START2

Superfund Technical Assessment and Response Team 2 - Region VIII

United States
Environmental Protection Agency

Contract No. 68-W-00-118

FIELD SAMPLING PLAN
for FOCUSED SITE INSPECTION

CHEYENNE PCE PLUME (26th and Pioneer)
Cheyenne, Laramie County, Wyoming

TDD No. 0306-0006

August 21, 2003

START2 EPA REGION VIII

URS OPERATING SERVICES, INC.

In association with: Tetra Tech EM, Inc.
URS Corporation
LT Environmental, Inc.
TN & Associates, Inc.
TechLaw, Inc.

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1.0 INTRODUCTION

URS Operating Services, Inc. (UOS) has been tasked by the U.S. Environmental Protection Agency (EPA), Region VIII, to conduct a focused Site Inspection (SI) at the Cheyenne PCE Plume (26th & Pioneer) site in Cheyenne, Laramie County, Wyoming (Figure 1). Field work for this focused SI is projected to be completed during September 2003.

This Field Sampling Plan (FSP) is designed to guide field operations during the focused SI, and has been prepared in accordance with Technical Direction Document (TDD) #0306-0006, the EPA "Guidance for Performing Site Inspections Under CERCLA," Interim Final, September 1992, the "Region VIII Supplement to Guidance for Performing Site Inspections Under CERCLA" and the "UOS Generic Quality Assurance Project Plan" (URS Operating Services, Inc. (UOS) 2001a; U.S. Environmental Protection Agency (EPA) 1992; EPA 1993). The focused SI field work will include sampling and non-sampling data collection. The Superfund Technical Assessment and Response Team 2 (START2) will collect soil gas and groundwater samples. Sampling procedures will adhere strictly to those outlined in the UOS Technical Standard Operating Procedures (TSOPs) for field operations at hazardous waste sites (UOS 2000). Samples will be field screened for the presence of perchloroethylene (PCE) using a gas chromatograph/mass spectroscope (GC/MS) and a colorimetric method for volatile organic halides (VOH) that will detect PCE and other similar chlorinated organic materials at or above concentrations of 5 part per billion (ppb). Ten percent of all samples per matrix will be submitted to and analyzed through a private contracted laboratory for volatile organic compounds (VOC) analysis.

Site characterization samples will potentially include 22 soil gas samples, 22 groundwater screening samples. Three samples from each matrix will be submitted for confirmation laboratory analysis along with the following Quality Assessment/Quality Control (QA/QC) samples: two duplicate groundwater samples, one rinsate blank, and one VOC trip blank (per shipment) (in addition to the laboratory matrix spike/matrix spike duplicate (MS/MSD) (Table 1). The QA/QC samples will follow the requirements of the "Region VIII Supplement to Guidance for Performing Site Inspections under CERCLA" (EPA 1993).

2.0 OBJECTIVES

The specific objectives of this focused site investigation are to:

- Collect soil gas and groundwater samples to document a PCE groundwater plume and determine its source.

3.0 BACKGROUND INFORMATION

3.1 SITE LOCATION AND DESCRIPTION

The site area is located in downtown Cheyenne, Wyoming. The initial point of interest is the Safeway store located at 2512 Pioneer Avenue. This store is located on the block between 25th and 26th Streets to the north and south, and by Pioneer Avenue and Thomes Avenue to the east and west, respectively. The site's township and range location are the northwest quarter of Section 31, T. 14 N, R. 66 W. The site coordinates are 41.13963 North latitude and 104.82290 West longitude. Twelve adjacent residences are located at 2502, 2514, and 2522 Thomes Avenue; 508, 510, 512, 514, and 516 West 25th Street; and 509, 513, 515, and 517 West 26th Street in Cheyenne, Wyoming. These properties are a part of a proposed expansion area for the parking lot of the future replacement Safeway store. The twelve residences are located west of the Safeway store, across Thomes Avenue, between 25th and 26th Streets. An alley runs perpendicular to the Safeway store through the residential block (Environmental Resources Management (ERM) 2003b; ERM 2002).

3.2 SITE HISTORY AND PREVIOUS WORK

The area where the existing Safeway store and residences are located was developed as a residential area in the early 1900s. The area of the existing Safeway store in 1907 consisted of six residences, and by 1912, two additional residences were added. The twelve single and multiple family residences of concern were constructed either prior to 1907 or between 1907 and 1912 (ERM 2002).

From 1923 to at least 1931, a large outbuilding located west of 2502 Pioneer Avenue (formerly Eddy Avenue) contained an auto repair shop. Another large outbuilding located north of 508, 510, and 512 West 25th Street contained a planing mill with electrical motor maintenance. The existing Safeway store replaced the large outbuilding and ten residences prior to 1960. According to Mr. Houser, the current resident of 2502 Thomes Avenue, the planing mill building was removed in the 1990s. Like the auto repair shop, a planing mill would have used petroleum lubricating products during operations (ERM 2002).

An outbuilding located at 2502 Thomes Avenue contained an auto repair shop from at least 1931 to approximately 1938. In 1939, the auto repair shop was replaced by a printing press operated by the Houser family. The printing press operated from approximately 1939 to 1964. The linotype metal was melted and punched into type in the southern portion of the northern room in the outbuilding. The finished type was washed with kerosene to prepare the surface to receive the ink and to also remove the ink when the printing was finished. The lead type was then remelted and reused. Lead filings from the type fell between the wooden floorboards of the outbuilding (ERM 2002).

The adjacent properties and surrounding area have been primarily residential since the early 1900s. Two blocks east of the site is the Wyoming State Capitol, and four blocks south of the site property is the primary commercial area of Cheyenne (ERM 2002). The properties across 25th and 26th Streets, Pioneer Avenue, and O'Neil Avenue have consisted of residences, churches, and office buildings. These past uses are consistent with current uses (ERM 2002).

A Phase I Environmental Site Assessment, a Limited Subsurface Investigation, and data collection per a Draft Work Plan to Evaluate Potential Site Impact to Groundwater Quality and to Obtain a Decision for a Letter of No Further Action from the State of Wyoming were conducted by Environmental Restoration Management (ERM) in August 2002, January 2003, and May 2003, respectively (ERM 2002; ERM 2003a; ERM 2003b). Based on findings from the Phase I, ERM collected core samples and groundwater samples from temporary monitoring wells in October 2002. In December 2002, ERM collected additional deeper soil samples within two feet of the original locations of October 2002. The results of these sampling events can be found in the ERM document, "Limited Subsurface Investigation" (ERM 2003b). This investigation showed PCE contamination of the groundwater above the EPA drinking water quality standard. This information was forwarded to the Wyoming Department of Environmental Quality (WDEQ). Possible sources include historical print shops, dry cleaners, and automobile service stations within the proximity of the site. An active dry cleaning establishment is located at 501 Randall Avenue approximately three blocks north of the site. Higher PCE concentrations in the groundwater trend toward the east of the Safeway site (ERM 2003a).

