Final
PFAS Preliminary Assessment Report

700 South 1600 East PCE Plume Site
Salt Lake City, Utah

Department of Veterans Affairs
Veterans Health Administration
Salt Lake City Health Care System

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Acronyms

bgs	below ground surface
DEEP	Connecticut Department of Energy and Environmental Protection
EPA	Environmental Protection Agency
MRI	magnetic resonance imaging
MW	monitoring wells
PA	Preliminary Assessment
PCE	tetrachloroethene
PFAS	per and polyfluoroalkyl substances
PFBA	perfluorobutanoic acid
PFBS	perfluorobutanesulfonic acid
PFDS	perfluorodecanesulfonic acid
PFHpA	perfluoroheptanoic acid
PFHxA	perfluorohexanoic acid
PFHxS	perfluorohexanesulfonic acid
PFNA	perfluorononanoic acid
PFOA	perfluorooctanoic acid
PFOS	perfluorooctanesulfonic acid
PTFE	polytetrafluoroethylene
SI	Site Inspection
SLC VAMC	Salt Lake City Veterans Affairs Medical Center
UFP- QAPP	Uniform Federal Policy - Quality Assurance Project Plan
VA	Department of Veterans Affairs

EXECUTIVE SUMMARY

The Salt Lake City Veterans Affairs Medical Center (SLC VAMC) is in an urban, developed area situated on the East Bench which separates the Salt Lake Valley from the Wasatch Mountains to the east **(Figure 1)**. The facility operates a 121-bed hospital and provides numerous healthcare services to veterans. The SLC VAMC is also in the process of remediating a tetrachloroethene (PCE) groundwater plume, attributed to dry-cleaning operations conducted from approximately 1976 to 1982.

Environmental Protection Agency (EPA) Region 8 expressed concerns regarding possible per- and polyfluoroalkyl substances (PFAS) contamination at the SLC VAMC due to the facility's historical and current site operations and history of a past chemical release of PCE. Although there have been no confirmed releases of PFAS at the SLC VAMC, the Department of Veterans Affairs (VA) agreed to conduct a Preliminary Assessment (PA) and if warranted, conduct limited sampling as part of an initial Site Inspection (SI). The PA summarizes current and historical operations, PFAS product usage, and general site characteristics.

Key findings of the PA are as follows:

- PFAS containing medical equipment and devices used at the hospital have no plausible environmental release pathway.
- Dry cleaning residuals and wash water from past laundering of PFAS-treated materials (pre-2019), and small volumes of spent x-ray developer (pre-2007) were historically discharged to the sanitary sewer system.
- Spent floor cleaning products containing perfluorobutanesulfonic acid (PFBS) are currently being disposed to the sanitary sewer system.

To evaluate whether there has been a substantial release of PFAS to the environment, a subset of the existing site monitoring wells will be sampled for PFAS using EPA Method 1633. The proposed sampling locations are monitoring wells (MW) primarily located near areas where historical PCE releases to groundwater have been observed, or near where PFAS-containing cleaning products may have been discharged to the sanitary sewer. The recommended monitoring locations include MW-30, MW-03R, MW-05R, MW-29, and MW-24.

Monitoring wells MW-30, MW-03R, and MW-29 are screened at multiple depths. The data collected will provide information on presence or absence of PFAS throughout the aquifer system.

An update to the site's Uniform Federal Policy–Quality Assurance Project Plan (UFP-QAPP) was developed to detail the data quality objectives, sample locations and collection procedures, laboratory methods and data quality and control measures for the limited sampling during the SI.

1.0 INTRODUCTION

The Department of Veterans Affairs has prepared a Preliminary Assessment to determine if historical and current operations at the SLC VAMC could have resulted in a significant release of PFAS to the environment.

The SLC VAMC is comprised of 28 buildings, including a 121-bed hospital that provides emergency, primary and mental health care to veterans and their families. The SLC VAMC also offers specialty care such as dental, audiology and speech, hematology/oncology, pulmonary medicine, rehabilitation, and extended care. There is a pharmacy, medical research facilities, a senior living center, and child daycare on campus.

The SLC VAMC is currently evaluating remedial action alternatives for the 700 South 1600 East PCE Plume Superfund Site. The PCE groundwater plume is attributed to historical dry-cleaning operations at the facility from approximately 1976 to 1982. Spent solvent and dry-cleaning residuals were disposed of in the sanitary sewer and, due to a break in the downstream line, contaminated the groundwater with PCE. To investigate the PCE plume, the SLC VAMC has constructed an extensive monitoring well network at the site.

