UTAH DEPARTMENT of ENVIRONMENTAL QUALITY

Utah Department of Environmental Quality

Sampling and Analysis Plan

Statewide PFAS Monitoring Phase I: Drinking Water Systems

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Version 1.0

Utah Department of Environmental Quality
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Salt Lake City, UT 84116

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Acronyms/Abbreviations

µg	Microgram
AFFF	Aqueous Fire-Fighting Foam
ASTM	American Society for Testing and Materials
ATSDR	Agency for Toxic Substances and Disease Registry
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CWA	Clean Water Act
COC	Chain of Custody
DDW	Division of Drinking Water
DEQ	Department of Environmental Quality
DERR	Division of Environmental Response and Remediation
DOD	Department of Defense
DOH	Department of Health
DPM	Designated Project Manager
DQO	Data Quality Objectives
DWQ	Division of Water Quality
EDD	Electronic Data Deliverable
EPA	Environmental Protection Agency
EQBK	Equipment blank
ETFE	Ethylene Tetrafluoroethylene
FB	Field blank
FEP	Fluorinated Ethylene Propylene
FRB	Field Reagent Blanks
HA	Health Advisory
HAFB	Hill Air Force Base
HDPE	High density polyethylene
ITRC	Interstate Technology and Regulation Council
LC-MS/MS	Liquid Chromatography Tandem-Mass Spectrometry
LCS	Laboratory Control Sample
LCSD	Laboratory Control Sample Duplicate
LDPE	Low Density Polyethylene
LFB	Laboratory Fortified Blank
LFSM	Laboratory Fortified Sample Matrix
LHA	Lifetime Health Advisory
LRB	Laboratory Reagent Blank
LS	Laboratory Spike
MB	Method Blank
MDL	Minimum Detection Limit
MRL	Minimum Reporting Limit
MRM	Multiple Reaction Monitoring
MS	Matrix Spike
MSD	Matrix Spike Duplicate
NAICS	North American Industry Classification System
PFAAs	Perfluoroalkyl acids, as carboxylates

PFAS	Per- and Polyfluoroalkyl Substances
PFBS	Perfluorobutane Sulfonate
PFCAs	Perfluoroalkyl Carboxylates
PFHpA	Perfluoroheptanoic acid
PFHxS	Perfluorohexanesulfonic acid
PFNA	Perfluorononanoic Acid
PFOA	Perfluorooctanoic Acid
PFOS	Perfluorooctane sulfonic acid
PDF	Portable Document Format
PPE	Personal Protective Equipment
PPE	Polypropylene containers
ppt	Parts per trillion
PTFE	Teflon, Polytetrafluoroethylene
PVC	Ployvinyl chloride
PVDF	Polyvinylidene Fluoride
PWSS	Public Water Supply System
QA	Quality Assurance
QAPP	Quality Assurance Project Plan
QC	Quality Control
RCRA	Resource Conservation and Recovery Act
RPD	Relative Percent Difference
RV	Result Values
SAP	Sampling Analysis Plan
SOP	Standard Operating Procedures
SDWA	Safe Drinking Water Act
SPE	Solid-Phase Extraction
SURR	Surrogate Recovery
TB	Trip Blank
TSCA	Toxic Substances Control Act
U.S.	United States of America
UCMR	Unregulated Contaminant Monitoring Rule
UCMR3	Third Unregulated Contaminant Monitoring Rule
UPCC	Utah Poison Control Center
UTANG	Utah Air National Guard
WMRC	Division of Waste Management and Radiation Control
XLSX	File extension for Microsoft Excel spreadsheet format

1.0 Introduction

Per- and polyfluoroalkyl substances (PFAS) are a group of man-made chemicals that includes PFOA, PFOS, GenX, and many other chemicals. PFAS have been manufactured and used in a variety of industries around the globe, including in the United States since the 1940s. Perfluorooctanoic acid (PFOA) and perfluorooctane sulfonic acid (PFOS) have been the most extensively produced and studied of these chemicals. Both chemicals are very persistent in the environment and in the human body – meaning they don't break down and they can accumulate over time. There is evidence that exposure to PFAS can lead to adverse human health effects (EPA,2016). More than 6,000 PFAS compounds are known to exist, although not all are in current use or production.

PFAS compounds have become essential in many industries due to the useful and unique properties they exhibit. They are chemically stable, reduce surface tension to a much lower state than other surfactants, repel water and oil, possess friction-reducing properties, and can function in environments where other products would degrade (3M Company, 1999). It's these properties which have given rise to a variety of industrial and commercial products that are resistant to oil, grease, water, soil, and stain. The products are used in firefighting foams, metal plating and coating formulations, polyurethane production, inks, varnishes, and lubricants (3M Company, 2006). Additionally, they are considered vital to the aviation, mining and gas, photographic imaging, semiconductor, automotive, construction, and electronics industries (EPA). PFAS are found in many consumer products like cookware, food packaging, and stain repellants. PFAS manufacturing and processing facilities, airports, and military installations that use firefighting foams are some of the main sources of PFAS. PFAS may be released into the air, soil, and water, including sources of drinking water. PFOA and PFOS are the most studied PFAS chemicals and have been voluntarily phased out by industry, though they are still persistent in the environment. There are many other PFAS, including GenX chemicals and Perfluorobutane Sulfonate (PFBS) in use throughout our economy (EPA,2016).

Currently, PFAS are not regulated by United States Environmental Protection Agency (EPA) under the Safe Drinking Water Act (SDWA). PFAS are not currently listed as federal Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) hazardous substances. No PFAS are listed as hazardous wastes under the federal Resource Conservation and Recovery Act (RCRA) nor are they regulated under the Toxic Substances Control Act (TSCA). Finally, no PFAS are listed as a toxic or priority pollutants under the federal Clean Water Act (CWA).

After PFAS were found in drinking water in several locations in the United States, the concern regarding PFAS rapidly increased. While significant progress has been made, characterization efforts continue to be hampered by the analytical challenges associated with PFAS. In addition, only limited toxicity data are available for a limited number of PFAS. The available data demonstrate that PFAS exposures are a human health hazard. However, data is generally lacking to further characterize the hazard and provide reliable estimates of the human health risk. PFAS science is rapidly evolving and the recommendations in this document represent our

current understanding. As the science advances and more information become available, the recommendations will be modified as appropriate.

2.0 Objectives and Design of Investigation

The Utah Department of Environmental Quality (DEQ) convened an internal workgroup in 2019 to develop a monitoring strategy to address potential PFAS contamination in Utah. The workgroup consists of representatives from the Utah Department of Environmental Quality (DEQ) Divisions of Drinking Water (DDW), Water Quality (DWQ), Waste Management and Radiation Control (WMRC), Environmental Response and Remediation (DERR), and the Utah Department of Health Bureau of Epidemiology. Its primary purpose is development of an ongoing, adaptive monitoring and reporting strategy to determine whether Utah's drinking water, groundwater, surface waters, or land is contaminated by PFAS, and if so, whether this contamination threatens public health and/or the environment. Initial efforts will focus on potential human exposure to PFAS from areas where these compounds are known to have been used or disposed.

The workgroup compiled information on PFAS use in Utah and identified potential sources of contamination. DEQ will sample selected drinking water sources that pose the highest potential risk of contamination to determine if PFAS are present. Decisions regarding additional actions will be made according to each division's regulatory authorities.

A systematic planning process ensures that the data collected support the objectives of the project and make efficient use of available resources and funding. DEQ will use the Data Quality Objective (DQO) process to determine the type, quantity, and quality of data needed to reach defensible decisions and make credible estimates. DQO begins by stating the problem or issue under investigation, identifying key members of the project team and their roles, and selecting. specific goals for the investigation. . The project scope establishes boundaries and identifies key constraints. The analytic approach describes how the project will be implemented, and the decision criteria describe how the data will be interpreted and actions implemented. The DQO is summarized in Table 1.

Table 1. Summary of Data Quality Objectives

Issue	The results of the 2013 Third Unregulated Contaminate Monitoring Rule (UCMR3) (EPA(f), 2017) indicate that the drinking water for approximately six million U.S. residents is contaminated with PFOS or PFOA at concentrations exceeding the EPA Lifetime Health Advisories (ITRC(e), 2018) of 70 nanograms per liter (ng/L). The EPA sampled locations for the UCMR3 implementation in Utah and did not detect PFAS above the 70 ng/L Lifetime Health Advisory (LHA) concentration in samples from 61 of Utah public drinking water systems that serve populations of more than 10,000 residents (Table 2). However, data are needed to confirm the presence or absence of PFAS contamination in

	Utah smaller drinking water systems.
Project Goals	The project has three primary goals: • Determine if PFAS are present in a selection of Utah's 489 community water systems. • Communicate how these results impact the public's health. • Provide drinking water providers and other regulated entities with information to mitigate impacts to the public from PFAS contamination.
Team Members and Roles	Utah DEQ Division of Drinking Water • Outreach and coordination with drinking water providers Division of Water Quality • Coordination and sample collection/analysis Utah Department of Health • Outreach and consultation Utah Poison Control • Consultation and reporting Drinking water providers • Coordination, sampling assistance, outreach and mitigation
Study Boundaries	**Phase 1 Target Population**: The study targets Utah's community (public) drinking water systems and selected private wells. **Time**: A sampling plan that can be developed and implemented rapidly is preferred because the safety of drinking water is a high priority of the study. **Resources**: The initial sampling plan must be executable using the available existing resources. **Target Analytes**: The analyses must generate data that are accurate and precise. Commercial laboratories have modified and validated EPA Methods 537.1 and 533 for selected PFAS. Analytical methods continue to evolve, and the number of target PFAS will be reviewed and potentially revised and validated prior to implementation of this plan. **Target Levels**: No EPA maximum contaminant level (MCL) is available for any PFAS. EPA Lifetime Health Advisories (LHAs) are available for both PFOA and PFOS. The EPA LHAs for PFOS and PFOA of 0.07 µg/L (70 ng/L) will be used as comparison values for the 32 PFAS tested. If EPA or the Agency for Toxic Substances and Disease Registry (ATSDR) develops drinking water recommendations for additional PFAS, these new values will be incorporated into the comparisons.

Analytic Approach	Drinking water samples will be analyzed once for PFAS compounds using a modified version of EPA Methods 537.1 and 533.
Decision Criteria	Immediate resampling will occur if PFAS are detected above MDL. If PFAS are not detected, resampling is unnecessary. Immediate actions are required if any PFAS are confirmed to be present. If any individual PFAS concentration or PFAS concentrations combined exceed 70 ng/L, the public water system will be notified and appropriate actions will be taken, in consultation with the LHD and DOH.

2.1 Data Quality Objectives

2.1.1 Problem Statement

The results from the 2013 UCMR3 (EPA(f), 2017) indicate that the drinking water for approximately six million U.S. residents is contaminated with PFOS or PFOA at concentrations exceeding the EPA Lifetime Health Advisory level (ITRC(e), 2018). In other states, public and private drinking water have been contaminated with PFAS at locations where PFAS were manufactured or where large quantities of PFAS were used in other manufacturing processes. Of the six specific PFAS examined in Utah during UCMR3 monitoring (Table 2), none were detected in the samples collected from 61 public drinking water systems above the reference concentration of 7.0 ng/L. These samples were collected between 2013 and 2016 from systems serving populations greater than 10,000 residents, representing approximately 2.5 million people, or 86% of Utah's population.