3.3 SITE CHARACTERISTICS

3.3.1 Physical Geography

The site area is located at an elevation of approximately 6,085 feet above mean sea level (amsl). The existing Safeway store is approximately 40,000 square feet (ft^2). The surface topography of the subject property is relatively level and topographic relief across the site is one to two feet. The nearest surface water to the site is Crow Creek, which is located approximately 0.6 mile west of Safeway (Figure 1). Surface water drainage in the general vicinity of the site is toward the south (ERM 2002).

3.3.2 Geology

Cheyenne, Wyoming, is located in the High Plains section of the Great Plains physiographic province. The area has a high eastward-sloping surface that is underlain by Tertiary sediments. Structurally, the Cheyenne area lies on the northwest flank of the Denver Basin. The surface has a gently rolling topography of low to moderate relief that is cut by ephemeral and intermittent eastward flowing streams of the South Platte River drainage.

The thin surficial alluvial deposits in the Cheyenne area are underlain by Upper Tertiary sedimentary rocks of the Ogallala Formation. The Ogallala is of heterogeneous character, consisting of lenticular beds of sand and gravel deposited by braided streams, and of silt, clay, and thin limestone beds deposited in temporary lakes. The Ogallala varies from unconsolidated material to material that is well-cemented with calcium carbonate. Generally, topography where the Ogallala is exposed consists of rounded hills and shadowed valleys (UOS 2001b).

3.3.3 Hydrogeology

The Upper Tertiary regional aquifer system is the main source of drinking water in the Cheyenne area. The Upper Tertiary aquifers consist of the Ogallala Formation and the Arikaree Formation. The Ogallala Formation yields water more readily with its consolidated sand and gravel beds than the Arikaree Formation, which is primarily

sandstone. The hydraulic head in the High Plains aquifer system is greatest near Cheyenne. The water in this aquifer system moves eastward at an estimated average velocity of about one foot per day. Recharge enters the aquifer system as direct infiltration of precipitation and as seepage through beds of streams or from irrigated land (U.S. Geological Survey (USGS) 2003).

The depth to groundwater was between 10.4 feet and 16.6 feet below ground surface (bgs) and was estimated to flow to the south/southeast (ERM 2002). There are also perched groundwater features in the area. One area of perched groundwater was identified on the 2502 Thomes Avenue property. Sample location SWC-2 in this area contained an upper perched water zone at 10.4 feet bgs, as indicated by saturated silty sand at that interval and underlying non-saturated sandy clay. The subsurface soil at 2502 Thomes Avenue is interbedded and contains many clayey layers. The subsurface soil at sample location SWC-3 on the existing Safeway property is not interbedded and contains much more sand and gravel (ERM 2003b).

3.3.4 Hydrology

The Cheyenne PCE Plume site is on the northern edge of the Crow Creek alluvial floodplain. Crow Creek is a stream located approximately three quarters of a mile southwest of the site. (USGS 1978). Crow Creek is the largest stream in the area and originates in the Laramie Mountains in the extreme northeast corner of Laramie County. Crow Creek flows east toward Carpenter, Wyoming, then flows south to its confluence with the South Platte River, southwest of Greeley, Colorado (USGS 1972).

3.3.5 Meteorology

The climate in the Cheyenne area is characterized by low precipitation, low humidity, a high evapotranspiration rate, prevalent sunshine and wind, and a wide range of temperatures. The mean annual precipitation as totaled from the University of Delaware (UD) database is 16.93 inches. The net annual precipitation as calculated from precipitation and evapotranspiration data obtained from the UD database is 1.46 inches (University of

Delaware, Center for Climate Research, Department of Geography 1986). The 2-year, 24-hour rainfall event for this area is 1.5 inches (Dunne, Thomas and Luna B. Leopold 1978).

4.0 PRELIMINARY PATHWAY ANALYSIS

4.1 WASTE CHARACTERIZATION

Residences at 508, 510, 512, 514, and 516 West 25th Street and 2522 Thomes Avenue have conducted vehicle maintenance on their properties. ERM observed slight to moderate petroleum staining, approximately one to three feet in diameter on the unpaved driveways of the residences on West 25th Street. Moderate to heavy petroleum staining was observed on the unpaved soil adjacent to the garage at 2522 Thomes Avenue (ERM 2002).

The outbuilding located at 2502 Thomes Avenue contained an auto repair shop from at least 1923 to 1931 and was later replaced by a printing press operated by the Houser family. Mr. Houser stated that the floorboards of the auto repair shop, which his family converted to a printing shop, were heavily stained, and the Houser family painted the floorboards to cover the staining. Soils beneath the floorboards may have been impacted. The printing press used a lead-based linotype metal and printer's ink in their operations. The linotype metal was smelted and punched into type in the southern portion of the northern room in the outbuilding. The finished type was washed with kerosene. Lead filings from the type fell between the wooden floorboards of the outbuilding at 2502 Thomes Avenue (ERM 2002).

An active dry cleaning service that has used PCE in the past is located at 501 Randall Avenue, approximately three blocks north of the Safeway site.

Prior to 1960 two gasoline filling stations were located near 27th Street and Thomes Avenue. The Phase I also identified three out-of-service underground storage tanks (USTs) at 301 Randall Avenue (ERM 2002).

During the Limited Subsurface Investigation in October and December 2002, ERM collected groundwater and soil samples from soil borings from the property at 2502 Thomes and from the northwest corner of the existing Safeway property. Lead, petroleum related constituents, and

solvent-related constituents were detected only in the shallow soil samples collected from the 2502 Thomes Avenue property. The detection values for PCE and trichloroethylene (TCE) ranged from 25 ppb to 150 ppb in the three temporary groundwater wells, including the "upgradient" well, at 2502 Thomes Avenue. The EPA drinking water maximum contaminant level (MCL) standard for PCE is 5 ppb. One of the groundwater samples collected from beneath the former print shop on the 2502 Thomes Avenue property slightly exceeded the WDEQ Quality Standards for Wyoming Groundwaters, Underground Water Class I Domestic Use standard for total lead (50 micrograms per liter (µg/L)) with a detection of 52 µg/L (ERM 2002). This information was reported to the WDEQ, and subsequently six temporary wells were installed at the site and sampled. All of the samples collected from these six temporary wells exceeded the EPA standard (5 µg/L) for PCE and TCE. PCE levels increased in the north/northeast direction. One sample in an "upgradient" area in the far north corner of the site contained PCE at 198.7 ppb and the sample collected farthest to the east contained PCE at 275.3 ppb. Based upon the historical information in ERM's Phase I, combined with the analytical data from subsequent investigations, there does not appear to be an on-site source of PCE. The possible source(s) of PCE are upgradient of the site and possibly to the northeast as indicated by the groundwater sample analytical results (ERM 2003a).

4.2 GROUNDWATER PATHWAY

This site consists of an undefined PCE groundwater plume of unknown origin. No other environmental pathways will be investigated during this focused SI.