1.1 Purpose and Objectives

The purpose of this PA is to identify processes and locations at the SLC VAMC where PFAS-containing products may have been used, assess the likelihood of a release to the environment, and to conduct an initial assessment of possible migration pathways and receptors.

The primary objectives of the PA are to:

- Identify current and historical operations conducted at SLC VAMC that may have included the use of PFAS containing substances.
- Evaluate possible PFAS release pathways to the environment from current and historical operations.
- Differentiate areas that warrant further investigation from those that pose little or no potential threat to human health and the environment.
- Develop a limited sampling plan to evaluate if there has been a release of PFAS to the environment at concentrations that pose a potential threat to public health or the environment.

1.2 Background

Due to a wide array of properties associated with PFAS, they are found in a variety of products used in various industries, including healthcare. PFAS are used in inert and clot-resistant coatings which are commonly applied to catheters, stents, sutures, device surface coatings, and needles. Many surgically implanted devices (surgical patches and cardiovascular grafts) are composed of polytetrafluoroethylene (PTFE) (i.e., Teflon®) due to its high “biocompatibility” and extremely low coefficient of friction, minimizing negative host response (Henry et al. 2018; ITRC 2023a).

PFAS are also found within high-frequency devices (pacemakers, magnetic resonance imaging [MRI] imaging machines, etc.) due to its ability to function as an insulator (Youman, 2024). Many gaskets, O-rings, and tubing are composed of PTFE due to its durability and innate resistance to chemicals, particularly common within dialysis membranes, anesthesia, and machine components (Henry et al. 2018; ITRC, 2023a). PFAS are also common in both photographic film (x-ray) and as a surfactant in mixtures used to process imaging films (Connecticut Department of Energy and Environmental Protection [DEEP], 2018).

While PTFE is an unregulated PFAS, several impurities and degradation products, such as perfluoroalkyl acids perfluorooctanoic acid (PFOA) and perfluorobutanoic acid (PFBA), have been identified as a concern by EPA.

Structural similarities between carbon-hydrogen (C-H) bonds and carbon-fluorine (C-F) bonds allows certain pharmaceuticals to take advantage of a stronger C-F bond without sacrificing molecular structure, making PFAS a common component of certain pharmaceuticals (Cichocki, 2023).

PFAS are also a common additive to stain- and water-repellent protective medical fabrics like surgical drapes and gowns. Through the addition of PFAS, these fabrics are more resistant to water and stains while also creating a barrier that minimizes the transmission of infections and disease within a hospital (3M New Center, n.d.). Laundering and drycleaning of fabrics that contain PFAS can potentially create a release pathway via laundry rinse water and solvents (Barnes, 2021).

Many PFAS exhibit diverse surfactant properties making them useful in certain cleaning products to help liquids mix more effectively and improve spreading and foam control. PFAS can be found in glass and hard surface cleaners and aerosol propellant-based cleaners (Geller and Beittel, 2023).

1.3 Environmental Setting

Environmental setting information, including descriptions of site geology and hydrogeology, are summarized from information included in the Final Remedial Investigation Report, Operable Unit 1, 700 South 1600 East PCE Plume Site completed in 2022 (CDM Smith, 2022).

The SLC VAMC is in an urban, developed area situated on the East Bench which separates the Salt Lake Valley from the Wasatch Mountains to the east. The facility is in a mixed commercial and residential area, and the major streets that bound the site include 500 South to the north, Michigan Avenue to the south, 1100 East to the west and Foothill Drive to the east.

To the west of the SLC VAMC is a city park and recreation facility, University of Utah athletic fields and training buildings, elementary schools, and a residential community. Previously, a National Guard facility and a US Forest Service Fire Center were located west of the campus on Guardsman Way.

To the north and east of the SLC VAMC is the University of Utah campus, which includes a hospital and other medical buildings and labs, and student housing. A research park consisting of ARUP, Biofire Energy & Geosci Institute, Teva Pharmaceuticals, and an Armed Forces Reserve Center are located to the east of the SLC VAMC. The reserve center was previously the location of Fort Douglas, an active US Army base since 1878.

