitoring (if applicable).

2. When it is time for sample collection, the sampler must first dispose of the pair of gloves used for Step 1, and wash their hands with approved soap and distilled or deionized water thoroughly.

3. The sampler must put on a new, clean pair of gloves before each of the following:

- Labelling bottles with information for the laboratory.

- Sample collection for PFAS ***first,*** prior to collecting samples for any other parameters into any other containers. The individual shall remove the bottles (one at a time) from the plastic bag, remove the cap and obtain the sample.

4. Do not place the sample bottle cap on any surface when collecting the sample and avoid all contact with the inside of the sample bottle or its cap including the sample ports, spigots, and tubes.

5. Once samples are collected, bottleware is to be placed back in the Ziploc® bag provided by the laboratory and placed in a designated cooler.

6. At no point in steps 2 and 3 shall the individual contact anything (equipment, skin, hair, other sample bottles, etc.) other than the PFAS samples bottles.

Two-Person Sampling Methodology

Where practicable and for any samples collected from drinking water supplies, the two-person sampling procedure shall be used. During sample collection each person has a different role. One person is responsible for handling and labelling the sample bottles and physically collecting the sample (referred to as Clean Hands). The other person is responsible for purging and disposing of purge water and handling all non-dedicated equipment (referred to as Dirty Hands). The typical sampling procedures is:

1. Clean Hands puts on a new pair of gloves and labels the bottles with information for the lab.
2. Clean Hands then places the bottleware back in the Ziploc® bag provided by the laboratory.
3. After donning a new pair of nitrile gloves, Clean Hands collects the sample for PFAS ***first***, prior to collecting samples for any other parameters into any other containers; this avoids contact with any other type of sample container, bottles or packaging materials that may have PFAS-related content. Clean Hands shall remove the bottles (one at a time) from the plastic bag, remove the cap and obtain the sample. Gloves are removed after each sample and clean gloves are donned for subsequent PFAS samples.
4. Do not place the sample bottle cap on any surface when collecting the sample and avoid all contact with the inside of the sample bottle or its cap including with sample ports, spigots, and tubes
5. Once the sample is collected, capped and labeled, place the sample bottle(s) in the laboratory-provided Ziploc® bag and place in a PFAS sample-dedicated cooler packed only with double-bagged ice.

SAMPLES COLLECTED FROM DRINKING WATER SUPPLY WELLS

1. Contact the owner to get permission to sample their drinking water supply well.
2. Collect as much data about the well as possible, such as: the well depth, type of well (e.g., deep bedrock or shallow dug well) and type of treatment system, if any (e.g., a cartridge filter, a water softener, pH adjuster, point of entry, radon, carbon or an ultra violet system).
3. The sample must be collected from a point in the plumbing system that is prior to any type of water treatment system, preferably from the closest spigot to the holding tank in the plumbing system, or the treatment system must be bypassed. For convenience and to prevent unnecessary loading of the septic system, an outside spigot (if available) is preferable to an inside faucet. Note that during winter or freezing conditions or for residences where the spigot is close to the ground, the closest available sample point meeting these requirements may be inside.
4. The water (cold water) is typically purged at a high rate of flow (tap fully open) for 10-15 minutes (a minimum of 10 minutes) and until the full volume of the pressure tank has been purged (typically 42 gallons).
5. Once the well has been purged, reduce the rate of flow to a rate slow enough to allow water to run gently down the

inside of the bottle without splashing.

6. As described above in the **Sample Collection Method/Sequence** section, don a new pair of nitrile gloves and collect PFAS samples ***first***, prior to collecting samples for any other parameters. Remove all adapters, hoses, and attachments from the spigot or sampling port. The PFAS sample must be collected directly from the spigot or sampling port.
7. Do not place the sample bottle cap on any surface when collecting the sample and avoid all contact with the inside of the sample bottle or its cap including sampling ports and spigots.
8. Once the sample is collected, capped, and labeled place the sample in an individual re-sealable plastic bag and then into double-bagged ice (preferably from a verifiable PFAS-free source) within the cooler.
9. Once the PFAS samples have been collected, samples for other parameters (if required) may be collected. Once sampling is complete, shut the water off.
10. Samples should be submitted for analysis for PFAS by EPA Method 537, Revision 1.1 (or the most current revision number).