According to the Cheyenne Board of Public Utilities (CBOPU) municipal water is supplied to the area located near the existing Safeway. This municipal system uses groundwater as a supplement to the surface water supply for the drinking water system. The blend is approximately 25-30% groundwater and 70 -75 % surface water. The wells used by CBOPU are all publicly owned municipal wells and serve approximately 53,000 main customers. In addition, they supply a few other smaller systems that add 10,000 to 13,000 more users. The municipal well field is located upgradient of the site, approximately five miles to the northwest (Cheyenne Board of Public Utilities (CBOPU) 2003).

A review of the Wyoming State Engineers database for the wells located in Section 31of T. 14 W. and R. 66 N. indicates that there are 105 wells within this one-square-mile area. Two of the wells

are listed for domestic use. Both are located at least one-half mile away from the site toward the east and the southeast. The remaining wells in the database are used as observation and monitoring wells, many of which appear to be part of the groundwater monitoring requirements for the UST program. There are no wells listed for the quarter/quarter section in which the site is located.

5.0 FIELD PROCEDURES

5.1 CONCEPT OF OPERATIONS

5.1.1 Schedule

Field work is scheduled for September 2003. Sampling is estimated to be completed in less than two weeks dependent upon the actual number of sample locations utilized. Non-sampling data collection will be performed as appropriate (Table 2).

5.1.2 Safety

All field activities will be conducted in strict accordance with an approved UOS Site Health and Safety Plan, which will be developed before the start of field activities. It is anticipated that all field work can be accomplished in Level D personal protective equipment.

5.1.3 Site Access and Logistics

UOS will obtain site access with the assistance, if necessary, of the EPA Region VIII Site Assessment Manager for this site. UOS will need written consent only from the city of Cheyenne prior to the field sampling event because it is anticipated that all sampling activities will be conducted in city of Cheyenne rights-of-way.

5.2 SAMPLE LOCATIONS

This focused SI involves the collection of 44 field samples (Figure 2) (Tables 1 and 3). These samples will initially include 22 soil gas samples and 22 groundwater for screening purposes. Ten percent of the field samples will be submitted to a laboratory for confirmation of the screening

sample results. Based on the screening results from groundwater collected from these locations, the dimensions and direction of the contaminant plume will be determined. More sampling locations may be added to further delineate the plume. All sample points will be located on a site map with a Global Positioning System (GPS) device after sample collection. This procedure will allow documentation of changes in sample locations as they occur in the field due to unanticipated site conditions.

Sampling strategy will utilize the gridded layout of the streets in the immediate Cheyenne area. Samples will be collected from the existing alleyways and the area between the sidewalk and the curb (boulevard parkway) that are city property. The initial 12 samples will be collected from the next ring of city blocks surrounding the existing Safeway store and residences proposed for purchase. This will include 24th Street, 27th Street, Bent Avenue, and Carey Avenue. The next set of 10 samples will be collected from the area near the existing dry cleaners at 501 Randall Ave. and include locations along 28th Street and 29th Street.

Because of the large number of samples that may be collected during this focused SI, the following sample identification system will be used: Sample IDs will start with the designation "CP" to indicate the Cheyenne PCE Plume project. This will be followed by a two-character matrix identifier (either "GW" for groundwater or "SG" for soil gas). This will be followed by six or seven characters that identify the cross streets. Hence, CP-GW-28PION would identify the groundwater sample collected at the intersection of 28th Street and Pioneer Avenue. The designation CP-SG-27.5RAND would identify the soil gas sample collected at the alley between 27th Street and 28th Street at Randall Avenue.

5.3 SAMPLING METHODS

Geoprobe® groundwater and soil gas sampling will be conducted according to those procedures outlined in UOS TSOP 4.12, "Groundwater Sampling" and UOS TSOP 4.19, "Soil Gas Sampling," and methods outlined in the Geoprobe® Systems Operations Manual (UOS 2000; Kejr Engineering 1990). All sample locations will be photographed and documented in accordance with the procedures outlined in UOS TSOP 4.5, "Sample Location Documentation" (UOS 2000) Additionally all Geoprobe® sample locations will be identified with a GPS instrument. Depth to groundwater will be estimated from the ground surface at each location using a groundwater level

indicator. Measurements will be taken every two minutes until three consecutive readings within 0.1 foot are obtained.

Sampling will begin after the identification of the locations of any existing underground utilities. The Geoprobe® drive rods will be threaded together and a retractable drive point will be attached. They will be advanced to the desired depth and then retracted approximately six inches to open the retractable tip and create a small void at the end of the rods to allow the movement of soil gas. The soil around the top of the drive rods will be compressed to prevent movement of ambient air down along the annular space created by the drive rods. The drive cap on the top drive rod will be removed and an appropriate length of rigid tubing with a PRT (post run tubing) fitting on the end will be placed into the hollow drive rod string and threaded into the top end of the retractable tip. This will ensure that the soil gas being collected is from the end of the retractable tip and not any ambient air from the inside of the drive rods. A soil gas monitoring devise will be attached to the top end of the rigid tubing and the pump turned on to draw out the ambient air from the inside of the tubing. The monitoring device should indicate the presence of the soil gas to be sampled after approximately three quarters of a liter of air is drawn. Once soil gas monitoring measurements are taken the tubing will be closed off and the monitoring device will be removed. The end of the rigid tubing will be attached to Tedlar bag through an opening in a vacuum chamber used to fill the bag. When the chamber is sealed and a vacuum has been created inside by using a vacuum line on the Geoprobe®, soil gas will be drawn through the tubing into the Tedlar bag to replace the air removed from the chamber. The Tedlar bag will be filled with a representative amount of soil gas for screening purposes. This method ensures that only soil gas will be collected in the bag and not diluted with any ambient air.

Soil gas screening samples will be collected at eight feet bgs. This will provide information for potential soil gas vapors that may enter homes through cracks in the basement side walls or floors.

After collection of the soil gas sample at eight feet bgs, the rods will be advanced at three-foot intervals to determine the level of the groundwater at the sampling location since there is evidence that there may be some perched groundwater within the area of the investigation. After each length of drive rod is advanced the drilling string will be retracted six inches to open the retractable tip. A water level indicator probe will be lowered into the hollow drive rods to detect the presence of water.

Once depth to groundwater is determined the soil gas sampling string will be pulled from the ground and a screen point groundwater sampler attached. The screen point sampler and the drive rod string will be pushed approximately three feet deeper than the estimated depth to groundwater and then pulled back three feet to expose the wire-wound stainless steel screen that remains at the bottom of the advanced depth. Tubing will then be inserted into the drive rods and screen and attached to a peristaltic pump. The peristaltic pump will be used to slowly purge the groundwater in the screened interval and a groundwater sample will be collected into the appropriate containers. Standard groundwater parameters of temperature, pH, and conductivity will also be recorded.

All reusable equipment will be thoroughly decontaminated prior to its next use. A rinsate sample will be collected each day that this equipment is used and screened for the presence of PCE to document and ensure that the decontamination procedure is effective.