1.3.1 Site Geology

The SLC VAMC is located near the eastern edge of the Salt Lake Valley. The valley is bounded by the Wasatch Range to the east, the Oquirrh Mountains to the west, the Traverse Mountains to the south, and the Great Salt Lake to the North. The two Quaternary geologic features that produce the modern physiogeography at the site are the Wasatch Fault Zone and the Pleistocene Lake Bonneville.

The Wasatch Fault Zone separates the Salt Lake Valley from the Wasatch Mountains to the east. The Wasatch Fault Zone has been divided into 10 segments, including the Salt Lake City Segment, which has been subdivided into three sections from north to south: Warm Springs Fault, East Bench Fault, and Cottonwood Fault.

The Site is bisected by the East Bench Fault and the East Bench Fault Spur. The East Bench Fault is considered an active segment of the Wasatch Fault (the spur segment is not).

Lake Bonneville, the predecessor to the Great Salt Lake, filled the Salt Lake Valley from 30 thousand to 10 thousand years ago. The Lake Bonneville highstand (maximum shoreline elevation approximately 5,090 feet above mean sea level) was approximately 18 thousand years ago. The Provo phase of Lake Bonneville occurred when the elevation stabilized at approximately 4,760 feet above mean sea level from 15 thousand to 14 thousand years ago.

The surficial geology at the site is mapped as alluvial fan deposits and lacustrine deposits. The alluvial fan deposits are from aggraded stream and debris flow deposits likely sourced from Red Butte Canyon and Dry Creek Canyon. The alluvial fan deposits are described as clast supported pebble and cobble gravel, occasionally with boulders, with a sand and silty matrix.

The lacustrine deposits may be either Lake Bonneville highstand or Provo phase deposits. The Lake Bonneville highstand deposits are predominantly silt and clay with some fine sand and fine gravel. The Provo phase deposits are clast-supported pebble and cobble gravel in a sand matrix with minor silt.

Overall, the surficial geology grades from coarse-grained alluvial fan/Provo phase deposits on the east, to finer-grained lacustrine deposits to the west. The topography of the site slopes to the west-southwest at an approximate grade of 4 percent, until the grade steepens to 10 percent near the East Bench Fault (CDM Smith, 2022).

1.3.2 Site Hydrogeology

Groundwater in the Salt Lake Valley occurs in the alluvial fan and lacustrine deposits within perched, unconfined, and deep aquifers. The deposits are very complex and consist of multiple aquifers and semi-confining layers that are laterally discontinuous and internally heterogenous.

At the VAMC campus, groundwater was encountered generally from 185 to 200 feet (ft) below ground surface (bgs). Moving west and southwest, groundwater becomes shallower, with depth to groundwater at approximately 155 ft bgs to the west of the VAMC campus near Guardsman Way. In the residential area located approximately 4,000 ft downgradient from the VAMC campus boundary, shallow groundwater was encountered at approximately 15 ft bgs to above the ground surface (i.e., artesian conditions).

At the site, groundwater flows through perched, unconfined shallow, and semiconfined deep aquifer systems. Surface discharge of groundwater through seeps and springs located to the east of the fault occur and are cumulatively a significant component of the local water balance. Historically, water supply and irrigation well pumping have come primarily from the semiconfined deep aquifer, deflecting the groundwater flow toward these wells (CDM Smith, 2022). The nearest water supply well for consumptive use is Salt Lake City Department of Public Utilities Drinking Water Well #18 (SLC-18), located approximately 1,000 feet northwest of the SLC VAMC at the northwest corner of 500 South and Guardsman Way. SLC-18 has not operated since 2004.

1.3.3 Hydrologic Setting

The closest surface water body is Red Butte Creek located to the east and south of the site, which flows to the southwest before traveling more westerly approximately 1,500 feet to the southwest of the site. The peak flow of Red Butte Creek occurs in late April through June because of snowmelt. Red Butte Creek is a losing stream as it flows across the primary and secondary recharge areas near the Wasatch Front, including the eastern portions of the site. Red Butte Creek receives surface water via both direct runoff and storm water discharges.