Table 2. UCMR3 (Six Perfluorinated Compounds)

Contaminant	CAS Registry Number[1]	Minimum Reporting Level	Sampling Points[2]	Analytical Methods
Perfluorooctanesulfonic acid (PFOS)	1763-23-1	4.0 ng/L	EPTDS	EPA 537 Rev 1.1
Perfluorooctanoic acid (PFOA)	335-67-1	2.0 ng/L	EPTDS	EPA 537 Rev 1.1
Perfluorononanoic acid (PFNA)	375-95-1	2.0 ng/L	EPTDS	EPA 537 Rev 1.1
Perfluorohexanesulfonic acid (PFHxS)	355-46-4	3.0 ng/L	EPTDS	EPA 537 Rev 1.1
Perfluoroheptanoic acid (PFHpA)	375-85-9	1.0 ng/L	EPTDS	EPA 537 Rev 1.1
Perfluorobutanesulfonic acid (PFBS)	375-73-5	9.0 ng/L	EPTDS	EPA 537 Rev 1.1

Utah's remaining 428 public water supply systems (PWSSs) have not been sampled. This includes two new systems that serve more than 10,000 people, 52 medium systems, 134 small systems, and 240 very small systems. Data are needed to confirm that these public drinking water systems are not contaminated with PFAS at levels dangerous to long-term human health.

Analytical methods for PFAS continue to evolve rapidly. Currently, validated analytical methods are available for 32 PFAS by EPA 537.1 and 25 PFAS by EPA 533. The Utah samples collected between 2013 and 2016 were analyzed for six PFAS. Data are currently unavailable for additional PFAS for the 61 drinking water systems sampled under the 2013 UCMR3 monitoring.

2.1.2 Project Goals

DEQ has identified three goals for the sampling project:

- Determine if PFAS contamination is present in public drinking water systems identified as highest priority for sampling due to the potential risk of PFAs contamination.

- Communicate these results along with any associated health concerns to drinking water providers, health officials, and the public.
- Communicate these analytical results to the water providers and regulated entities so they can take additional measures, such as engineering or administrative controls, to reduce PFAS exposure from drinking water.

The Division of Drinking Water (DDW) is leading this particular phase of PFAS monitoring. DDW has the authority to implement the Safe Drinking Water Act (SDWA) in Utah and implementing any regulatory actions regarding public drinking water. The division is responsible for all DEQ communication and coordination with the water system operators and the public.

The Division of Water Quality (DWQ) routinely implements similar sampling protocols for Utah's streams and reservoirs, including coordination with analytical laboratories. DWQ is the primary author of this SAP. DWQ has primary responsibility for coordinating with the analytical laboratories, assembling appropriate sampling gear, recommending appropriate sampling procedures, conducting or overseeing the sampling, and ensuring that the samples are delivered to the laboratory under appropriate chain of custody and environmental conditions. DWQ will validate sample results and prepare a summary to distribute to partner agencies and drinking water providers..

The Bureau of Epidemiology, Utah Department of Health (DOH), is responsible for assessing the potential human health risks for PFAS. DOH will coordinate these efforts with DDW, the Utah Poison Control Center, and local health departments. DOH will provide recommendations to the public on ways to mitigate or reduce human exposures. The Utah Poison Control Center will respond to inquiries from the public and health care providers. DWQ is responsible for coordinating with Poison Control and DOH by sharing anticipated sampling events and sample results.

2.1.3 Project Boundaries

While it would be beneficial for DEQ to collect PFAS data from all 489 of Utah's public water system PWSSs, it is not feasible at this time due to resource limitations. As a result, this SAP will focus on water supplies near known or suspected sources of PFAS based on DEQ's analysis of drinking water sources and their potential for contamination (see Strategy).

Most drinking water contamination in other states is localized and associated with PFAS manufacturing facilities, manufacturing facilities where large amount of PFAS were used in a process, or large quantities of Aqueous Fire Fighting Foam (AFFF) have been released (see Figure 2). No PFAS manufacturing facilities or manufacturing activities that use large amounts of PFAS were identified in Utah, but these investigations are incomplete. AFFF has likely been applied at emergency response sites such as tanker accidents along with repeat applications at airports, military bases, and petroleum refineries.

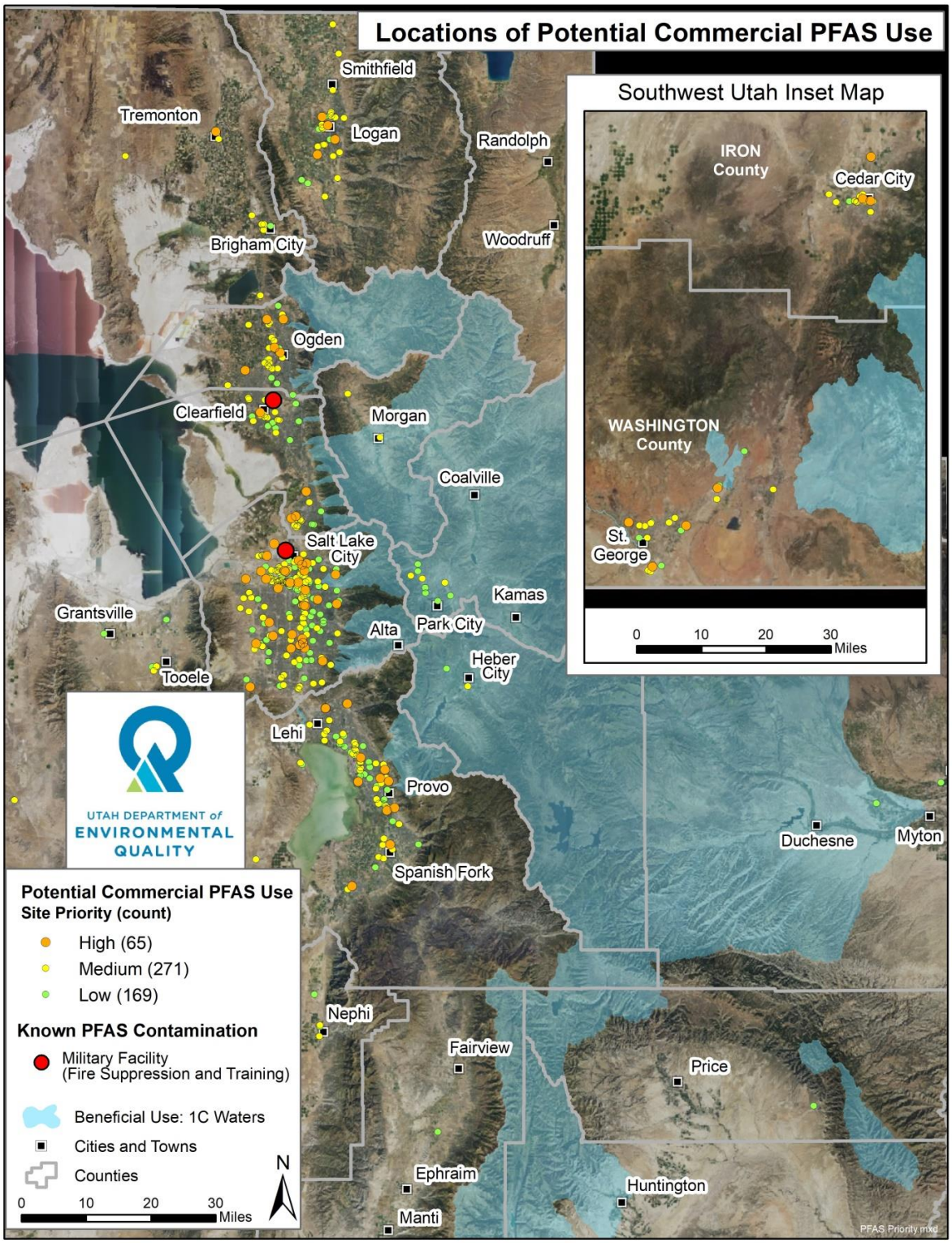

Figure 1. Locations of known or potential commercial use of PFAS

DEQ compiled a list of the North American Industrial Classification Codes (NAICS) for industries that potentially use PFAS. The businesses were prioritized based on best professional judgment regarding the likelihood and quantities of PFAS used but the current confidence in these identifications and prioritizations is low. Confidence may increase in the future by reviewing existing Utah DEQ Division of Waste Management and Radiation Control (DWMRC) inspection reports and conducting site visits.

The locations of businesses that may use PFAS were compared to DWQ Class 1C (drinking water) streams and reservoirs and DDW (groundwater) 15-year -travel -time Source Protection Zones. With the exception of the upper Jordan River, Class 1C surface waters are not near any locations expected to be significant sources of PFAS (**Error! Reference source not found.**). hile the upper Jordan is protected for drinking water use, it is not currently used as a drinking water source.

PFAS groundwater contamination has been confirmed at two locations in Utah: the Utah Air National Guard (UTANG) at the Salt Lake City International Airport and Hill Air Force Base (HAFB) (**Error! Reference source not found.**). No Source Protection Zones are located in he vicinity of the UTANG at the Salt Lake International Airport. HAFB has the potential to affect some of the Source Protection Zones for HAFB, South Weber Water Conservancy District, Clearfield, Roy, and the Weber Basin Water Conservancy District. All of these systems were previously sampled for the 2013 UCMR3 for the six PFAS compounds.

Additional comparisons to DDW Source Protection Areas identified 101 wells co-located with higher priority businesses potentially using PFAS. These wells are predominantly located in urban areas (**Error! Reference source not found.**). Recharge areas for the drinking water quifers on the valley floors are in the Wasatch Mountains and secondarily from the benches. On the valley floors, the drinking water aquifers are confined and protected by thick layers of low-permeability clay that helps protect the aquifer from surface contamination. In addition, these areas are served by wastewater collection systems (sewers), further decreasing the likelihood of drinking water aquifer contamination.

Drinking water may be provided from multiple locations (e.g., different wells) in a Source Protection Zone. In the case of a centralized treatment plant, samples should be collected where the water enters the distribution system. Where individual wells or well fields serve the public, samples should be collected from each unique source where the water enters the distribution system. The numbers of these sample locations are shown in **Error! Reference source not ound.**. The sampling locations were determined by reviewing each system to determine the number of sample locations needed.

Error! Reference source not found. divides all non-transient PWSSs in Utah into eight cenarios. The scenarios are intended to support phasing of the implementation because of resource limitations. Ideally, priority would be based exclusively on the potential for PFAS contamination. However, as previously discussed, accurately characterizing the potential for PFAS contamination is uncertain because of a lack of data. Therefore, the scenarios are based primarily on PWS size and, secondarily, the potential for PFAS contamination. System size is important because it directly correlates with number of people potentially affected, and larger

PWSSs are likely to have Source Protection Zones based on the volumes of drinking water provided. Therefore, PWSSs serving more people are a higher priority under this sampling plan. Utah's large and very large PWSSs were previously sampled and PFAS were not detected at levels above the LHA. The scenarios also consider if the presumed lack of contamination in these previously sampled PWSSs should be confirmed.