5.4 CONTROL OF CONTAMINATED MATERIALS

Investigation-derived waste (IDW) generated during the focused SI will be handled in accordance with UOS TSOP 4.8, "Investigation Derived Waste Management," and the OERR Directive 9345.3-02, "Management of Investigation Derived Waste During Site Inspections," May 1991 (EPA 1991; UOS 2000).

5.5 ANALYTICAL PARAMETERS

Table 3, the Sample Plan Checklist, lists all sample parameters. All samples sent to the laboratory will be analyzed for VOCs (Table 3).

Soil gas and groundwater samples will be screened in the field for PCE concentrations. Soil gas will be analyzed initially using a Hapsite (a field portable GC/MS). This instrument will separate and identify the individual organic vapors in the soil gas to 1 ppb concentration. Ten percent of the soil gas samples will be sent to a laboratory for volatile organic analysis. These will be from locations that will be selected to be re-sampled for soil gas due to possible breakdown of the vapors caused by exposure to sunlight, higher ambient air temperatures, and lower sample volume in the Tedlar bags following the sample screening technique. The soil gas samples to be sent to the laboratory for analysis will be collected using the same technique but will be collected in Summa canisters rather

than Tedlar bags. Each Summa canister is already under vacuum and will be attached directly to the sample tubing to draw the required amount of soil gas into the canister.

The Hapsite will also be used to screen the groundwater samples. Since the Hapsite can be used only for gasses and vapors, a method will be used in which the groundwater is heated releasing volatile components into the head space of a sample preparation vial. The gasses and vapors in the head space can then be drawn into the Hapsite and analyzed.

Groundwater will be initially screened using an "SDI Quickcheck" VOH Water Test Kit that will detect the presence of VOHs at a level as low as 5 ppb and as high as 2000 ppb. (See Appendix A). The screening test method is based on a photochemical reaction that produces color proportional to the concentration of the contaminants in water. It does not provide a specific concentration for each VOH but rather gives a measurement of total VOHs in the water. Other common VOHs that may be detected are trichloroethylene (TCE), trihalomethanes, and carbon tetrachloride. The method will indicate whether there are VOHs in the groundwater and can be used to track a contaminant plume. Ten percent of the groundwater samples will be sent to a laboratory for VOCs analysis to identify the individual contaminant constituents.

6.0 FIELD QUALITY CONTROL PROCEDURES

All samples will be handled and preserved as described in UOS TSOP 4.2, "Sample Containers, Preservation and Maximum Holding Times." Calibration of the pH, temperature, and conductivity meters will follow instrument manufacturers' instruction manuals and UOS TSOP 4.14, "Water Sample Field Measurements."

All sampling equipment will be decontaminated prior to initial use. All non-disposable sampling equipment will be decontaminated after the collection of each sample in accordance with UOS TSOP 4.11, "Equipment Decontamination." Basic decontamination will consist of washing or brushing gross particulate off sampling equipment with tap water and a scrub brush, followed by washing equipment with a solution of Liquinox® and water, rinsing with distilled water, rinsing with methanol, and finally rinsing with distilled water. After decontamination, the equipment will be allowed to gravity drain and then will be wrapped in aluminum foil to minimize potential contamination (UOS 2000).

The following samples will be collected to evaluate quality assurance at the site in accordance with the "Guidance for Performing Site Inspections under CERCLA," Interim Final September 1992, the "Region VIII Supplement to Guidance for Performing Site Inspections under CERCLA," and the "UOS Generic Quality Assurance Project Plan" (UOS 2001a; EPA 1992; EPA 1993):

- One rinsate blank for the groundwater matrix will be collected for the site;
- One trip blank for VOC analyses for groundwater per shipment will be collected for the site;
- One duplicate aqueous sample per set of 20 aqueous samples collected. One will be required for this site; and
- One triple volume sample to be used for a MS/MSD for the groundwater matrix (the triple volume sample will not be counted as a separate sample).

In addition, a rinsate blank will be collected on a daily basis and analyzed using the field screening technique to verify that the decontamination procedures are effective for the non-disposable equipment such as the Geoprobe® well screen and drive rods.

Field duplicates for the screening methods will be run at a rate of 1 per 20 samples to verify analytical precision.

The "UOS Generic Quality Assurance Project Plan" serves as the primary guide for the integration of QA/QC procedures for the Superfund Technical Assessment Response Team (START) contract (UOS 2001a).

7.0 CHAIN OF CUSTODY

After sample collection and identification, all samples will be handled in strict accordance with the chain-of-custody protocol specified in UOS TSOP 4.3, "Chain of Custody" (UOS 2000).

8.0 DATA REDUCTION, VALIDATION, AND REPORTING

UOS will prepare a draft Sampling Activities Report (SAR) by November 25, 2003, as per the TDD for this project. An Analytical Results Report (ARR) is scheduled to be submitted by December 20, 2003, as per the TDD for this project. Data validation will be conducted by EPA Region VIII or a UOS contracted validator. The SAR and ARR will conform to the "Guidance for Performing Site Inspections under CERCLA," Interim Final September 1992 and the "Region VIII Supplement to Guidance for Performing Site Inspections under CERCLA" (EPA 1992; EPA 1993).

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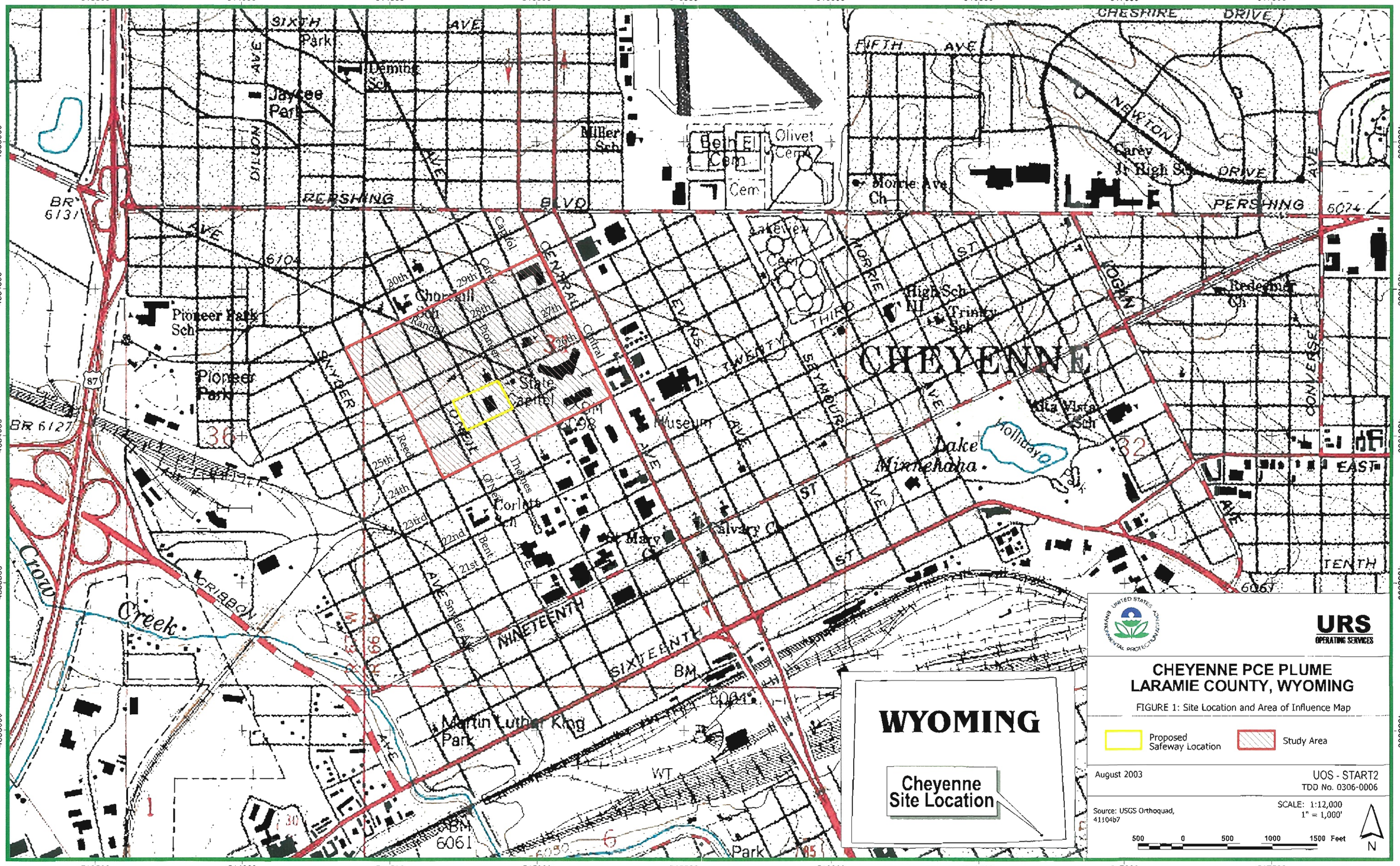