The headwaters of Red Butte Creek are in the Wasatch Range. Red Butte Creek is divided into two subwatersheds, and the lower subwatershed flows near the site. The upper subwatershed is on U.S. Forest Service land and is designated a Research Natural Area closed to public access. As Red Butte Creek exits the Wasatch Range through Red Butte Canyon, it enters the Salt Lake Valley. While the upper subwatershed is undisturbed, the lower is within a fully urbanized area and flows through developed business and residential areas including the University of Utah campus, the SLC VAMC campus, Sunnyside Park, and residential neighborhoods. Red Butte Creek then flows west-southwest through Miller Park toward Liberty Park Pond. Surface exposure of Red Butte Creek ends east of Liberty Park and the creek is diverted underground into the 1300 South conduit where water is conveyed to the Jordan River via an underground pipe that is about four miles long. Water from Red Butte Creek supports recreational areas, such as the pond, in Liberty Park (CDM Smith, 2022).

The SLC VAMC's stormwater collection system drains into Red Butte Creek through three outfalls.

1.4 Preliminary Assessment Methods

The development of the PA included the following activities:

- Reviewing published research into the prevalence of PFAS within the healthcare industry.
- Reviewing VA property records and operational site history.
- Reviewing VA's Safety Data Sheet/Chemical Inventory database for PFAS-containing products used at the facility.
- Conducting interviews of site personnel in Janitorial Services, Research, Radiology, Safety, Operations and Maintenance, and Biomedical Engineering.
- Reviewing environmental data records collected by the EPA and the Utah Department of Environmental Quality during the PA/SI phase of the 700 South 1600 East PCE Plume Superfund Site.
- Reviewing general physical properties of PFAS and their effect on environmental fate and transport.

1.5 Report Organization

The PA is organized as follows:

- Section 1 – Introduction. Provides a project overview, the environmental setting, and the methods used to conduct the PA.
- Section 2 – Site Description and Operational History. Provides a summary of PFAS in healthcare and a description of the operational history of the facility.
- Section 3 – Potential Exposure Pathways. Discusses potential release mechanisms and exposure pathways based on most likely release scenarios.
- Section 4 – Summary and Conclusions. Summarizes and provides conclusions for potential PFAS usage and release at the facility.
- Section 5 – References. Provides details about the references consulted to produce the PA report.

2.0 SITE DESCRIPTION AND OPERATIONAL HISTORY

The SLC VAMC campus was constructed in 1950 as a subsection of the established Fort Douglas Military Reservation. The first buildings constructed included the main hospital (Building 1), a psychiatric/tuberculosis hospital (Building 2), an infirmary, kitchen and cafeteria, boiler plant and shops, a laundry facility, and various residential buildings. Expansion of the campus continued into the late 1990s (SWCA, 2011).

Currently, the SLC VAMC campus is comprised of 28 buildings, including a 121-bed hospital that provides emergency, primary and mental health care to veterans and their families. The SLC VAMC also offers specialty care such as dental, audiology and speech, hematology/oncology, pulmonary medicine, rehabilitation, and extended care. There is a pharmacy, medical research facilities, a senior living center, and child daycare on campus **(Figure 2)**.

Laundry operations for the medical facility, including a short period of drycleaning, were conducted in Building 7 from 1952 until 2019. Drycleaning operations, conducted from 1976 to 1982, are a presumed source for the PCE groundwater plume already being addressed at the site.

The SLC VAMC is a small quantity generator of hazardous waste (UT9360090048). Typical hazardous wastes generated at the facility include expired/unused pharmaceuticals, barium contrast (radiology), and xylene, isopropyl alcohol, and formalin (histology and pathology labs). Hazardous waste is picked up monthly and transported off-site for disposal.

The SLC VAMC has never been a manufacturer of PFAS nor used high purity PFAS in any processes, nor does the SLC VAMC operate a fire department on campus that may have used PFAS-containing firefighting foams.

PFAS usage at the SLC VAMC is similar to usage at other comparable size healthcare facilities. Possible uses of PFAS-containing materials include medical equipment and devices used for both patient care and research, pharmaceuticals, cleaning supplies, laundry services, and other operational and maintenance activities.

While historical uses of PFAS-containing materials have been evaluated at the VAMC campus, locations and processes which may have released PFAS to the environment have not been identified or investigated and represent a data gap in the Conceptual Site Model for PFAS at the site.

2.1 Medical Equipment and Devices

As presented in Section 1.2, PFAS can be found in a variety of products used in the healthcare industry. Most common is PTFE as it's found within O-rings, gaskets, cardiovascular grafts, sutures, tubing, dialysis membranes, and other machines and diagnostic instruments (Henry et al., 2018). At the SLC VAMC, medical equipment is located in the hospital (Buildings 1 and 14) and in Medical Research (Building 2).