Table 3. Drinking water sampling scenarios. Scenario 4 is the targeted sample population.

Scenario	Number of Public Systems	Number of Sample Locations
1. **Sample highest priority locations potentially impacted by known PFAS contamination located near source protection zones (Hill AFB, Utah National Guard) excluding locations sampled for 2013 UCMR3 monitoring.**	0	0
2. **Sample highest priority (groundwater) source protection zones based on nearby or known PFAS contamination (Hill AFB), including locations sampled for 2013 UCMR3 monitoring.**	5	22
3. **Sample highest priority locations based on the location of high priority PFAS businesses located near source protection zones (groundwater), excluding locations sampled for 2013 UCMR3 monitoring.**	3	5
4. **Sample highest priority locations based on the location of high priority PFAS businesses located near source protection zones (groundwater), including locations sampled for 2013 UCMR3 monitoring.**	22	76*
5. **Repeat 2013 UCMR sampling (all large and very large systems (serving >10,000)**	63	194
6. **Sample all medium public water systems (serving between 3301-10,000 people)**	52	[104 estimated]
7. **Sample all small public water systems (serving between 500-3300 people)**	134	[201 estimated]
8. **Sample all very small public water systems (serving <500people)**	240	[240 estimated]

*After working with LHDs on locations of private wells in target areas, DEQ will target an additional 40 private wells for voluntary monitoring for PFAS.

Scenario 1 is based on sampling PWSSs potentially impacted by known PFAS contamination that have never been sampled for PFAS. Of the two known locations of contamination in Utah, only HAFB is co-located with Source Protection Zones. All of the potentially affected Source Protection Zones at HAFB were previously sampled under the UCMR3, so under this scenario, no sampling is recommended. However, this sampling occurred over five years ago, and since that time, analytical methods have been developed for up to 32 PFAS from the previous 6 PFAS for UCMR3.

Scenario 2 identifies five PWSSs that are potentially impacted by HAFB. These five PWSSs have 22 unique sampling locations where drinking water is distributed to the public.

Scenario 3 is based on sampling Source Protection Zones co-located with businesses most likely to use PFAS, and locations of known PFAS contamination (**Error! Reference source ot found.**) that were not sampled as part of UCMR3 because they serve less than 10,000 people. Five potentially affected PWSSs are identified that were not previously sampled as part of UCMR3.

Under **Scenario 4,** if these previously sampled UCMR3 sites are included with the additional five PWSSs, then 124 samples for 22 PWSSs are required. This is the initial sampling scenario selected for implementation under this SAP because it addresses PWSSs at highest risk based on currently available data. In addition to these providers, DWQ will attempt to sample private wells on a voluntary basis to evaluate PFAS from other groundwater sources in the areas of concern.

Scenarios 5 through 8 identify the number of PWSSs and number of sampling locations based on PWS size only. For very small through medium sized PWSSs, the number of unique sampling locations are estimated using best professional judgment because this information is not readily available. The estimations are based on the assumption that PWSSs serving smaller populations are less likely to have multiple unique locations where the drinking water enters the distribution system. The Source Protection Zones are also likely smaller for the smaller PWSSs and therefore, less likely to be impacted by contamination. Scenarios 5 through 8 are used to estimate the resources required to sample all Utah PWSSs or only a portion based on size. For instance, to sample all Utah's 489 non-transient PWSSs would require approximately 739 samples. Under Scenario 4, 463 PWSSs would not be sampled, but 38 of these were previously sampled for UCMR3.

2.1.4 Analytic Approach

The analyses must generate data that are accurate, precise, and defensible. Currently, EPA Method 537.1 is validated for 18 PFAS. Six of the 18 PFAS were target analytes for the previous 2013 UCMR3 sampling in Utah. The specific PFAS are shown in Table 9. Commercial laboratories have modified and validated Method 537.1 to quantify 14 additional PFAS, or 32

total PFAS. EPA Method 533 is validated for 25 PFAS compounds (11 are not covered by 537.1). Note that over6,000 PFAS are thought to exist.

No EPA maximum contaminant level (MCL) is available for PFAS. EPA drinking water LHAs are available for both PFOA and PFOS. Some states have published similar health-based concentrations for PFOA, PFOS, and 17 additional PFAS (ITRC(f), 2019).However, there are large variations between some of the state values, and this illustrates the uncertainties in determining safe drinking water concentrations with the scant available data. **Error! eference source not found.** illustrates the extreme variability between state and federal comparison values for PFOS and PFOA, which range over four orders of magnitude. To have sufficient confidence in these state-derived comparison values, a detailed review of their derivation would be required.

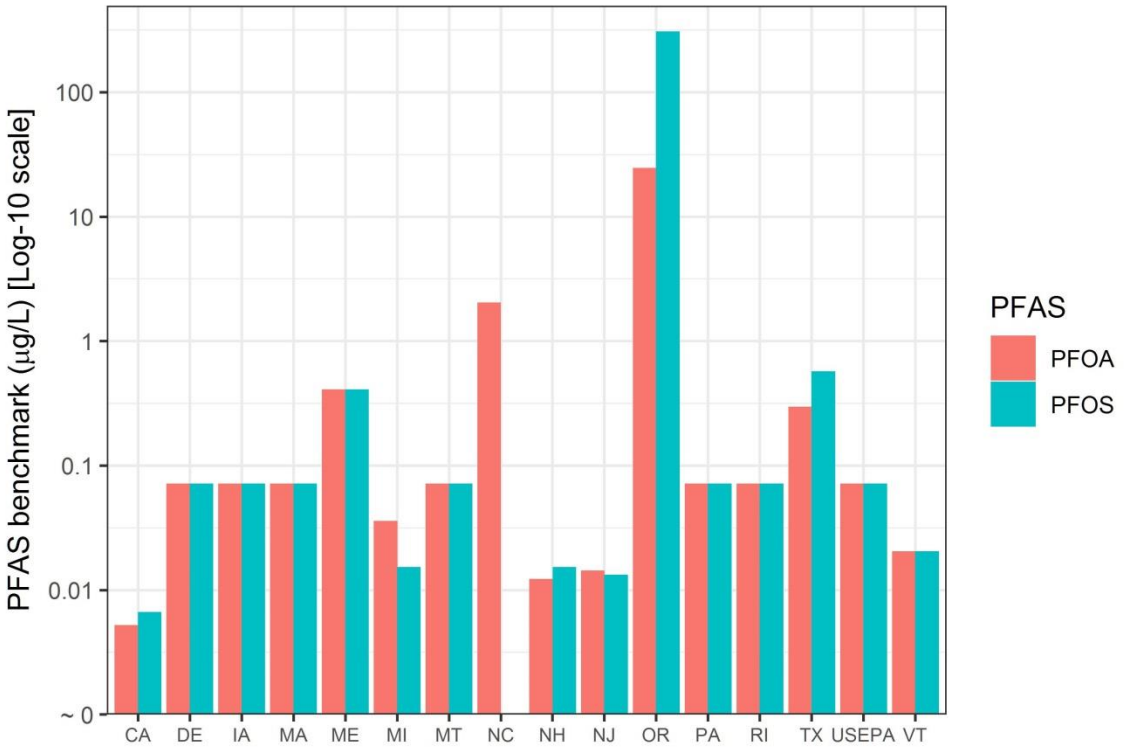

Figure 2. Variability in benchmark values for PFOA and PFOS for safe drinking water based on Table 4 of (ITRC(f), 2019)

Instead, to provide a consistent benchmark for comparison, the EPA LHAs for PFOS and PFOA of 7ng/L will be used. Both individual and summed PFAS concentrations will be compared to 7 ng/L. Due to the uncertainties regarding the protectiveness of 7 ng/L for PFAS other than PFOA and PFOS, all reliable detections of a PFAS may be further investigated and potential exposures eliminated to the extent practical.

2.1.5 Decision Criteria

A reliable detection of any PFAS will trigger immediate resampling due to the potential for PFAS contamination, not representative of the sample, to occur during sampling or in the laboratory. After the 2nd sample is collected, a 3rd sample will be collected more than 2 weeks later and less than 2 months from the second sample. The purpose of the third sample is to confirm the results of the 2nd sample, in particular, if the result of the 2nd sample is non-detect. If PFAS concentrations combined exceed 0.07 µg/L, the affected consumers, UDOH, LHDs and the Utah Poison Control Center will be notified. DDW will work with drinking water providers to identify the specific source of the PFAS.

DDW will assist drinking water providers to determine the specific source of PFAS detected at concentrations less than 0.07 µg/L. This might include, but is not limited to, actions such as consumer notification, consumer advice, or consultation from the Utah Poison Control Center (UPCC).

3.0 Special Precautions and Safety Plan for PFAS

3.1 Health and Safety

Hazardous conditions can exist in any environment. When unfavorable conditions are present at the time of sampling, field personnel should reschedule the site visit. If hazardous weather conditions arise, such as lightning or high winds, during sampling, personnel should cease sampling and move to a safe location.

Proper safety precautions shall be observed when traveling to and from sites and when collecting environmental samples. All field crews shall be equipped with safety equipment such as proper field gear, gloves, first aid kits, cellular phone, etc. Field personnel should follow specific health and safety practices when operating watercraft and working on, in, or around water, along possibly steep or unconsolidated banks of surface waters, or when sampling on the property of drinking water or wastewater treatment facilities.

When collecting PFAS-related environmental samples, bottles may contain preservatives as required by a particular method (e.g. TRIZMA in sampling bottles for PFAS for finished (chlorinated) drinking water, following EPA Method 537.1) and will commonly be prepared by the contracted lab. During packing and handling of bottles, be sure that caps are tightly sealed. Take care to avoid contact with preservative. If minor skin contact occurs, rinse with copious amounts of water. If major skin or internal contact occurs, seek medical attention. Field crews should have the supplies and training to provide first aid in the event of an injury or illness. Wear gloves and be sure to wash hands prior to and after sampling, especially when working in potentially contaminated areas.

4.0 Field Sampling Methods and Documentation

This section summarizes the sample collection workflow and provides reference to standard operating procedures (SOPs) and other protocols, primarily from drinking water systems, and incorporates the Data Quality Objectives outlined in Section 0.

4.1 Special Training Requirements

Field crews will review this SAP and all applicable SOPs prior to conducting any sample collection activities and acknowledge they have done so via a signature page kept on file by the field-crew lead or manager of the Monitoring Section. Personnel performing water sampling must be familiar with SOPs for sampling techniques, safety procedures, proper sample handling, shipping, and recordkeeping.

4.2 General Sample Collection Considerations

Because of the ubiquity and low ambient concentrations of PFAS in the environment (micrograms per liter (µ/L), special precautions are required during field procedures, particularly between field personnel and sample-collection materials, to:

- Avoid cross-contamination between samples
- Reduce the chance of false positive detections, and
- Minimize the potential for elevated detection limits because of background contamination.