SAMPLES COLLECTED FROM MONITORING WELLS

1. If collecting field parameters using a multiparameter meter, samples for laboratory analyses must be collected before the flow-through cell and the three-way stopcock. This will be done by disconnecting the three-way stopcock from the pump discharge tubing so that the samples are collected directly from the pump tubing.
2. When feasible, use dedicated, single-use, or disposable polyethylene or silicone materials (tubing, bailers, etc.) for monitoring well purging and sampling equipment.
3. When reuse of materials or sampling equipment across multiple sampling locations is necessary, follow project decontamination protocols as defined in the QAPP and using allowed materials identified in the table below. If reusable equipment is used, incorporate collection of equipment blanks into the sampling program.
4. When using positive displacement/submersible pump or bladder pump sampling equipment, familiarize yourself with the sampling pump/accessory equipment specifications to confirm that device components are not made of nor contain polytetrafluoroethylene (PTFE, also known as Teflon®) or other PFAS-containing components. For details, please see the list of prohibited and allowed items below.
5. Samples should be submitted for analysis for PFAS by a Department of Defense (DOD)-approved isotope dilution method.

SAMPLES COLLECTED DURING PRODUCTION WELL PUMPING TESTS

1. If feasible, do not use tape or pipe thread sealant containing Teflon on pipe fittings or sampling tap threads on the pump discharge pipe.
2. As with all other sample parameters, the sample for PFAS will be collected at the last hour (or hours) of the pumping portion of the testing program, but before the collection of other sample parameters.
3. Discharge water will be purged through the sampling tap on the discharge pipe for a minimum of 20 minutes prior to collection of samples.
4. Drinking water production well samples should be submitted for analysis for PFAS by EPA Method 537, Revision 1.1 (or the most current revision number). Non-drinking water samples should be submitted for analysis for PFAS by a DOD-approved isotope dilution method.

SAMPLES COLLECTED FROM SOIL BORINGS, TEST PITS, SURFACE WATER, OR SHALLOW SOIL/SEDIMENT

1. Don't use detergent to decontaminate drilling or excavation equipment unless otherwise specified in the QAPP, scrub with a plastic brush and rinse thoroughly in approved tap water, then triple-rinse in distilled or deionized water.
2. Use PFAS-free drilling fluids; collect representative water sample used during drilling activities (see sample handling and chain of custody SOP in Appendix A of the site-specific QAPP).

3. Don't re-use PVC materials.
4. Surface water must be collected by inserting a capped sampling container (polypropylene or HDPE) with the opening pointing down to avoid the collection of surface films. The bottle shall be re-capped below the water surface. For additional details see the surface water sampling SOP in Appendix A of the site-specific QAPP.
5. Soil and sediment core samples must be collected directly from single-use PVC liners that must not be decontaminated or reused at different locations.
6. Samples should be submitted for analysis for PFAS by a DOD-approved isotope dilution method.

DECONTAMINATION

Decontamination fluids have been viewed as a possible source of equipment cross-contamination. Therefore, more frequent changes of decontamination liquids may be warranted. Refer to the *Equipment and Materials Table* below for prohibited and acceptable decontamination liquids.

A final rinse with "PFAS-free" deionized (DI) water is required.

ADDITIONAL CONSIDERATIONS

1. No food or drink shall be brought on-site, with the exception of bottled water and hydration drinks (i.e., Gatorade® and Powerade®) and available for consumption only outside of the exclusion zone.
2. When field personnel require a break to eat or drink, they should remove their gloves and coveralls (if used) and move to an appropriate (downwind) location. When finished, field personnel should then wash with approved materials and put their coveralls (if used) and gloves back on prior to returning to the exclusion zone.
3. Visitors to the site are asked to remain outside of the exclusion zone. Visitors wishing to enter the exclusion zone must have appropriate PPE, be trained on applicable portions of this SOP, and will be subject to GZA's health and safety plan.
4. Note that "PFAS-free" water may contain other contaminants (such as VOCs); therefore, equipment blanks collected for PFAS should utilize "PFAS-free" water while those collected for other analytes should use laboratory-provided water or commercial deionized water depending on the site-specific QAPP requirements.
5. Collect a field blank from each batch of PFAS-free DI water while in the field by pouring an aliquot of the water into the appropriate PFAS sample container. Leaving the lid off of the PFAS-free water container and submitting that container to the laboratory is not acceptable.
6. Refer to the site-specific QAPP for the quantity of field blanks to be collected. At a minimum, field blanks must be collected by the person (clean hands) collecting PFAS samples. Consideration should also be given to when the field blank should be collected so that it is representative of the conditions most likely to influence the sample.

EQUIPMENT AND MATERIALS

The following table provides a summary of items that are likely to contain PFAS (i.e., prohibited items) and that are not to be used by the sampling team at the site, along with acceptable alternatives. This list may change as new information becomes available.