The Biomedical Engineering Department at the SLC VAMC maintains medical equipment and devices. When medical equipment and devices have reached the end of their useful life, items are surplussed, recycled, or disposed of as solid waste.

The Biomedical Engineering Department uses a variety of corrosion protection lubricants and pipe thread sealers that contain perfluoroalkylethers and PTFE to maintain equipment; however, these products are not used on water lines nor wastewater lines and do not have a likely release route to the environment.

Additionally, Medical Research (Building 2) currently uses an aerosol non-stick dry film lubricant that contains PTFE. Similarly, it is used on medical equipment with no likely release route to the environment.

2.2 Pharmaceuticals

The SLC VAMC has an onsite compounding pharmacy located in Building 1. The pharmacy primarily stores and dispenses medicines but can also compound custom medications to fit a patient's needs. Medical Research (Building 2) also stores and uses pharmaceuticals.

Unused or expired pharmaceuticals are managed as hazardous waste and incinerated at an offsite facility. Sink disposal or flushing of any pharmaceutical is not an approved disposal method and is against SLC VAMC policy.

Given the broad range of PFAS definitions, some pharmaceuticals may be considered a PFAS. Common pharmaceuticals like fluoxetine (Prozac), sitagliptin (Januvia), atorvastatin (Lipitor), ciprofloxacin (Cipro) and fluticasone propionate (Flonase) meet the broad range of PFAS definitions; however, using EPA's definition, only four commonly used organofluorine pharmaceuticals are considered PFAS (Perflutren, Perflubron, Perflubutane, and Fulvestrant) (Hammel et al., 2022)

The SLC VAMC Pharmacy formulary does not include the EPA defined PFAS pharmaceuticals; they are not available for use at the hospital.

Pharmaceutical packaging may also contain PFAS. While limited information has been published in this area, it is likely pharmaceutical packaging contains similar PFAS as food packaging (PFOA, GenX, and PFBS) (Food Packaging Forum, 2024). Pharmaceutical packing is disposed in the trash or as non-hazardous pharmaceutical waste.

2.3 X-Ray Development

The SLC VAMC currently uses digital medium to complete all x-rays, but historically, x-ray film was used. X-ray film was developed within the Radiology Department within Building 1. The film was recycled for its silver content, while development solution was mostly depleted during the development process, small volumes were discharged to the sanitary sewer by the automated development equipment. X-ray film development ceased in 2007, when the SLC VAMC transitioned to a digital medium (McPherson, 2024).

PFAS are a component of both x-ray film and developer. It functions as a friction reducer, reduces static electricity, and reduces surface tension. PFAS functions primarily as a surfactant within the developing solution. Known PFAS used in the photographic industry include: PFOA, perfluorooctanesulfonic acid (PFOS), PFBS, perfluorohexanesulfonic acid (PFHxS), and perfluorodecanesulfonic acid (PFDS) (Connecticut DEEP 2018).

2.4 Cleaning Supplies

SLC VAMC janitorial staff use a variety of Scotchgard® cleaning products that contain PFBS such as pretreatment cleaner, floor finish, and extraction cleaner. These products may be used throughout the campus but are primarily used in the hospital, and medical research buildings (Buildings 1, 2, and 14). Usage of these specialty cleaners varies depending on department and product used. Tile floor finish is used about two times per month. Pretreatment and extraction cleaner for carpets are used more sparingly, about once per month (Smith, 2024). Spent cleaning solutions are disposed of through the sanitary sewer (e.g., emptying mop buckets).

2.5 Laundry Services

PFAS-containing chemicals are a common treatment to garments and uniforms in use within a healthcare setting, because of their water and stain resistant properties. Stain resistant materials (scrubs, gowns, etc.) laundered at the facility (Building 7) could have released residual PFAS into the wash water which was discharged to the sanitary sewer system. Additionally, Scotchgard® brand detergents, likely containing PFOS (pre-2000), PFBS, and other PFAS, were used in the laundry service to remove stains.

SLC VAMC contracted with a commercial laundry facility in 2019, and all laundering stopped in Building 7. All laundering equipment has been removed and Building 7 is being converted to storage and administrative space. The laundering of PFAS-containing materials may have historically resulted in a release like PCE from the dry-cleaning operation, presenting a potential release pathway to the environment.