4.2.1 Minimize Background PFAS Contamination

To minimize background PFAS contamination to samples, sampling crews shall review materials and sampling protocols,(including this SAP and associated SOPs, prior to any sample collection event. Personnel should take care to ensure there is no transfer of PFAS from sampling gear or personal protective equipment to field samples. Cross-contamination could occur from sun screen and insect repellent, personal hygiene and personal care products, or food packaging.

In general, field-gear and sampling equipment that contain the following materials should not be used during field sampling, since these materials could contaminate samples with PFAS:

- Teflon®, polytetrafluoroethylene (PTFE)
- Common water-proof coatings such as durable water repellent (DWR) or fabric softener containing PFAS
- Fluorinated ethylene propylene (FEP)
- Ethylene tetrafluoroethylene (ETFE)
- Low-density polyethylene (LDPE) [1]

[1] LDPE equipment may be used if prior analysis has confirmed equipment blanks to be PFAS-free; LDPE does not include PFAS as raw material, but may contain PFAS from the manufacturing process. Additional detailed information on the potential for PFAS contamination from particular materials is available from the Michigan DEQ General PFAS Sampling Guidance (Michigan DEQ, 2018).

- Polyvinylidene fluoride (PVDF)
- Pipe thread compounds and tape (e.g., Teflon® tape)

Three tables below identify some common *allowable*and *prohibited* materials for sampling equipment, field gear, and sunscreen/personal care products to guide field crews prior to sampling. A Quick Reference Guide is available from Michigan DEQ's PFAS response guidance (Michigan DEQ, 2018)[1], and some field gear and sampling equipment materials have been examined as well (Danish Environmental Protection Agency, 2015) However, this is not a guarantee that the following are PFAS-free.

Table 4. Allowable and Prohibited Materials for Sampling Equipment

Sampling Equipment, Sample Storage and Sample Preservation	
Allowable	**Prohibited**
HDPE (High-density polyethylene) [sample bottles; **RECOMMENDED CONTAINER**]	Items or materials containing any fluoropolymer
LDPE (Low-density polyethylene) [tubing]	PTFE (Polytetrafluoroethylene) lined bottles or bottle-caps
PPE (Polypropylene) [sample bottles]	
Stainless steel	
Glass jars	
Wet ice	Chemical or blue ice
LDPE re-sealable storage bags	

Table 5. Allowable and Prohibited Personal Field Gear

Field Gear and Personal Equipment (clothing, boots, rain gear, etc.)	
Allowable	**Prohibited**
Synthetic or 100% cotton clothing, washed without Fabric Softeners	New or unwashed clothing
	Items recently washed with fabric softeners or stain-resistant chemicals
Items made with polyurethane, PVC (polyvinyl chloride), wax-coated fabrics, rubber/neoprene, uncoated Tyvek®	Items that contain Gore-Tex™ or other water-resistant synthetics, including coated Tyvek
Powder-less nitrile gloves	Latex gloves

Powder-less nitrile gloves should be changed frequently and any time there is an opportunity for cross-contamination. For example:

- Before sample collection
- While handling a sample, including Quality Assurance/Quality Control (QA/QC) samples, such as field reagent blanks (field blanks)
- Handling of any non-dedicated sampling equipment (i.e., used for more than one specific location), contact with non-decontaminated surfaces, or when deemed necessary

Because biological hazards (sunburn, mosquitos, ticks, etc.) may be encountered during sampling, and since many types of sunscreens or insect repellants may contain PFAS in the product or during manufacture, this project seeks to minimize the potential for PFAS contamination while maintaining personal safety. The table below identifies a few examples of sunscreens, insect repellants, and decontamination solutions that have previously been identified as PFAS-free. However, this is no guarantee, and other products may meet project sampling goals.

Table 6. Allowable and Prohibited Personal-care and Decontamination Products

Sunscreen, Personal-care Products and Decontamination Solutions	
Allowable	**Prohibited**
PCPs, sunscreen or insect repellents shall be only applied away from sample bottles and sampling equipment, followed by thorough hand-washing	Any PCPs, sunscreen, or insect repellant applied in the sampling area
Banana Boat® Sport Performance Broad Spectrum SPF 30	
Coppertone® Broad Spectrum SPC 50	
Neutrogena® Beach Defense Water+Sun Broad Spectrum SPF 30	
Deep Woods OFF®	
Permethrin-based repellents	
Alconox / Liquinox	Decon90

PFAS are known to be prevalent in food packaging. As such, food packaging shall not be present in the sampling or sample-staging areas during sampling. Field personnel will wash hands and put on a new set of gloves prior to returning to the sampling area after eating.

Field personnel should follow these general procedures to prevent contamination before, during, and after sample collection:

- Obtain PFAS sampling bottles, with preservatives if applicable, from the laboratory that will perform the chemical analysis, This includes sufficient certified PFAS-free deionized

(DI) water for use in field blanks (one per site), equipment blanks (when additional sample collection equipment is required), and trip blanks (may include one per sampling day)
- Wash hands well before leaving the staging area and prior to sampling.
- Put on clean (new) powder-less nitrile gloves before collecting samples, handling sample containers, or handling sampling equipment.
- Keep the sample bottle must be kept sealed and open only during sample collection.
- Never set the cap down, touch any part of the cap that contacts the bottle, or let anything touch the rim of the bottle or inside of the cap.
- Ensure that no dust or fibers fall into the sample bottle.
- Take care that no splashed drops of water from a sink or ground enter the sample bottle,
- Fill sample bottle to the neck only; do not let the sample bottle overflow, particularly for finished drinking water samples. If the bottle overflows, the Trizma preservative will be flushed out or diluted
- Use PFAS-free markers (e.g., fine or ultra-fine point Sharpies®) to label the empty sample bottle prior to sample collection. Make sure the cap is on the sample bottle and gloves are changed after bottle labeling. Allow ink to dry completely before proceeding. Pre-printed labels may also be used.
- Cap the bottle and gently agitate by hand until preservative (solid) is dissolved. Do not reopen the sample bottle.
- Double-bag samples in re-sealable LDPE or disposable HDPE bags.
- Chill samples chilled on water-ice. Sample temperature must not exceed 10 degrees C during first 48 hours after collection

Recommended sampling materials and equipment for PFAS (See (DOD(a), 2017)):
- HDPE and silicon for tubing, bailers, tape, and plumbing paste
- Acetate liners for direct-push technologies
- Nitrile gloves (powder-less)
- Loose paper with Masonite clipboards
- Pens known to be PFAS-free
- Bags of ice
- Alconox/Liquionox and methanol for decontamination solutions
- Laboratory-supplied and verified “PFAS-free” DI water for the trip, field, decontamination blanks, and decontamination processes

4.3 Field Collection Protocols by Sample Type

Utah’s public drinking water systems are the target group for this project is , as described in Section 2.0 of this document. The following sub-sections briefly outline procedures for sample collections from finished (treated) drinking water, groundwater source waters (via wells) and surface waters (springs, streams, lakes, etc.). Samples from one or more of the above sample types will be used to assess the level of quantifiable PFAS for that drinking water system. Because DEQ’s goal is to protect the public from exposure to PFAS-contaminated drinking water, initial sampling is intended to focus on source water conveyed to public consumers.

However, the structure of Utah's public drinking water systems varies across the state, and as such, specific sampling locations will be determined for each drinking water system on a case-by-case basis.

Samples of source water from treatment plants can be obtained at the sampling port for each well. Since the system is continuously operating, minimal flushing will be required and no special sampling equipment (e.g., pumps or tubing) is expected. However, if the drinking water treatment system contains multiple water sources, including intermittent sources, samples of raw water may be collected either at the point of entry (prior to any treatment) or at the source. Sample collections from these locations could require methods used for monitoring or production groundwater wells, or even from surface waters. Once the sample population has been selected, a site-specific review will identify the appropriate sampling locations for each site.

4.3.1 Finished Drinking Water

The project team will identify water treatment devices and appropriate sample locations prior to visiting a drinking water treatment site. Initially, samples are expected to be taken from post-treatment finished water. EPA Method 537.1 requires the sampler to open the finished water sampling port and allow the system to flush until water temperature has stabilized (typically 3-5 minutes). In Utah, public drinking water plants are required to use chlorination in the treatment process, so sample bottles for finished drinking water must be preserved with Trizma.® Sample bottles will be prepared by the analytical laboratory, but field crews will follow PFAS-contamination reducing measures identified in previous sections when sample bottles are labeled. When collecting a sample of finished water, great care must be taken to ensure that bottles are not overfilled such that the Trizma® preservative is lost.

4.3.2 Groundwater

When raw-water sources to drinking water plants are sampled, specific sample collection procedures may vary, depending in part on the status of the well. Production wells are usually continuously flowing. Monitoring wells and offline production wells are commonly static and must be purged prior to sampling, or a new sampling well could be installed for site-specific sampling. Sampling from online production wells, either at the point of entry to the treatment facility prior to any treatment or near the raw-water source would be conducted from a dedicated sampling port.

Sampling from static monitoring wells requires a more involved procedure. Briefly, a minimum of three (3) well-water volumes are purged to avoid sampling stagnant groundwater that may not be representative of the current aquifer conditions. Measurements of total well depth and depth to water, along with well-casing diameter, are used to calculate the volume of water in the well, and therefore how much water needs to be purged. In some cases, e.g., wells with screened depths in tight formations and with low porosity, a low-flow purging method would be employed, where water chemistry parameters would be monitoring and sampling would occur only after some stabilization criteria have been met. Measurement procedures, suitable equipment, and purging method will vary, depending on the size, depth, and type of well. When required, DEQ will develop specific details for sampling various well types in coordination with drinking water facility personnel or other knowledgeable experts. PFAS sampling plans

developed by the state of North Dakota (North Dakota DOH, 2016) and Department of the Navy (NCBC, 2019) were used as reference documents and contain additional detail for developing site-specific well-monitoring protocols.

4.4 Equipment Decontamination

Decontamination of sampling equipment must be conducted consistently to assure the quality of samples collected. Dedicated sampling equipment (disposable) is preferred to reduce the potential for sample contamination. All non-disposable equipment used in the field and that comes into contact with potentially contaminated soil or water must be cleaned and/or disinfected according to the procedures described in each applicable SOP and broadly outlined here. For non-dedicated (reusable) sampling equipment, decontamination materials should include (CWRB(b), 2019):

- Alconox®, Liquinox®, and Citranox® can be used for equipment decontamination. Do not use Decon 90® as it contains fluorosurfactants.
- Laboratory-supplied PFAS-free deionized water is preferred for decontamination as rinse water.
- Sampling equipment can be scrubbed using a polyethylene or polyvinyl chloride (PVC) brush to remove particulates.
- Equipment should be triple-rinsed with PFAS-free water. If equipment or rinsate blanks demonstrate signs of background contamination, LC/MS-grade methanol may be used as part of the rinsing process

One decontamination method using three PFAS-free buckets is provided below:

(1) Wash equipment with mixture of PFAS-free water and PFAS-free soap in In PFAS-free bucket #1
(2) Rinse equipment with PFAS-free water n PFAS-free bucket #2
(3) Do final rinse of equipment with PFAS-free water In PFAS-free bucket #3
(4) Change decontamination-water between cleanings if multiple pieces of equipment require decontamination or if multiple sites are visited in a day.