Category	Prohibited Items	Allowable Items
Field Equipment Including: • Pumps • Tubing • Bailers	Teflon and other fluoropolymer-containing materials (e.g., Teflon tubing, bailers, tape; Teflon-containing plumbing paste, or other Teflon materials) **Note**: The Grundfos Redi-Flow Submersible Pump is a submersible pump which, as of this revision, has a Teflon impeller and wire coatings that are known to be PFAS-containing and is not recommended for collecting PFAS samples.	High-density polyethylene (HDPE) - *preferred,* or silicone tubing Polypropylene hose barbs and T barbs HDPE or stainless steel bailers Peristaltic pumps Stainless steel submersible pumps (e.g., ProActive stainless steel pumps with PVC [polyvinyl chloride]) leads and Geotech Stainless Steel Geosub pumps) Bladder pumps with polyethylene bladders and tubing need to be evaluated on a case by case basis because the gaskets and O-rings may contain PFAS. Equipment with Viton components needs to be evaluated on a case by case basis. Viton contains PTFE, but may be acceptable if used in gaskets or O-rings that are sealed away and will not come into contact with sample or sampling equipment.) Gasoila NT Non-PTFE Thread Sealant™ has been confirmed by the manufacturer to be PFAS-free and is acceptable for use.
Decontamination	Decon 90	Alconox®, Liquinox®[1], or Citranox®, potable water followed by triple rinse with "PFAS-free" deionized water.
Sample Storage and Preservation	LDPE or glass bottles, PTFE-or Teflon-lined caps, chemical ice packs	Laboratory-provided sample container -*preferred*; or, HDPE or polypropylene bottles with an unlined plastic screw cap, as specified by the laboratory doing the analysis, regular ice double-bagged in Ziploc® brand bags.
Field Documentation	Waterproof/treated paper or field books, recycled paper, plastic clipboards, binders, Sharpie® and other markers, Post-It® and other adhesive products.	Plain Paper, metal clipboard, ballpoint pens Duct Tape is acceptable provided it doesn't contact the media that is being sampled.
Clothing/Laundering	**If possible, avoid:** Clothing or boots made of or with Gore-Tex™ or other synthetic water proof/ resistant and/or stain resistant materials, coated Tyvek® material that may contain PFAS, fabric protectors (including UV protection), insect-resistant chemicals, stain-resistant chemicals; Fabric softener	**Preferred:** Synthetic or cotton material. Polyurethane and wax coated materials. Boots made with polyurethane and PVC, untreated leather boots. Tyvek material that is PFAS free (e.g., uncoated)

Category	Prohibited Items	Allowable Items
Personal Care Products (for day of sample collection)	**Avoid Contact with Hands:** Cosmetics, moisturizers, hand cream, scented body wash/shampoo/conditioner and other related products. **Avoid onsite / wash hands after using:** Dental floss and plaque removers.	**Preferred PFAS-Free Sunscreens:** Alba Organics Natural Yes to Cucumbers Aubrey Organics Jason Natural Sun Block Kiss My Face Baby-safe sunscreens ('free' or 'natural') **Preferred PFAS-Free Insect Repellents**: Jason Natural Quit Bugging Me Repel Lemon Eucalyptus Herbal Armor California Baby Natural Bug Spray BabyGanics Deep Woods OFF Sawyer Permethrin **Combination Sunscreen and Insect Repellents:** Avon Skin So Soft Bug Guard-SPF 30
Food and Beverage	**Avoid onsite / wash hands after using:** Pre-packaged food, fast food wrappers or containers. Non-stick cookware & containers, aluminum foil.	Food should be eaten outside the exclusion zone. Hands should be thoroughly washed with soap and water after consuming food and before entering the exclusion zone.

1. While Alconox and Liquinox soap is acceptable for use for PFAS decontamination, they may contain 1,4-dioxane. If Alconox and Liquinox soap is used at sites where 1,4-dioxane is a COC, then equipment blanks must be analyzed for 1,4-dioxane.

REFERENCES

Bartlett SA, Davis KL. Evaluating PFAS cross contamination issues. *Remediation.* 2018;28:53-57. https://soi.org/10.1002/rem.21549.

Michigan Department of Environmental Quality (MDEQ), Draft Final Wastewater PFAS Sampling Standard Operating Procedures, April 2018.

The Northeast Waste Management Officials' Association (NEWMOA), five-part webinar training series, 2016; http://www.newmoa.org/cleanup/workshops.cfm

NH PFAS Investigation at https://www4.des.state.nh.us/nh-pfas-investigation/