Based on the information gathered from the *Florida Statewide PFAS Pilot Study at Drycleaning Sites (2021)* and the article *PFAS in the textile and leather industries* (2023), common PFAS additives used in water- and stain-resistant fabrics include PFOA, PFOS, PFBS, perfluoroheptanoic acid (PFHpA), perfluorohexanoic acid (PFHxA), PFHxS, and fluorotelomer alcohols (Barnes, et al, 2021; Minnesota Pollution Control Agency, 2023).

2.6 Operational and Maintenance Activities

There are 19 other buildings on the SLC VAMC campus that perform a variety of services both for patients and to support facility operations. The electrical shop (Building 6) uses a no-flash contact cleaner that contains PFAS. This product is used to clean energized equipment with no likely release pathway into the environment beyond the equipment housing structure(s). The machine shop (Building 6) uses an acoustic sealant that contains 3,3-dichloro-1,1,1,2,2-pentafluoropropane and 1,3-dichloro-1,1,2,2.3-pentafluoropropane. This sealant is used throughout the facility but presents no likely release pathway. A gel guard aerosol PTFE was historically used at the boiler plant (Building 7) and the grounds shop (Building 38). It was used as a spray lubricant on metal equipment with no likely release pathway (Stuart, 2024).

The SLC VAMC does not have records of emergency response events that used aqueous film-forming foam (a common source of PFAS contamination) at the facility nor does the SLC VAMC operate a fire department (Treasure, 2024).

The hospital has a helicopter pad to facilitate patient transport. The helicopter pad is located southwest of Building 14. There is no dedicated or specialized fire suppression equipment at the helipad, only a large ABC fire extinguisher. The SLC VAMC does not have records or institutional knowledge of incidents where firefighting foam may have been used (Treasure, 2024). The VAMC does not have records or documentation of spills of materials containing PFAS at the site.

3.0 POTENTIAL EXPOSURE PATHWAYS

Based on historical and current uses of PFAS-containing materials at the site, it is possible a release to the environment may have occurred. Because PFAS sampling has not been completed at the site, data gaps remain with regard to identification of complete or potentially complete exposure pathways for PFAS. The most likely release mechanisms and exposure pathway are discussed in the following sections.

3.1 Preliminary Conceptual Site Model

A preliminary Conceptual Site Model was developed to focus potential environmental media sampling by identifying possible exposure pathways. Each pathway represents a means by which hazardous substances may pose a threat to human health or the environment. The pathways are described below:

Groundwater: Hazardous substance migration to and within aquifers; potential threats to drinking water.

Groundwater is considered a potential exposure pathway due to (1) past laundering processes at the facility that used and discharged wash water and dry-cleaning residuals potentially containing PFAS to the sanitary sewer system, where release to the subsurface may have occurred through defects in the sewer line, and (2) proximity to municipal drinking water well SLC-18 (approximately 1,000 feet northwest of the SLC VAMC boundary and hydraulically down- and cross-gradient to the facility), which has been offline since 2004.

Surface Water: Hazardous substance migration to surface water bodies; potential threats to drinking water supplies, human food chain and/or sensitive environments.

Based on past and current processes at the facility, there is no evidence to support a release of PFAS to the facility's stormwater collection system from overland flow or flooding and discharge to Red Butte Creek nor does the site hydrogeology indicate a migration pathway from groundwater to surface water. Therefore, surface water is not considered a potential exposure pathway through use as a drinking water source or sustainment of aquatic life.

Soil: Potential threat to people on or near the site who may encounter exposed wastes and/or impacted soil; includes both soil ingestion and dermal exposure.

Based on past and current processes at the facility, there is no evidence to support a release of PFAS to the surrounding soils. The SLC VAMC did not operate an on-site landfill. Also, there are no documented incidents where firefighting foam was used at the facility, nor does the SLC VAMC have a fire department that may have trained using foam. Therefore, soil is not considered a potential exposure pathway for dermal or ingestion exposure.

Air: Hazardous substance transport in gaseous or particulate form; potential threats to people and/or sensitive environments.

Based on past and current operations at the facility, there is no evidence to support a release of PFAS to the air; therefore, air migration is not considered a likely exposure pathway.

3.2 Fate and Transport

PFAS typically do not readily decompose under normal environmental conditions, which makes an understanding of PFAS environmental transport crucial for completing an exposure assessment.