4.5 Field QC samples

Cross-contamination of samples during sample collection, transport, or storage is possible due to the prevalence of PFAS in a wide range of materials and may lead to false detections, elevated background concentrations, or a positive in sample concentrations of PFAS. Field quality control samples should be collected to evaluate the potential presence and magnitude of cross-contamination.

The two main types of quality control samples are blanks and replicates, and these QC-sample types are employed during both field sampling and laboratory analysis.

Field blanks are prepared in the laboratory by placing an aliquot of PFAS-free water reagent water in a sample container and treating it as a sample in all respects, including shipment to the sampling site, exposure to sampling site conditions, storage, preservation, and all analytical procedures. At the sampling location, the field blank is uncapped and transferred to a second

bottle, then immediately capped and stored. Field blanks are used to determine if method analytes or other interferences are present in the field environment. Field blanks sample frequency will be the greater of one per sample site, or one field blank for every 10 field samples.

Trip blanks are a bottle of PFAS-free water prepared in the laboratory, shipped to the sampling site, and then transported back to the laboratory without having been exposed to any other sampling procedure. While the trip blank is typically used only for volatile analytes, it may be recommended for PFAS sampling to assess laboratory and shipping-procedures cross-contamination. Trip blanks can be compared to field blanks to account for site-specific aerosolized PFAS contamination. One trip blank will be collected for each sampling day.

When non-disposable equipment is used to collect environmental samples, **equipment blank** samples are collected by passing laboratory-prepared-and-verified PFAS-free water over or through decontaminated field sampling equipment before the collection of samples. This allows the assessment of the adequacy of decontamination procedures and/or evaluation of the magnitude of potential contamination from the equipment used during sampling. One equipment blank sample will be collected per day when non-disposable equipment is used.

Field replicates are two separate samples collected at the same time and place under identical circumstances and treated exactly the same throughout field and laboratory procedures. These samples are submitted to the laboratory as two different distinct samples. Field replicates help quantify both field and laboratory precision. Because this is an initial survey of potential contaminants to drinking water, DEQ recommends that field replicates be collected every 10 samples, field blanks collected at every system (PWS Facility), and an additional set of duplicate samples collected either at every water system or for every 10-20 samples, as appropriate, for matrix spike and matrix spike duplicate samples.

4.6 Field Sampling Documentation

Field personnel will properly document the sample collection activities from sampling itself to the chain of custody (COC). This documentation constitutes a record that allows for the reconstruction of field events and helps with data review and interpretation. DEQ will retain all project-specific documents, including COC records, field sampling forms, field notebooks, and equipment calibration logs. Hard copies will be kept for five years; electronic copies will be stored indefinitely on the DWQ network.

DDW staff will determine water sources and sample collection locations for the site (PWS) before sampling. The goal is to sample any water source where drinking water enters the distribution system. Surface water systems are typically treated at a centralized plant, whereas groundwater may enter the distribution system from multiple locations. In the field notebook or prepared field sheets, field crews will record sample collection date and time, PWS name, whether sample is pre- (raw water) or post-treatment (finished water), and clear description of sample location (i.e. well number, sample port) and if the sample was chemically preserved.

Field personnel will adhere to all relevant elements of this SAP and DWQ's QAPP for monitoring activities (Utah DWQ, 2014). If field conditions warrant a deviation from this SAP, the

Designated Project Manager (DPM) will be notified to discuss potential deviations and formulate alternate sampling plans. The agreed upon deviations will then be documented in the field sampling form and field notebook. The following details should be noted:

- Reason for the deviation
- Corrective action to be taken
- Identification of the samples and parameters that may be impacted, and
- Significance of the potential impacts to the integrity of each sample

4.6.1 Data Reporting Elements

Because the target population for this monitoring project centers around public drinking water systems, the data reporting elements produced below (Table 7) are based on EPA's Third Unregulated Contaminant Rule (UCMR3) program (EPA(f), 2017).

Table 7. Minimum Data Reporting Elements from Field Records

Data Element	Definition
PWS ID	Public Water System (PWS) Identification code. Format: UT[nnnnnnn] {7}
PWS Name	Name of Public Water System
Size	PWS size-class (L: > 10,000; S: ≤ 10,000 population served)
Facility ID	PWS Facility Identification code. Format: [nnnnn] {5}
Facility Name	Name of facility within PWS
Facility Water Type	Source of water to facility [*]
Sample Point ID	ID for each sample location in PWS
Sample Point Name	Name of sample location
Sample Point Type	PWS sampling point code: EP – entry point to distribution system; MR – distribution system at max. residence time
Disinfectant Type	Type of treatment used [†]
Sample Date	Date of sample collection (YYYY-MM-DD)
Sample ID	Laboratory Sample Number
Contaminant (analyte)	Name of analyte reported (may also include a CAS no.)
Method ID	Identification code of analytical method
MRL	Minimum Reporting Limit reported from lab
Result Code	Identifier for result relative to detection limit, reporting limit, or upper range of calibration curve
Result Value	Numerical value of result
Result Units	Units of numerical result and MRL for a contaminant
Lab ID	Identifier for laboratory conducting analysis
Sample Collection Method	Reference to sample collection method for various sample types [‡]

*Facility water types: SE (surface water); GW (groundwater); GU (groundwater w/ surface water influence); MX (mixed sources).
†Disinfectant types: CLGA (gaseous chlorine); CLOF (offsite-generated hypochlorite, stored as liquid); CLON (Onsite-generated hypochlorite, no storage); CAGC (chloramine, from gaseous chlorine); CAOF (chloramine, from offsite hypochlorite); CAON (chloramine, from onsite hypochlorite); CLDO (chlorine dioxide); OZON (ozone); ULVL (ultraviolet light); OTHD (other types), NODU (no disinfectant used).
‡Sample collection methods may include grab-sampling from surface waters, purge-method for sampling from groundwater wells, etc.

4.6.2 Sample Bottle Labeling

Prior to sample collection, sample containers should be labeled. Field personnel should use an indelible ink pen/marker or pre-printed labels when available and not record sample information on the sample bottle lid. Label information must include:

- Facility name
- Unique site identifier
- Date
- Time of collection written in military time
- Initials of collector
- Preservation (chemical and/or cooling)

For example, a sample taken from the pre-treatment spigot from the "Anytown Drinking Water Treatment Plant" on September 24, 2020 at 11:00 a.m. will be labeled as follows:

- Facility name: Anytown DWTP
- Unique site identifier: Pre-treatment
- Date: 2020/09/24
- Time: 1100
- Collector initials
- Preservation (e.g., wet ice, no Trizma[2])

[2] The Trizma chemical preservative is only required for finished drinking water, where the treatment stream may have been chlorinated

Containers for both field and QA/QC samples should be prepared at the same time (batch).

4.7 Field Sampling Workflow

To maintain safety protocols and ensure proper locations of samples collected, field staff should observe the following workflow:

1. Make planning arrangements with facility at least three weeks prior to sampling. Be sure to provide facility personnel with information on clothing or personal care product requirements (see Tables 3-5 and Section 4.6 of this SAP).
2. Arrive at facility.
3. Check-in and coordinate with facility point-of-contact.
   a. Review sampling logistics, including schedule.
   b. Assure point-of-contact debriefs monitoring staff on safety precautions at facility.
4. Arrive at sampling location.
5. Ensure there are no safety concerns. If at any point monitoring staff feel unsafe with sampling conditions, they should cease sampling efforts and report issues to DPM.
6. Prepare sampling equipment.
7. Conduct sampling efforts.
8. Assure sample bottles and paperwork are legible and complete.
9. Clean-up sampling environment.
10. Relocate to next sampling location at facility and follow steps 3-9 if applicable.
11. Check out with facility operators.
12. Complete a chain-of-custody form and ship samples.

4.8 Sampling Complications and Corrective Actions

Prior to field visits and any sample collection activities, sites and sampling locations will be evaluated to ensure that:

- The site is a member of the target population
- DWQ field crews have received explicit permission to access sites located on private property. In some instances, a facility chaperone or site guide may be required by the facility.
- The site contains the specific sample collection locations necessary to meet project goals as identified in Section 2.0 (DQOs)
- Field crews have the required number and type of sample containers (bottles) and other sampling equipment.

If a previously evaluated site or sampling location no longer represents the sample target for this project, the field crew will contact the DPM for further instructions and then continue on to the next sample collection location.

To clarify sample design and sampling terminology:

- Facility is synonymous with drinking water system and analyzed as a stratum
- Wells, sites, or facility outfalls are synonymous with sampling location and analyzed as a sample element

Abnormal field conditions could arise during the course of sampling. Field crews are required to adhere to all proper safety precautions and plans during the execution of this project, particularly when sample collection activities may be affected by weather conditions such as hard rain, high winds, or excessive lightning; facility construction; or facility operation and maintenance.

The DPM will work closely with the contract laboratory and the DWQ QA Officer conducting the data review to examine data that fall outside of QC criteria. The DPM will determine whether data should be re-analyzed, rejected, or used with appropriate qualification

5.0 Project Team and Responsibilities

One team member from the Monitoring Section (DWQ) will be assigned the duty of coordinating monitoring efforts for this phase of PFAS sampling (Field Coordinator). Other monitoring staff will be made available to help the Field Coordinator with sampling efforts as needed. This person will be responsible for the following:

- Coordinate with the PFAS Workgroup (guidance/direction on sampling efforts, reporting, etc.).
- Coordinate sampling logistics such as planning, scheduling, and reporting. Act as lab liaison and coordinate with the facility or landowner.
- Conduct field sampling events.
- Organize field data.

6.0 Data Management

Data management describes the data path from generation in the field or laboratory to final use or storage. This includes standard record-keeping procedures, document control systems, and the approach for data storage and retrieval.

Field observations, including site maps and photos, will be stored in site-specific subfolders within the PFAS project folder located on the DEQ internal network. Special care will be taken to employ a succinct and consistent sample labeling scheme for all samples collected from all sites. Sample results from the analytical laboratory will be provided to DEQ as an analytical report, including a detailed sample narrative, in PDF format. Final sample data will also be submitted to DEQ in a common electronic data deliverable (EDD) format. DEQ will perform an external data validation on all results reported from the laboratory. Once data review is complete and results are finalized, these data will be submitted to DDW using a template appropriate for DDW's Safe Drinking Water Information System (SDWIS) database. DDW staff are responsible for maintaining the SDWIS database.

Finalized annual or final project reports, including all appendices, data tables and any other project deliverables, will be stored in DEQs D2 electronic document archival system. DEQ staff are responsible for maintaining the document control system.

7.0 Laboratory Sample Handling Procedures

All sample collections will be obtained following the field-protocols outlined above in section 4.0, and as necessary, described in method-specific SOPs (Appendix A).