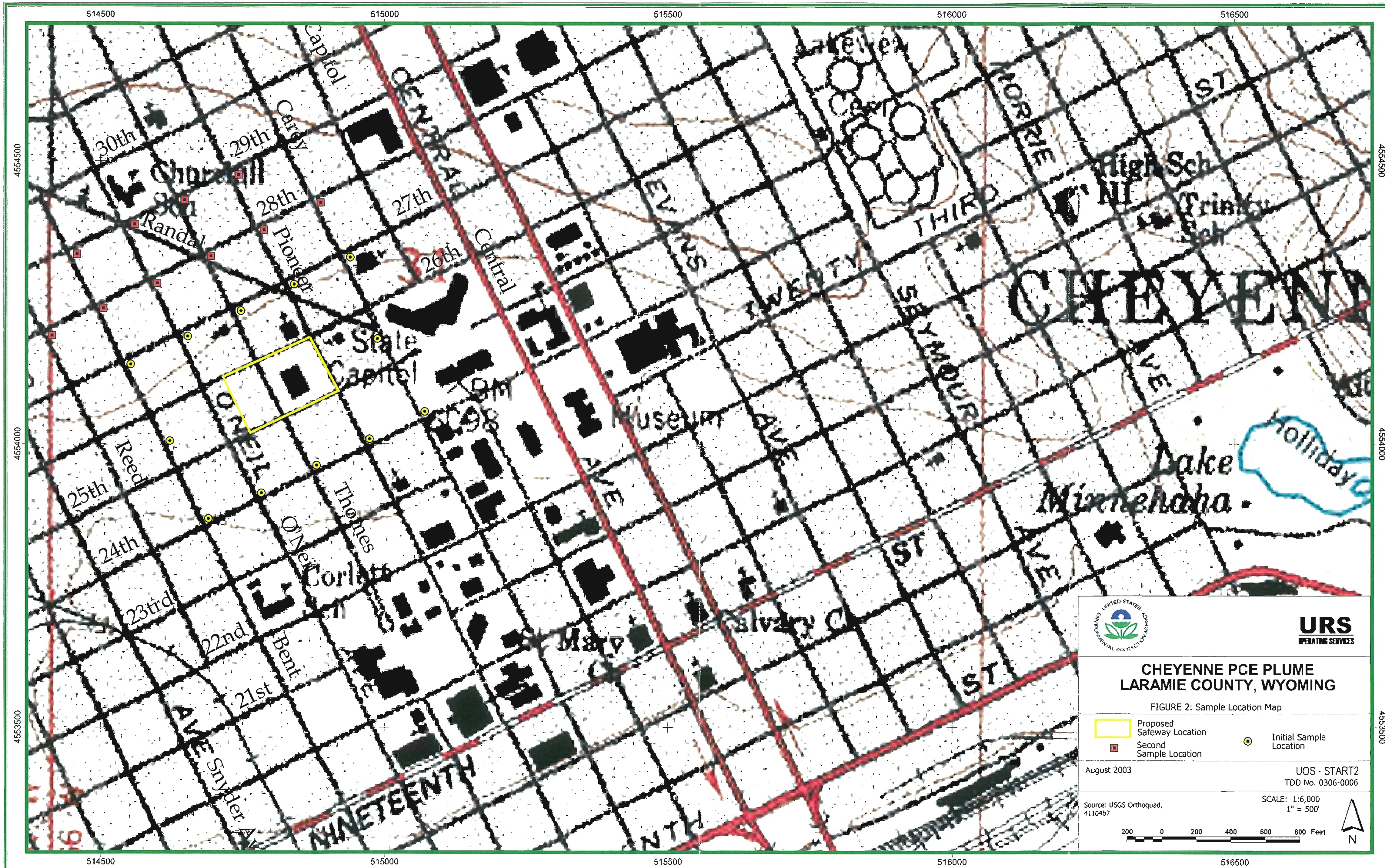

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Museum
Corlett
St Mary
Calvary
High Sch
Trinity
CHEYENNE
Lake Minnehaha
Holliday
NINETEENTH
THIRD
SEYMOUR
EVANS
MORRIE
AVE
ST
URS
OPERATING SERVICES
CHEYENNE PCE PLUME
LARAMIE COUNTY, WYOMING
FIGURE 2: Sample Location Map
Proposed Safeway Location
Second Sample Location
Initial Sample Location
August 2003
UOS - START2
TDD No. 0306-0006
Source: USGS Orthoquad, 41104b7
SCALE: 1:6,000
1" = 500'
200 0 200 400 600 800 Feet
N