PFAS, primarily perfluoroalkyl acids and perfluorosulfonic acids, are composed of both hydrophilic and hydrophobic subsections, complicating transportation through groundwater. Additionally, the water solubility of PFAS is highly variable, with solubility decreasing as carbon chains increase. Due to the variation in molecular composition, many PFAS are strongly drawn to the air-water interface, with the hydrophobic carbon-fluorine chain oriented towards the air and the hydrophilic head group oriented toward the water (Krafft and Riess, 2015). This leads to a higher retardation factor at the air-water interface with PFAS, such as PFOA and PFOS (Brusseau, 2018).

PFAS soil partitioning is driven primarily through electrostatic interactions and sorption to organic matter via hydrophobic interactions (ITRC, 2023b). Once accumulated within the soil, PFAS can move to deeper soil levels and groundwater through percolating water, the rate of this movement varies depending on the PFAS. Smaller chained PFAS, like PFBS, can move to groundwater from soil quickly while longer chain PFAS such as perfluorononanoic acid (PFNA) may take decades to reach groundwater (www.eea.europa.eu, 2024).

PFAS are not known to be particularly volatile, especially compared to chlorinated solvents like PCE. Therefore, PFAS presents minimal indoor air vapor intrusion risk.

4.0 SUMMARY AND CONCLUSIONS

PFAS have been extensively used in a variety of consumer and healthcare products since the 1940s. The SLC VAMC has never been a manufacturer of PFAS nor used high purity PFAS in any processes, nor does the SLC VAMC operate a fire department on campus that may have used PFAS-containing firefighting foams.

Although there is no confirmed release of PFAS, any potential PFAS contamination would likely be the result of products that contain trace amounts of PFAS (e.g., cleaning products) or from laundering stain- and water- resistant fabrics. Both scenarios result in disposal of spent and residual products to the sanitary sewer system.

The sanitary sewer system at the SLC VAMC campus is divided into two sections, without any crossovers. Sanitary sewer lines from Buildings 1, 5, and 14 combine near the western property line and connect to Salt Lake city's main line near the intersection of 500 S and Guardsman Way. All other campus sewer lines combine near the southern boundary, near Sunnyside Park, and connect to the main line on Sunnyside Avenue.

Based on the potential exposure pathways for PFAS, limited groundwater sampling is recommended using existing monitoring wells near the laundry service (Building 7), the main hospital (Buildings 1 and 14), the research building (Building 2), near the identified break in the sanitary sewer line, and the western facility boundary (hydraulically downgradient) from these buildings **(Figure 2)**. The recommended sampling locations are summarized below.

Building / Area	Activities	Monitoring Well ID	Location/Justification
1 and 14	Use of cleaning supplies and former x-ray development equipment resulting in past and current disposal of residual PFAS to sanitary sewer	MW-30	MW-30 is hydraulically downgradient from Buildings 1 and 14. Northwest property boundary; onsite monitoring closest to SLC-18.
2	Use of cleaning supplies resulting in disposal of residual PFAS to sanitary sewer	MW-05R	MW-05R is hydraulically cross gradient from Building 2. This well is also upgradient of the PCE plume and of potential release points near Building 7 and will be used as the upgradient comparison location for PFAS samples

			collected within the PCE plume.
7	Dry-cleaning and laundry service resulting in historical disposal of PFAS to the sanitary sewer	MW-24	MW-24 is hydraulically down gradient of the sewer line exiting Building 7, 6 and 2, and upgradient of the PCE plume.
Sanitary Sewer Line		MW-29	MW-29 is hydraulically downgradient of the identified break in the sewer line; a suspected source of PCE.
Western property boundary		MW-03R	MW-03R is hydraulically downgradient of campus activities and where the highest concentration of PCE has been observed.

To complete the sampling effort, an update to the site's UFP-QAPP was developed detailing the sampling locations and protocols, laboratory procedures and data quality control measures. Sampling is scheduled for Spring 2025, and the results of the sampling effort will be provided in a SI report in Fall 2025.