Table 8 lists the required container type, sample volume, sample-preservation (if any), and the allowable holding time for all possible sample collection activities in this project.

Table 8. Sample Container Requirements

SITE TYPE	SAMPLE TYPE	ANALYTICAL METHOD	CONTAINER TYPE	CONTAINER VOLUME	PRESERV.	HOLDING TIME & TEMP
Drinking Water	Finished Water	EPA 537.1	HDPE bottle	2 X 250 mL	**Trizma®** (5 g/L)	14 d at <6 °C
	Raw Source Water	EPA 537.1 [mod]	HDPE bottle	2 X 250 mL	*none*	14 d at <6 °C
	Raw Groundwater	*EPA 537.1 [mod]*	*HDPE bottle*	*2 X 250 mL*	*none*	*14 d at <6 °C*

Table-details derived from EPA Method 537.1 (ver. 1.0) and sample requirements obtained from Eurofins TestAmerica Inc.

7.1 Sample Shipping

DWQ is working with TestAmerica Inc. laboratory in Sacramento, CA. Shipping address and contact information:

TestAmerica Sacramento
880 Riverside Parkway
West Sacramento, CA 95605
Ph: 916.373.5600
Contact: Jill Kellmann (jill.kellmann@testamericainc.com)

COC forms, sample containers, etc. are available from the TestAmerica contact person listed above.

DWQ has an electronic copy of TestAmerica's Corporate Quality Management Plan (dated 03/28/2019; Doc. No. CA-Q-M-002, rev 4.1) for reference. This document serves as a broad QAPP. However, specific laboratories may have QA Manuals that, per CQMP, take precedence over the CQMP.

FedEX Shipping labels are available at Susan Woeppel's office or can be printed from FedEx's website. Regardless of which label is used, a receipt must be obtained for each shipment and submitted to Susan within one week of the shipment. Be sure to include DWQ billing (unit and program) on the receipt (coding has yet to be determined at this time).

The sample acceptance policy of the contracted lab defines and identifies the conditions where "compromised" samples must be documented and reported to the client (DWQ). In some cases,

compromised samples may not represent credible data, but the full sample result should be reviewed. Samples will be considered "compromised" by TestAmerica if the following conditions are observed upon receipt:

- Samples outside temperature specification or beyond holding time
- Broken, leaking, or inappropriate containers
- COC items that do not match sample-labels or are incomplete or missing
- Breakage of any Custody Seal
- Apparent tampering with cooler or samples
- Seepage of extraneous water/materials into samples
- Inadequate number or volume of samples
- Illegible, impermanent, or non-unique sample labeling

Upon receipt of samples, TestAmerica will contact DWQ and report the status of all received samples prior to initiation of sample preparation and analysis.

8.0 Analytical Methods and Laboratory Documentation

The analytical approach developed for detection, identification, and quantitation of PFAS is based on solid-phase extraction (SPE) from aqueous samples, followed by liquid chromatography tandem-mass spectrometry (LC-MS/MS), with multiple reaction monitoring (MRM) of mass-specific parent-to-product ion transitions for all targeted analytes. The addition of isotopically-labeled surrogates prior to extraction is used to monitor analyte recovery through the entire sample preparation and analysis process. The entire sample should be used for laboratory analysis, such as solid-phase extraction of PFAS from water samples.

A key challenge in developing a baseline survey of PFAS in Utah PWSSs involves identifying which PFAS compounds to evaluate. Well over 6,000 distinct PFAS have been produced or released to the global environment (Wang et al, 2017). EPA's UCMR3 survey of public water systems using EPA Method 537 included six PFAS (see Table 9. PFAS Analyte list for EPA Method 537.1 (ver. 1.0)). EPA Method 537 includes 14 compounds, while the updated EPA 537.1 Method includes 18 compounds. Some commercial labs have modified EPA 537 to analyze 24 to 32 PFAS from surface water, groundwater, or biota. A new method, EPA Method 533 (EPA, 2019), was released in late 2019, and includes 25 compounds, 11 of which are shorter-chain compounds TestAmerica has indicated that it expects to be ready to process EPA Method 533 samples, even suggesting it as preferable to EPA Method 537.1 due it its isotope dilution methodology and coverage of a greater number of the newer PFAS compounds. Other methods being developed through ASTM, ISO, and DOD (consensus-based standards organizations) are performance-based (i.e., they rely heavily on recovery of isotopically labeled surrogates and internal standards; the number of analytes potentially available is only restricted by the ability to meet specific QC requirements) (DOD(b), 2017).

As described in this SAP, the focus of this project is finished (post-treatment) drinking water and/or raw sourcewater to drinking water treatment facilities. Because EPA does not currently regulate PFAS under the Safe Drinking Water Act, there are no regulatory requirements for

monitoring that states and PWSSs must undertake to create continuity with national water quality monitoring programs, Utah DWQ will build on prior work from the UCMR3 study using an updated and expanded analytical method for analysis of PFAS from drinking water (EPA 537.1).

Table 9. PFAS Analyte list for EPA Method 537.1 (ver. 1.0) and Method 533

Acronym	Analyte Name	CAS	UCMR 3	EPA 537.1	EPA 533	Advisory Level	MRL*
PFBA	Perfluorobutanoic acid	375-22-4			x		-
PFMPA	Perfluoro-3-methoxypropanoic acid	377-73-1			x		-
PFEESA	Perfluoro(2-ethoxyethane)sulfonic acid	113507-82-7			x		-
PFBS	Perfluorobutanesulfonic acid	375-73-5	x	x	x		2.0
PFPeA	Perfluoropentanoic acid	2706-90-3			x		-
PFMBA	Perfluoro-4-methoxybutanoic acid	863090-89-5			x		-
NFDHA	Nonafluoro-3,6-dioxaheptanoic acid	151772-58-6			x		-
4:2 FTS	4:2 Fluorotelemer Sulfonate	757124-72-4			x		-
PFPeS	Perfluoropentanesulfonic acid	2706-91-4			x		-
PFHxA	Perfluorohexanoic acid	307-24-4		x	x		2.0
GenX	HFPO-DA (GenX)	13252-13-6		x	x		4.0
DONA	DONA (Dioxa Nonanoate)	919005-14-4		x	x		2.0
PFHxS	Perfluorohexanesulfonic acid	355-46-4	x	x	x		2.0
PFHpA	Perfluoroheptanoic acid	375-85-9	x	x	x		2.0
6:2 FTS	6:2 Fluorotelemer Sulfonate	27609-97-2			x		-
PFHpS	Perfluoroheptanesulfonic Acid	375-92-8			x		-
PFOA	Perfluorooctanoic acid	335-67-1	x	x	x	70 †	2.0
F-53B maj	F-53B Major	756426-58-1		x	x		2.0
8:2 FTS	8:2 Fluorotelemer Sulfonate	39108-34-4			x		-
NMeFOSAA	N-methyl perfluorooctanesulfonamido acetic acid	2355-31-9		x			20.0
NEtFOSAA	N-ethyl perfluorooctanesulfonamido acetic acid	2991-50-6		x			20.0
PFOS	Perfluorooctanesulfonic acid	1763-23-1	x	x	x	70 †	2.0
PFNA	Perfluorononanoic acid	375-95-1	x	x	x		2.0
PFDA	Perfluorodecanoic acid	335-76-2		x	x		2.0
F-53B min	F-53B Minor	763051-92-9		x	x		2.0
PFUnA	Perfluoroundecanoic acid	2058-94-8		x	x		2.0
PFDoA	Perfluorododecanoic acid	307-55-1		x	x		2.0
PFTriA	Perfluorotridecanoic acid	72629-94-8		x			2.0
PFTeA	Perfluorotetradecanoic acid	376-06-7		x			2.0

*** Units are ng /L; MRL values are max-reported values from September 2019 (Test-America), for surface water samples; these values are expected to be maximum MRLs using the methods described above. MRLs for analytes only from Method EPA 533 are unknown.**
† Benchmark values listed for PFOA and PFOS are EPA Lifetime Health Advisories (LHA) for drinking water (EPA(e), 2019).

8.1 Identify and Control Sample Matrix Effects

While less an issue with drinking water or groundwater samples, identification and quantitation of PFAS extracted from some surface waters and soils/biosolids can be substantially influenced by the combined effect of all the non-target components in the sample (Delaney, M.F., 2017; Krynitsky, A.J., et al.). Surface waters (streams, lakes, wetlands), wastewaters (influent and

effluent), and samples extracted from soils usually have higher concentrations of suspended solids, dissolved organic compounds, or dissolved inorganic solutes (salts) compared to relatively pure finished drinking water and ultraclean laboratory water. Since most analytical methods of environmental samples were developed and calibrated under controlled laboratory conditions, differences between an environmental sample and laboratory water/reagents can interfere with otherwise accurate analytical procedures and result in poor sensitivity or biased results.

Laboratory techniques, such as the addition of isotopically labeled surrogate compounds, can help identify strong reductions in extraction efficiency. This is particularly true when surrogate and internal standard compounds are added prior to sample-extraction or cleanup steps.

Field-based QC checks include routine collection of supplemental field sample bottles for use as matrix spikes. Recovery of added analyte from matrix spike samples is compared to recovery from lab control spikes (lab method blank spiked before analysis) to identify instrument performance vs. matrix interference. In addition, collection of ancillary field measurements, such as water *in situ* pH or total suspended solids concentrations, may provide lab analysts and the Designated Project Manager (DPM) with information to better predict or interpret observed matrix effects.

9.0 Project Quality Control Requirements

Baseline QC requirements follow DWQ's Quality Assurance Project Plan for monitoring activities (Utah DWQ, 2014) (see also **Error! Reference source not found.**). However, this SAP document also includes some project-specific items. Activities related to sample-data-collection quality control occur throughout the lifetime of a project.

The broad goal of this investigation is to determine whether PFAS compounds are present at *measurable levels* in Utah's public water systems (Table 1. Summary of Data Quality ObjectivesTable 1). Sampling design is a key element for ensuring that a project meets its data quality objectives by considering the degree to which collected measurements are representative of the target population. For this project, public water supply systems (PWSSs) are the population of interest, and this population may include both the source water and the treated finished water for these systems. Given that available resources for this project are finite (see section 11.2, Estimated Costs), it is improbable that funds are available to sample all source water and outflows from allPWSSs. Instead, Sections 1.0 and 2.0 of this SAP describe possible scenarios for prioritizing which systems to sample, ranging from sampling restricted to areas of known PFAS contamination near source protection zones to a one-time census of all PWSSs.. Further consultation with project partners, including local health departments and managers of water supply systems, along with spatial analysis of potential sampling locations identified in **Error! Reference source not found.**, will identify the degree to which the sampling design s judgmental versus probability-based. Key factors controlling probability-based sampling are proportion of water systems that can be sampled and the number and importance of distinct water sources to each system.