TABLE 1
Sample Locations and Rationale

Matrix	Sample #	Location	Rationale
Geoprobe® Soil Gas	CP-SG-25.5BENT	Collected from the alleyway between 25th and 26th Streets at Bent Avenue.	Characterize PCE contaminants in the soil gas above the potential contaminant plume.
	CP-SG-24BENT	Collected from the boulevard parkway at 24th Street on Bent Avenue.	Characterize PCE contaminants in the soil gas above the potential contaminant plume.
	CP-SG-24ONEI	Collected from the boulevard parkway on 24th Street at O'Neil Avenue.	Characterize PCE contaminants in the soil gas above the potential contaminant plume.
	CP-SG-24THOM	Collected from the boulevard parkway on 24th Street at Thomes Avenue.	Characterize PCE contaminants in the soil gas above the potential contaminant plume.
	CP-SG-24PION	Collected from the boulevard parkway on 24th Street at Pioneer Avenue.	Characterize PCE contaminants in the soil gas above the potential contaminant plume.
	CP-SG-24CARE	Collected from the boulevard parkway on24th Street at Carey Avenue.	Characterize PCE contaminants in the soil gas above the potential contaminant plume.
	CP-SG-25.5CARE	Collected from the alleyway on Carey Avenue between 25th and 26thStreets.	Characterize PCE contaminants in the soil gas above the potential contaminant plume.
	CP-SG-27CARE	Collected from the boulevard parkway on 27th Street at Carey Avenue.	Characterize PCE contaminants in the soil gas above the potential contaminant plume.
	CP-SG-27PION	Collected from the boulevard parkway on 27th Street at Pioneer Avenue.	Characterize PCE contaminants in the soil gas above the potential contaminant plume.
	CP-SG-27THOM	Collected at the boulevard parkway on 27th Street at Thomes Avenue.	Characterize PCE contaminants in the soil gas above the potential contaminant plume.
	CP-SG-27ONEI	Collected from the boulevard parkway on 27th Street at O'Neil Avenue.	Characterize PCE contaminants in the soil gas above the potential contaminant plume.
	CP-SG-27BENT	Collected from the boulevard parkway on 27th Street at Bent Avenue.	Characterize PCE contaminants in the soil gas above the potential contaminant plume.

TABLE 1
Sample Locations and Rationale
(continued)

Matrix	Sample #	Location	Rationale
Geoprobe® Soil Gas (continued)	CP-SG-28REED	Collected from the boulevard parkway on Reed Avenue at 28th Street.	Characterize PCE contaminants in the soil gas above the potential contaminant plume.
	CP-SG-28BENT	Collected from the boulevard parkway on Bent Avenue at 28th Street.	Characterize PCE contaminants in the soil gas above the potential contaminant plume.
	CP-SG-28ONEI	Collected from the boulevard parkway on O'Neil Avenue at 28th Street.	Characterize PCE contaminants in the soil gas above the potential contaminant plume.
	CP-SG-28THOM	Collected from the boulevard parkway on Thomes Avenue at28th Street.	Characterize PCE contaminants in the soil gas above the potential contaminant plume.
	CP-SG-28PION	Collected from the boulevard parkway on Pioneer Avenue at 28th Street.	Characterize PCE contaminants in the soil gas above the potential contaminant plume.
	CP-SG-28CARE	Collected from the boulevard parkway on Carey Avenue at 28th Street.	Characterize PCE contaminants in the soil gas above the potential contaminant plume.
	CP-SG-29PION	Collected from the boulevard parkway on Pioneer Avenue at 29thStreet.	Characterize PCE contaminants in the soil gas above the potential contaminant plume.
	CP-SG-29THOM	Collected from the boulevard parkway on Thomes Avenue at 29th Street.	Characterize PCE contaminants in the soil gas above the potential contaminant plume.
	CP-SG-29ONEI	Collected from the boulevard parkway on O'Neil Avenue at 29th Street.	Characterize PCE contaminants in the soil gas above the potential contaminant plume.
	CP-SG-29BENT	Collected from the boulevard parkway on Bent Avenue at 29th Street.	Characterize PCE contaminants in the soil gas above the potential contaminant plume.
Geoprobe® Groundwater	CP-GW-25.5BENT	Collected from the alleyway between 25th and 26th Streets at Bent Avenue.	Characterize PCE in the potential groundwater plume.
	CP-GW-24BENT	Collected from the boulevard parkway at 24th Street on Bent Avenue.	Characterize PCE in the potential groundwater plume.

TABLE 1
Sample Locations and Rationale
(continued)

Matrix	Sample #	Location	Rationale
Geoprobe® Groundwater (continued)	CP-GW-24ONEI	Collected from the boulevard parkway on 24th Street at O'Neil Avenue.	Characterize PCE in the potential groundwater plume.
	CP-GW-24THOM	Collected from the boulevard parkway on 24th Street at Thomes Avenue.	Characterize PCE in the potential groundwater plume.
	CP-GW-24PION	Collected from the boulevard parkway on 24th Street at Pioneer Avenue.	Characterize PCE in the potential groundwater plume.
	CP-GW-24CARE	Collected from the boulevard parkway on24th Street at Carey Avenue.	Characterize PCE in the potential groundwater plume.
	CP-GW-25.5CARE	Collected from the alleyway on Carey Avenue between 25th and 26thStreets.	Characterize PCE in the potential groundwater plume.
	CP-GW-27CARE	Collected from the boulevard parkway on 27th Street at Carey Avenue.	Characterize PCE in the potential groundwater plume.
	CP-GW-27PION	Collected from the boulevard parkway on 27th Street at Pioneer Avenue.	Characterize PCE in the potential groundwater plume.
	CP-GW-27THOM	Collected at the boulevard parkway on 27th Street at Thomes Avenue.	Characterize PCE in the potential groundwater plume.
	CP-GW-27ONEI	Collected from the boulevard parkway on 27th Street at O'Neil Avenue.	Characterize PCE in the potential groundwater plume.
	CP-GW-27BENT	Collected from the boulevard parkway on 27th Street at Bent Avenue.	Characterize PCE in the potential groundwater plume.
	CP-GW-28REED	Collected from the boulevard parkway on Reed Avenue at 28th Street.	Characterize PCE in the potential groundwater plume.
	CP-GW-28BENT	Collected from the boulevard parkway on Bent Avenue at 28th Street.	Characterize PCE in the potential groundwater plume.

TABLE 1
Sample Locations and Rationale
(continued)

Matrix	Sample #	Location	Rationale
Geoprobe® Groundwater (continued)	CP-GW-28ONEI	Collected from the boulevard parkway on O'Neil Avenue at 28th Street.	Characterize PCE in the potential groundwater plume.
	CP-GW-28THOM	Collected from the boulevard parkway on Thomes Avenue at28th Street.	Characterize PCE in the potential groundwater plume.
	CP-GW-28PION	Collected from the boulevard parkway on Pioneer Avenue at 28th Street.	Characterize PCE in the potential groundwater plume.
	CP-GW-28CARE	Collected from the boulevard parkway on Carey Avenue at 28th Street.	Characterize PCE in the potential groundwater plume.
	CP-GW-29PION	Collected from the boulevard parkway on Pioneer Avenue at 29thStreet.	Characterize PCE in the potential groundwater plume.
	CP-GW-29THOM	Collected from the boulevard parkway on Thomes Avenue at 29th Street.	Characterize PCE in the potential groundwater plume.
	CP-GW-29ONEI	Collected from the boulevard parkway on O'Neil Avenue at 29th Street.	Characterize PCE in the potential groundwater plume.
	CP-GW-29BENT	Collected from the boulevard parkway on Bent Avenue at 29th Street.	Characterize PCE in the potential groundwater plume.
QA/QC	CP-GW-16REED	Duplicate of sample CP-GW-27CARE.	Document the precision of sample collection procedures and laboratory analysis.
	CP-GW-16CAPI	Duplicate of sample CP-GW-28THOM.	Document the precision of sample collection procedures and laboratory analysis.
	CP-GW-16BENT	Rinsate Blank.	Document thoroughness of decontamination process in the field.
	CP-GW-16ONEI	VOC Trip Blank.	Document potential for VOC contamination via transport.