5.0 REFERENCES

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FIGURES

Legend

George E. Wahlen Veterans Affairs Medical Center Boundary

Notes:

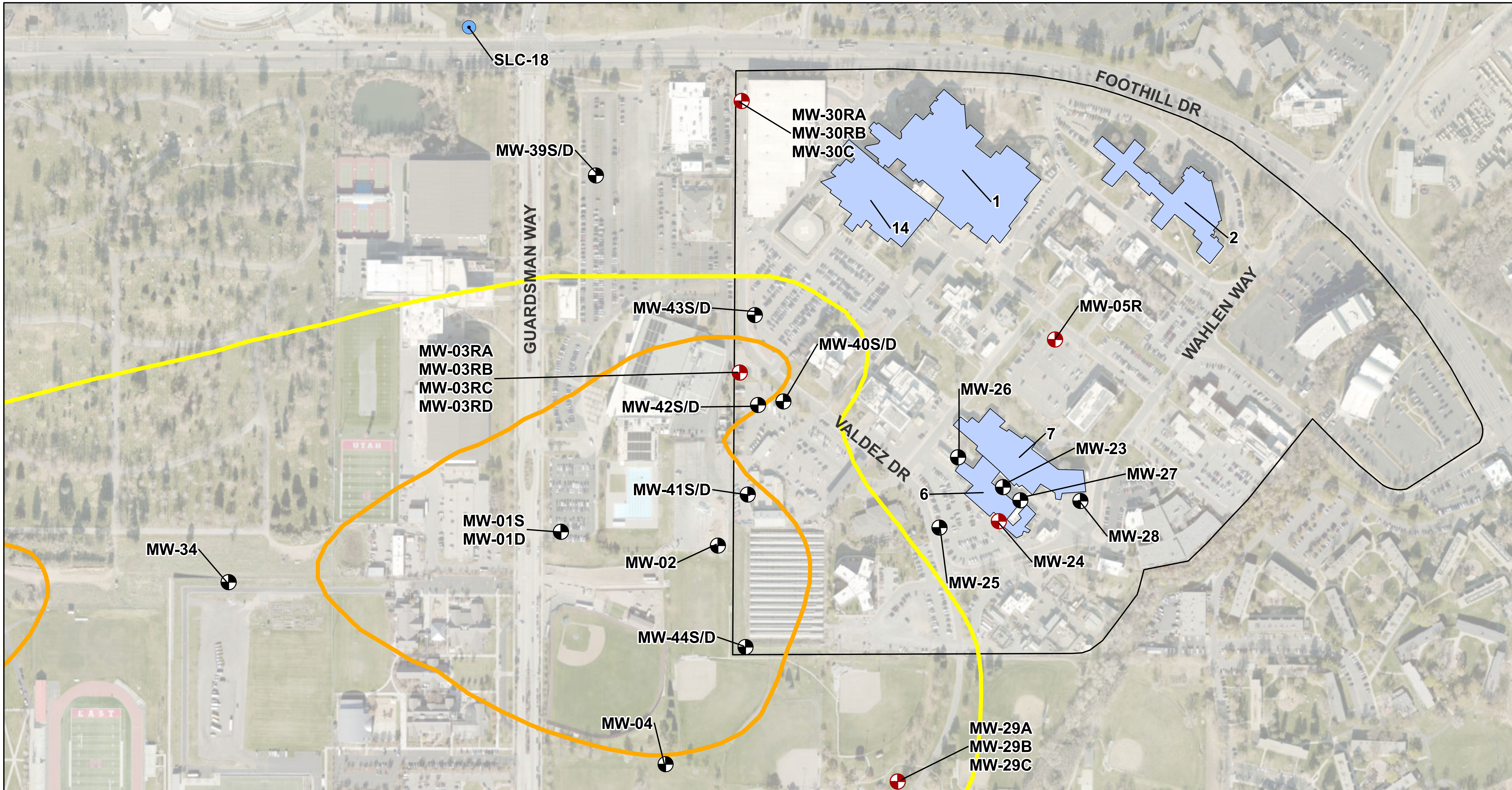
PCE = tetrachloroethene

Figure 1
Site Location Map

N

0 0.5 1 Miles

700 South 1600 East PCE Plume
Salt Lake City, Utah



Legend

- Drinking Water Supply Well
- Monitoring Well (MW)
- PFAS Sampling Location
- Veteran Affairs Medical Center Campus

PCE Isoconcentration Contours (data through November 2022)

Concentration

- 5 µg/L
- 50 µg/L

Notes
µg/L = micrograms per liter
PCE = tetrachloroethene
PFAS = per- and polyfluoroalkyl substances

N W E S

0 250 500 Feet

Figure 2
PFAS Sampling Locattions

700 South 1600 East PCE Plume
Salt Lake City, Utah