The requirements for field and lab analytical-activities for this project are described below. In general, QC samples are collected to establish the magnitude of potential sample contamination from field gear or sampling equipment, particularly when questionable materials may come into contact with a sample. The most frequent QC sample collected for PFAS monitoring is a field blank (also referred to as a field reagent blank or site blank), where PFAS-free water is dispensed to a sample bottle in the field and then otherwise treated the same as all other samples collected during that sampling event.

If supplemental sampling equipment is required to obtain a sample, such as sample tubing for pumps or transfer containers used to composite samples, one or more equipment blanks should be prepared for every five field samples collected. When ambient exposure of samples to PFAS is a concern, perhaps due to aerosolized PFAS or heavy storm events, a trip blank can be used in addition to a site-specific field blank to assess the degree of potential contamination.

One additional type of QC sample collected is a field replicate, where a second full set of samples are collected from a particular sampling location. Analyses of results from these samples help identify the level of precision, or repeatability, of the entire sample collection, handling, and laboratory analysis system.

Sample handling and collection requirements are often matrix- or sample type-specific:

- Finished Drinking Water: Approved bottles with preservative (Trizma), no transfer containers, and no PTFE-lined lids on sample bottles. Sample temperature must be maintained at or below 10 °C (wet ice only).
- Groundwater (from wells or source-water to drinking water facilities): Approved bottles, no preservative required (unless water has been chlorinated), no PTFE lids. Transfer bottles or tubing only as necessary. Sample temperature must be maintained at or below 10 °C (wet ice only).
- Surface Water: Approved bottles, no preservative, no PTFE lids. Transfer bottles or tubing as necessary. Sample temperature must be maintained at or below 10 °C (wet ice only).
- Soils / Sediments / Biosolids: Approved bulk containers (glass jars), no PTFE lids, appropriate sample collection and homogenization tools (stainless steel spatula and mixing bowls), and PFAS-free rinse and decontamination water (solutions) as necessary. Equipment blanks are expected. Review laboratory procedures and analytical method for additional sample preservation requirements.

9.1 Field QC Activities

Field QC samples will be collected as often as appropriate and practical during sampling activities. Performance goals for field replicates, field blanks, and equipment blanks are described below.

9.1.1 Field Replicates

Field replicate samples will be collected for every 10 field sample collections.

Performance Goal: Relative percent difference (RPD) in result values (RV) between replicate field sample pairs, overall and for each analyte, is less than 30% (e.g., see EPA Method 537.1, Sect. 9.3.7.2).

$$RPD = \frac{|RV_{1i} - RV_{2i}|}{(RV_{1i} + RV_{2i})/2} \times 100$$

Greater variability (i.e., lower precision) may be found when result values are within a factor of two of the minimum reporting level (MRL). Here, RPDs should be < 50%.

Corrective Action: If the RPD of any analyte falls outside the designated range, and lab performance for that analyte is shown to be within system acceptance limits, precision is affected by matrix interference and should be labeled/ flagged in the dataset. For larger projects, further review of additional field replicates in comparison with lab-QC analyses can provide insight to the magnitude and consistency of matrix effects compared to inadequate laboratory practices.

9.1.2 Field Blanks

Field blanks (FB), also called site blanks or field reagent blanks, are collected at every site (i.e., PWSS), and may also be collected after every five to 10 samples at a site. The goal here is to ensure that PFAS identified and quantitated in field samples were not inadvertently introduced to the sample during sample collection or handling. Generally, analysis of field blanks is only required when a field sample contains one or more analytes above the MRL.

Performance Goal: Concentration of any analyte in a field blank sample that is also detected in the associated field sample should be less than the MRL, preferably < 1/3 of MRL.

Corrective Action: For drinking water samples, if target analyte results are outside acceptance limits, EPA Methods 537.1 and 533 suggest all samples associated with that FB should be considered invalid and be recollected and re-analyzed. More detail on QC of blank results can be found in Section 9.2.1 of this SAP.

9.1.3 Equipment Blanks

Performance Goal: Concentrations of any analyte detected in the associated field sample should be less than the MRL, preferably < 1/3 of MRL.

Corrective Action: Interpretation of additional types of field blanks is dependent on the context of the sample set However, one result could be that concentrations of some target analytes could be considered positively biased and/or less precise (with result value qualified as ‘estimated’ “J”) when collected using field sampling or compositing equipment, compared to more directly acquired samples. This could have consequences on achieving data quality objectives for the project.

9.2 Laboratory QC Activities

Analytical QC requirements include the use of various types of control samples that are analyzed with each batch of samples to monitor laboratory performance in terms of accuracy, precision, sensitivity, selectivity, and interferences. General approaches and control samples are available for the contracted lab, TestAmerica, in the Corporate Quality Management Plan (TestAmerica,

2019 [*CBI*]), from Section 9.0 of EPA Method 537.1, and from a PFAS data review and guidance document (EPA(g), 2018).

More broadly, depending on the level of the QC-package requested, results from lab-internal QC samples can be provided directly as raw data, in blank /spike summaries, or reviewed in the case narrative supplied in the laboratory data package. In addition to raw sample data and descriptions of sample preparation work, laboratory data packages typically include a narrative specific to the samples analyzed that identify any data-quality issues and any potential impacts to data usability. While DEQ will review the case narrative for all laboratory results, at minimum, 10% of lab QC results will be reviewed by project personnel.

9.2.1 Field Quality Control Samples

Trip blank/ field blank [3]/ equipment blank (TB, FB, EQBK) cumulatively measure analyte contributions to sample contamination from source water and shipping, the environment of the sampling location, and field equipment used during sampling, respectively. Most common are field blanks, which are required at least once per site (i.e., PWSS)). Field blanks will be collected at each sampling location and held by the lab to be analyzed if sample results are above detection and will be compared to sample results to determine if contamination is present. If ambient analyte contamination is suspected at the sampling location (e.g., known release of contaminant to air, or severe weather conditions that promote mixing), collection of a trip blank is recommended to isolate the ambient- field source contamination from the sample material or shipping contribution.

Performance Goal: Similar to method blanks, if analytes are detected, concentrations should be below 1/3 of MRL (EPA 537.1) or less than MRL (EPA PFAS Data Review Guidance). It is expected that results from TBs should be most similar to method blanks (MBs), while results from EQBKs could be greater than or equal to values from FBs. Note that results from field blanks may have a "B" qualifier attached if the MB result for that analyte was detected and exceeded 1/3 MRL. Project QA personnel will review FB results and consider the context of target analyte "hits" from recovery of added surrogate compounds, detections from laboratory blanks, as well as magnitude of field-sample target analyte concentrations.

Corrective Action: If FB result is detected, and both MB and FB results are within acceptance criteria, no data qualifiers are required. When FB result is detected but exceeds acceptance criteria and the associated field-sample result is less than 10 times greater than FB, evidence exists for target analyte contamination and thus positive bias for that result. The result value should be qualified appropriately and the magnitude-to -background contamination reviewed for impacts to project objectives.

1.1.1 Laboratory Quality Control Samples

Laboratory control sample[4]/matrix spike (LCS, MS) are used to determine the accuracy of the method in a blank or a field-sample matrix, respectively. These are generated at least one per batch. For LCS, a sample of clean (analyte-free) lab water and/or method reagents is spiked with

[3] Field Blanks may also be called Field Reagent Blanks (FRB)

[4] Lab Control Samples may also be called Laboratory Fortified Blank or Lab Spikes

a known concentration of analyte(s), and processed through the entire sample preparation and analysis sequence. A laboratory control sample duplicate (LCSD) is a second sample prepared in the same way and provides an estimate of method precision from a blank matrix. In contrast, a MS is an aliquot (or an entire duplicate sample) of a field sample spiked with a known concentration of analyte(s) and processed through the entire sample preparation and analysis sequence. Similar to laboratory control samples, a MSD (matrix spike duplicate) is a second sample prepared in the same way as the MD and provides an estimate of method precision from a field-sample matrix.

Performance Goal: For spike levels greater than the lower third of the calibration range, spike recovery should be within 70-130% of the true value. If a lower concentration spike is used, e.g., from the lower third of calibration curve– and no greater than 2x MRL, spike recovery should be within 50-150% of the true value. If spike recovery is < 10%, associated results from that batch should be rejected, unless system setup is corrected and re-analysis of the sample falls within acceptance limits.

Corrective Action: If analyte recovery from an LCS sample is outside acceptance limits, at minimum, results from field samples should be qualified with a "J" flag. This identifies the reported concentration of the field result as estimated. For drinking water samples, if LCS recovery is outside acceptance limits, EPA Methods 537.1 and 533 suggest that all results in that preparation batch should be considered invalid (Section 9.3.3 of EPA 537.1). If analyte recovery from MS samples is outside acceptance limits while laboratory performance for those analytes is shown to be in control, then recovery is judged to be matrix-biased. Results for the corresponding analyte(s) in the unfortified sample are reported as "suspect-matrix." Project QA personnel will validate all results from LCS/LCSD and MS/MSD samples per batch and consider the consequences of data-qualifiers or other remedial actions, as appropriate.

Method Blank (MB; also known as Laboratory Reagent Blank (LRB)) measures the method contribution to any source of contamination, It is generated at least one per batch. MB samples are used to detect interferences during chromatography that may prevent the determination or quantitation of that analyte. The analyte then determines the source of contamination and eliminates the interference before processing samples.

Performance Goal: If analytes are detected, concentrations must be below 1/3 of MRL.

Corrective Action: For drinking water samples, if concentration of detected target analytes from MBs exceed 1/3 of MRL, EPA Methods 537.1 and 533 recommend that all results for that analyte in that preparation batch be considered invalid (Section 9.3.1).However, EPA PFAS data review guidelines suggest that these data may still be useful so long as field-sample results are more than 10 times the blank (MB). EPA recently promulgated changes to detection limit calculations as part of Clean Water Act Method Update Rule (EPA(h)), where estimated target analyte concentrations from MBs could be used to help derive matrix-specific MDLs. These updated, matrix-specific limits could then be used to obtain practical quantitation limits for complex fieldsamples.

Surrogate Recovery (SURR)is rRecovery of isotopically labeled surrogates that are added to all samples and quality control samples, MBs, LCS, etc., added prior to extraction. The sample is examined for all available surrogate compounds, and calculated as:

$$\%Recovery = \left(\frac{RV_i}{Spike.Conc_i}\right) \times 100$$

where the result value (RV_i)of the surrogate analyte is divided by the concentration of surrogate added ($Spike\ Conc_i$). Because surrogate compounds are added prior to sample extraction, and because they are added to all extracted samples including method blanks, MS/MSD and LCS/LCSD, they allow for comparisons of recovery of surrogate compounds with and without sample-specific matric effects.

Performance Goal: SURR recovery should be in the 70 to 130% range.

Corrective Action: If SURR recovery for MB or LCS is outside acceptance limits, the lab analyst should check performance of the system, correct any problems, and then re-analyze the extract (EPA 537.1, see 9.3.5). If SURR recovery is outside the 70-130% control range for a field blank, field sample, or matrix spike, but lab QC samples are in control, matrix interference is suspected, and target-analyte results associated with that surrogate should be qualified with "J" since confidence in reported concentration is compromised. If recovery of added surrogates is < 10%, associated results from that batch should be rejected, unless system setup is corrected and re-analysis of sample falls within acceptance limits.