TABLE 2
Non-Sampling Data Collection Rationale

Data Element	Data Collection Strategy and Rationale
Groundwater Exposure Pathway	Locate residences in the site area that may have unregistered shallow aquifer wells used for irrigation purposes. These may be designated with small signs in the yards that indicate that because of the watering restrictions in Cheyenne due to drought conditions that they are using a private water supply to irrigate their lawns as opposed to using the restricted municipal water. These locations may be used for future groundwater sampling locations.

TABLE 3
Sample Plan Checklist

Sample Location	Sample Type	Field Parameters			Analysis	Quality Control Samples		
		Temp	pH	Cond	VOC	Dup	Spike	Blank
CP-SG-25.5BENT	Soil Gas				X			
CP-SG-24BENT	Soil Gas				X			
CP-GW-24ONEI	Soil Gas				X			
CP-GW-24THOM	Soil Gas				X			
CP-GW-24PION	Soil Gas				X			
CP-GW-24CARE	Soil Gas				X			
CP-GW-25.5CARE	Soil Gas				X			
CP-GW-27CARE	Soil Gas				X			
CP-GW-27PION	Soil Gas				X			
CP-GW-27THOM	Soil Gas				X			
CP-GW-27ONEI	Soil Gas				X			
CP-SG-27BENT	Soil Gas				X			
CP-SG-28REED	Soil Gas				X			
CP-SG-28BENT	Soil Gas				X			
CP-SG-28ONEI	Soil Gas				X			
CP-SG-28THOM	Soil Gas				X			
CP-SG-28PION	Soil Gas				X			
CP-SG-28CARE	Soil Gas				X			

TABLE 3
Sample Plan Checklist
(continued)

Sample Location	Sample Type	Field Parameters			Analysis	Quality Control Samples		
		Temp	pH	Cond	VOC	Dup	Spike	Blank
CP-SG-29PION	Soil Gas				X			
CP-SG-29THOM	Soil Gas				X			
CP-SG-29ONEI	Soil Gas				X			
CP-SG-29BENT	Soil Gas				X			
CP-GW-25.5BENT	Groundwater	X	X	X	X			
CP-GW-24BENT	Groundwater	X	X	X	X			
CP-GW-24ONEI	Groundwater	X	X	X	X			
CP-GW-24THOM	Groundwater	X	X	X	X			
CP-GW-24PION	Groundwater	X	X	X	X			
CP-GW-24CARE	Groundwater	X	X	X	X			
CP-GW-25.5CARE	Groundwater	X	X	X	X			
CP-GW-27CARE	Groundwater	X	X	X	X			
CP-GW-27PION	Groundwater	X	X	X	X			
CP-GW-27THOM	Groundwater	X	X	X	X			
CP-GW-27ONEI	Groundwater	X	X	X	X			
CP-GW-27BENT	Groundwater	X	X	X	X			
CP-GW-28REED	Groundwater	X	X	X	X			
CP-GW-28BENT	Groundwater	X	X	X	X			

TABLE 3
Sample Plan Checklist
(continued)

Sample Location	Sample Type	Field Parameters			Analysis	Quality Control Samples		
		Temp	pH	Cond	VOC	Dup	Spike	Blank
CP-GW-28ONEI	Groundwater	X	X	X	X			
CP-GW-28THOM	Groundwater	X	X	X	X			
CP-GW-28PION	Groundwater	X	X	X	X			
CP-GW-28CARE	Groundwater	X	X	X	X			
CP-GW-29PION	Groundwater	X	X	X	X			
CP-GW-29THOM	Groundwater	X	X	X	X			
CP-GW-29ONEI	Groundwater	X	X	X	X			
CP-GW-29BENT	Groundwater	X	X	X	X			
CP-GW-16REED	Groundwater Duplicate of CP-GW-27CARE	X	X	X	X	X	X	
CP-GW-16CAPI	Groundwater Duplicate of CP-GW-28THOM	X	X	X	X	X		
CP-GW-16BENT	Rinsate Blank				X			X
CP-GW-16ONEI	VOC Trip Blank				X			X

TABLE 4
Field Screening Samples
Sample Container Types, Volumes, and Sample Preservation

Sample Matrix	Analysis	Analytical Method Number *	Required Detection Limits[1]	Units	Container Number and Type[2]	Required Volume[3]	Preservation[3]	Technical Holding Time[4]
Groundwater	VOC	Hapsite	1	µg/L	1 - AGV	40 mL	Cool to 4° C	14 days
Soil Gas	VOC	Hapsite	1	µg/L	1 Tedlar Bag	1 Liter	Cool to 4° C	24 hours

1 Detection limits are presented in this table as ranges. Values are based on method specifications and on project DQOs.
2 Recommended container types: AGV = amber glass vial; HDPE = high density polyethylene bottle and cap; AGB - amber glass bottle.
3 Preserve the samples as soon as they are collected. Add required preservatives to filtered samples following filtration. Completely fill containers used for volatile organic samples, permitting no head space.
4 Technical holding time is the time interval from sample collection until sample analysis (or until sample extraction for semivolatile compounds). Technical holding times are determined by method and by matrix.

TABLE 5
Laboratory Samples
Sample Container Types, Volumes, and Sample Preservation

Sample Matrix	Analysis	Analytical Method Number *	Required Detection Limits[1]	Units	Container Number and Type[2]	Required Volume[3]	Preservation[3]	Technical Holding Time[4]
Groundwater	VOC	CLP SOW OLC02.1	1	µg/L	4 - AGV	40 mL	Cool to 4° C; HCl to pH <2	14 days
Soil Gas	VOC	EPA Method TO-15	1	ppbv	1 Summa Canister	6 Liters	None	14 days

1 Detection limits are presented in this table as ranges. Values are based on method specifications and on project DQOs.
2 Recommended container types: AGV = amber glass vial; HDPE = high density polyethylene bottle and cap; AGB - amber glass bottle.
3 Preserve the samples as soon as they are collected. Add required preservatives to filtered samples following filtration. Completely fill containers used for volatile organic samples, permitting no head space.
4 Technical holding time is the time interval from sample collection until sample analysis (or until sample extraction for semivolatile compounds). Technical holding times are determined by method and by matrix.

APPENDIX A

SDI Quickcheck Manual

SDI Quick™

TABLE OF CONTENTS

SDI Quick™

Water Analysis Procedure for Volatile Organic Halides

Including: Trichloroethylene (TCE),Perchloroethylene (PCE), Trihalomethanes (THMs), and Carbon Tetrachloride (CCl_4)

IMPORTANT

Read all instructions and handling guidelines before using this kit.