9.3 Data Qualifiers

The following qualifiers are used in the data review process.

Table 10. Data Review Qualifiers

B	An analyte detected in the sample was also detected in a laboratory or field blank Result may be biased by low-level contamination
J	Result value is an estimated quantity of concentration of analyte in the sample. Result value was greater than method detection limit (MDL) and less than sample reporting limit. Field blanks, field sample, or matrix spikes are outside the acceptance limits, but the laboratory QC samples, method blank, and LCS spikes are in control, then matrix interference is suspected. The target analytes associated with surrogates outside acceptable limits will be flagged "J".
J+ / J-	Result value is estimated Results may be biased high or low, respectively.
R	Result is rejected due to serious deficiencies in meeting QC criteria.
U	The analyte was not detected above the level of the reported sample detection limit.

9.4 Data Quality Indicators

Table 11. Data Quality Indicators: Definitions, Criteria and Goals

Data Quality Indicator	QC Check / QC Sample	Evaluation Criteria	Goal
Precision: Measure of agreement among repeated measurements of the same property under identical or substantially similar conditions	Field replicates	Relative percent difference (RPD)	PFAS in Water samples: ± 30%; for results above lab reporting limits
	Laboratory duplicates	RPD	RPD from laboratory duplicates
	Matrix spike duplicates	RPD	RPD from laboratory data
Bias: The systematic or persistent distortion of a measurement process that causes errors in one direction	SOPs for environmental data collection are clean and concise	Qualitative determination of adherence to SOPs by all samplers	All data collected following SOPs or specific procedures in this SAP
	Field/equipment blanks	Result value (RVal) relative to reporting limit (RL)	RVal < RL
Accuracy: Measure of the overall agreement of a measurement to a known value, such as a reference or standard. Includes both random error (precision) and systematic error (bias) components of sampling and analytical operations	Method blanks	RVal relative to detection limit (MDL) or 1/3 RL	RVal < detection limit or RVal < 1/3 reporting limit
	Lab control/matrix spikes	% Recovery of spikes	% Recovery ~ 100 ± 30% (when spike > 2x RL)
Representativeness: Degree to which data accurately and precisely represent a characteristic of a population, parameter variations at a sampling point, or environmental condition	SOPs	Qualitative determination of adherence to SOPs and field audits	All data collected following SOPs
	SAP requirements	Adherence to sampling location, time, and conditions	100% compliance unless approved by Project Manager and noted in field notes
	Field notes & photos	Document variations from SAP/ SOP	100% compliance
	Holding times	Holding times	100% compliance
	Field replicates	RPD	Water samples: ± 30%

Data Quality Indicator	QC Check / QC Sample	Evaluation Criteria	Goal
Comparability: Qualitative term expressing the measure of confidence that one dataset can be compared to another and can be combined in order to answer a question or make a decision	SOPs (sample collection and handling)	Qualitative determination of SOP adherence	All data collected following SOPs or specific procedures described in this SAP
	Holding times	Holding times	100% compliance
	Analytical methods	DWQ- or EPA-approved, or other appropriate performance-based methods with compatible QC requirements	100% use of approved methods
	Similar frequency and types of QC samples (field dups, blanks, lab QA)	Verify	Evaluate for comparability
Completeness: Quantity of valid data obtained from measurement system compared to quantity of data expected	Complete sampling	% Valid data	100% completeness
Sensitivity: Capability of method or instrument to discriminate between measurement responses representing different levels of the variable of interest. Primarily a lab indicator	Laboratory detection limit	Must be below action level	100% compliance
	Laboratory reporting limit for target analytes	RL < 1/5 Action Level of 70 ng/L (HA)	100% compliance
RPD - Relative Percent Difference (RPD (%) = $\{(X_1 - X_2)/(X_1+X_2)\}/2 \times 100$, where X_1 = result from first sample and X_2 = result from second sample			

10.0 Data Analysis, Record-keeping, and Reporting Requirements

10.1 Project Record-keeping

In accordance with DWQ QAPP for Monitoring Activities (see **Error! Reference source not found.**), field personnel shall use field notebooks, pre-printed field worksheets, and/or electronic tablets to accurately document onsite conditions, field measurements, sample collection information, field instrument readings (as appropriate), and other pertinent site-related information obtained during sample collection activities.

Appropriate laboratory-analysis-request sheets and COC forms will be maintained before, during, and after sample collection and reviewed for accuracy before the samples and the lab sheet/COC forms are stored in the vehicle. Laboratory-specific sample acceptance criteria will be reviewed prior to sample storage, transport, and shipping.

11.0 Schedule and Budget

11.1 Schedule

There are five primary components to the overall structure of Phase 1 monitoring :

1. SAP development
2. Monitoring implementation
3. Data review/validation
4. Data reporting
5. Reassessment

Scheduling and implementation (monitoring) will be dependent on monetary resources allocated to this program. Monitoring staff are available to begin field sampling as early as May 2020 once project funding has been determined and logistics have been planned. Sites will be selected from target population of water providers identified under scenario 4 in Table 3 once input is given from DEQ management and input from the PFAS workgroup.

Considering there are many unknowns regarding this project, overall scheduling will be dynamic and subject to change. Ultimately, DWQ's Monitoring Section has staff resources allocated to allow for ongoing PFAS sampling into the near future. Continuous support from DDW, DERR, DWMRC, and DWQ will be needed to make to make the overall PFAS project a success. This includes help with project design, implementation, data review/analysis, and reporting. See Table 12 for more information on Phase 1 scheduling.

Table 12. Phase 1 Schedule

PFAS Phase 1 Schedule	2020 Q1	2020 Q2	2020 Q3	2020 Q4	2021 Q1
SAP development	X				
SAP approval	X	X			
Monitoring implementation		X	X		
Data review			X	X	
Reporting				X	
Reevaluation of monitoring plan				X	X
Phase 2 SAP development					X

11.2 Estimated Costs

Total Estimated Costs: $95,740

Budget Assumptions

Lab/analytical**:** The lab estimate is based on sampling the proposed target set of 26 water systems, which have an identified number of wells totaling approximately 161 sites (**Error! eference source not found.**; option 4). To maintain a 10% rate for collecting field blanks, an individual field blank per system, and an estimated number of trip blanks (assuming ~15 runs), the total number of QC samples is estimated to be an additional 56 samples. Analysis cost for the extended list of analytes (EPA Method 537.1 Modified) is $370/sample multiplied by 217 samples for an estimated total of $80,290.

Staff Time: This value is based on having two full-time employees from the Monitoring Section available to conduct sampling over ~15 separate sampling events. This includes time to sample, prepare and ship samples, and travel. It does not include time spent on logistical preparation or data management post sampling.

Supplies/consumables/shipping: This considers the consumption of general monitoring supplies that are often used to conduct sampling.

Transportation: This item is mostly associated with fuel costs to visit all sites. Travel will be heavily focused in the larger metro areas of Salt Lake, Provo, and Ogden. However, travel will occur as far north as Logan and as far south to Cedar City.

Travel: Travel costs will be minimal. However, overnight stays in Logan and Cedar City will be necessary.

A definitive funding source for this project has yet to be determined. This will be decided after DEQ upper management review and approval. Table 13 summarizes the estimated costs.

Table 13. Summary of Estimated Costs

	Estimated Costs
Lab/analytical	$80,290
Staff time (field work)	$9,000
Supplies/consumables/shipping	$450
Transportation	$5,000
Travel	$1,000
Total Estimated Costs	**$95,740**

12.0 Site List

A line-item site list will be created upon approval of this SAP by DEQ management. The PFAS workgroup will determine a final site list and implement sampling once a budget is provided and sites have been selected. The site list will be a working document and will depend on well locations and usage by drinking water systems, which may vary seasonally. Therefore, the target site numbers are an estimate for budget and planning purposes only and are subject to change. An addendum to this SAP will be added to this section once sites have been prioritized. It will include the following:

- Water provider name
- Number of sampling locations
- Unique site identifiers (monitoring location ID)
- Trip/equipment/field blank information
- Duplicate sample information

13.0 Decision Framework

Once results are received by DEQ, the DWQ QA officer will review and validate results and summarize any QC issues. DDW and DWQ staff will review the data packages and determine if results above detection are valid of a function of sample contamination. Additional samples will be collected to confirm results if results are above detection. Furthermore, individual results for PFAS compounds identified by the Agency for Toxic Substances and Disease Registry (ATSDR) summarized in Figure 3. If results exceed either the EPA advisory levels for all PFAS compounds or individual compounds in the list of ATSDR analytes, additional samples will be collected from the distribution systems supplied by the well. If contamination if confirmed in a drinking water system, DEQ and DOH staff will consult with the water provider to determine the best course of action.

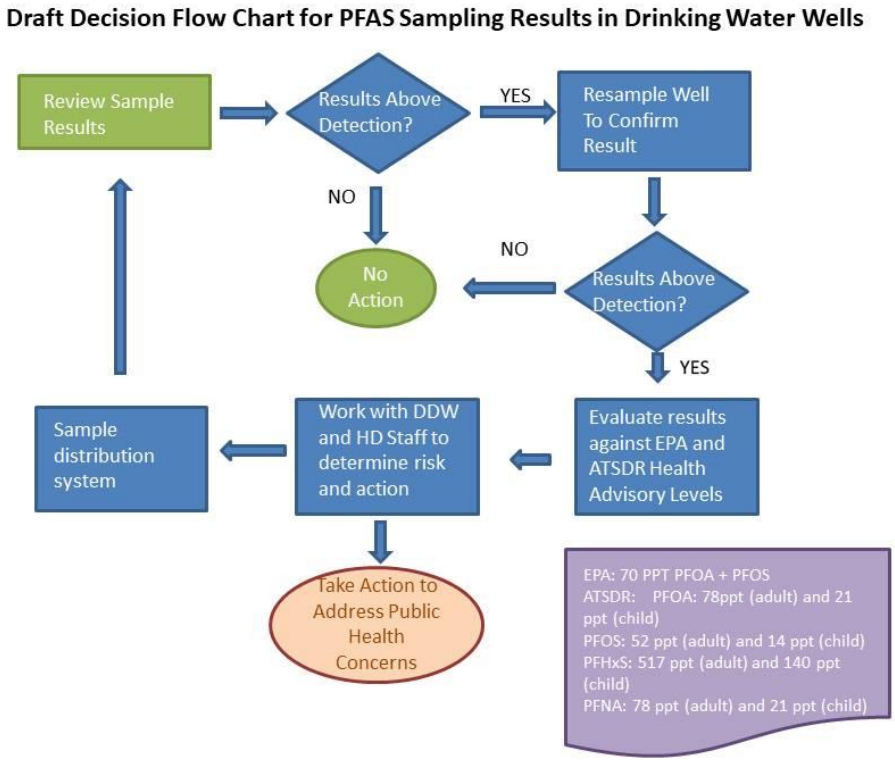

Figure 3. Decision flowchart for evaluating PFAS sample results

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