INTENDED USE

The SDI Quick™ Volatile Organic Halides (VOH) Water Test Kit for on-site and laboratory analysis is designed to give the user quick, reliable screening results for environmental decision making. The SDI Quick™ VOH Water Test Kit can be used for site characterization and mapping, ground water monitoring, selecting samples for laboratory analysis, and monitoring remediation processes.

INTRODUCTION (PRINCIPLE)

The SDI Quick™ VOH Water Test method is based on a photochemical reaction that produces coloration proportional to the concentration of the contaminant in water. A water sample is taken and mixed with a solvent to extract the analyte from the sample. Teflon® Tape is used in the extraction process to separate the extraction solvent from the water sample and minimize analyte volatilization. The Teflon Tape is removed and the extraction solvent containing the analyte is forced from the Teflon Tape, cleaned up, and mixed with a color reagent. The reagent-analyte complex is then exposed to ultraviolet (UV) light.

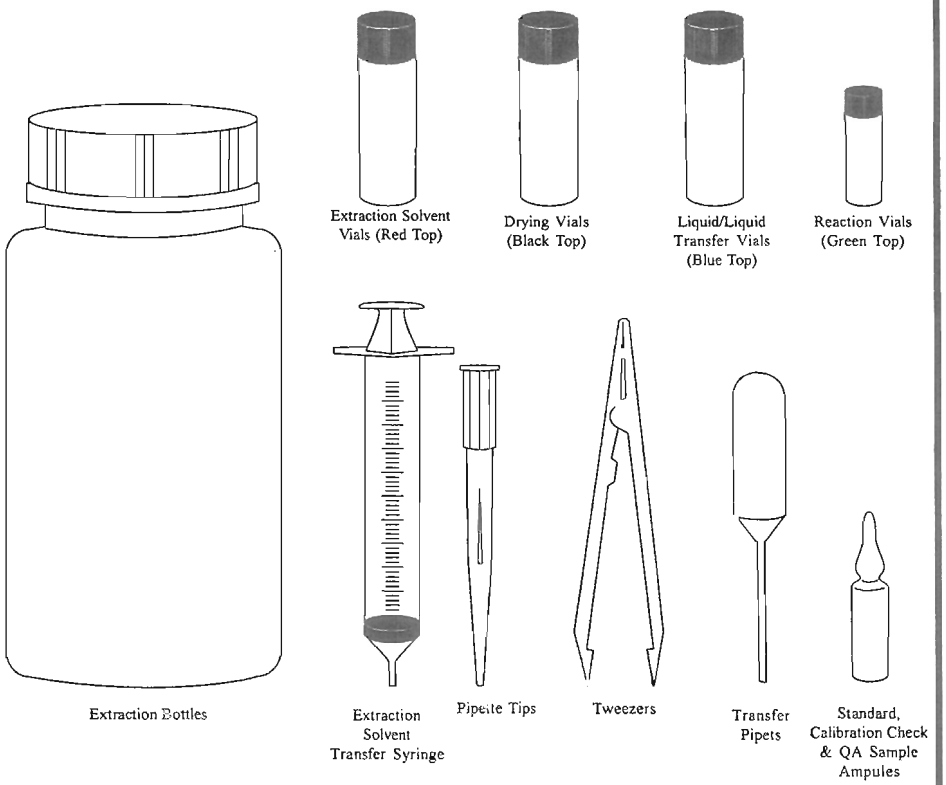
The Envirometer™ is used to both expose the sample to UV light and measure the absorbance produced by the reagent-analyte complex. The absorbance is compared to an internal standard curve that is stored electronically within the instrument. The concentration of the analyte in the sample is then displayed in ug/L or parts per billion (ppb). **Note: If multiple organic halides are present in the water sample the result will be a total of all organic halides.** Optimal agreement with a standard method is obtained by establishing a correlation between the SDI Quick™ VOH Water Test Kit and standard methods.

Standard solutions and calibration checks are provided with each Test Kit to ensure that quality control standards are met. The standard curve for the instrument should be established at the beginning of each testing period. The SDIQuick VOH Water Test Kit standard curve can be set and checked with the Trichloroethylene (TCE) standards supplied with the kit.

TEST KIT DESCRIPTION

The SDIQuick VOH Water Test Kit contains the components needed for the analysis of 10 water samples, two standard curve sets, two QA samples, and two Calibration Checks. Results obtained using the method are quantitative.

Materials Provided:
The following is a diagram and description of the components included in this test kit:



ACCESSORIES SUPPLIED BY USER:

- Timing device (minutes).
- Weigh boats.
- Safety gloves.
- Safety glasses.
- The Envirometer instrument.
- A permanent marker.

STORAGE & STABILITY

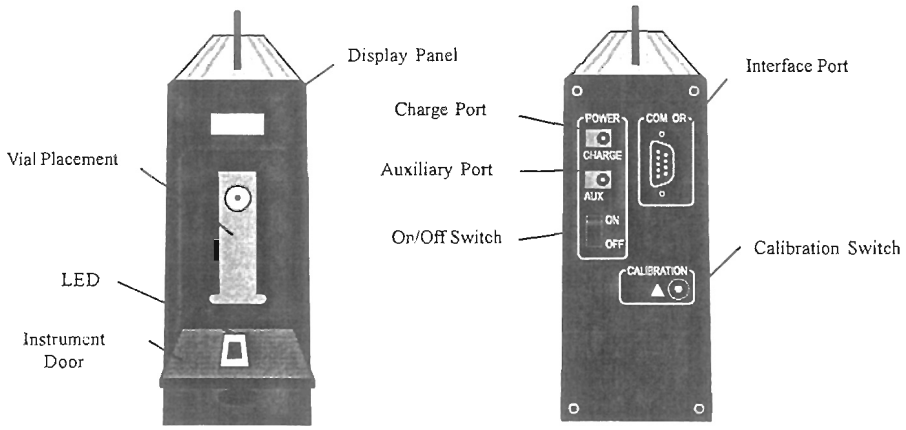
- Store at or near room temperature (~75°F).
- Avoid prolonged exposure of the SDI Quick VOH Water Test Kit to temperatures lower than 32°F (0°C) or greater than 100°F (38°C).
- Avoid exposure of Reagent Vials to direct sunlight. For specific storage data, see the package label.

PRECAUTIONS

- Protect eyes with safety glasses.
- Protect skin with safety gloves.
- Test samples may contain analyte or reagent solution.
- If solution comes in contact with skin, wash thoroughly with soap and water.

USE OF ENVIROMETER

For more detailed instrument instructions refer to manual included with the Envirometer.



Initial Start-up

Turn Envirometer on by operating the "On/Off" switch on back panel. The display will show "- -" which indicates power is on.

Instrument Warm-up

The Envirometer should be warmed-up when used for the first time each day. Warm up the Envirometer by placing an empty vial (supplied with Envirometer) in the exposure chamber and closing the door, as in normal operation. The Envirometer display will go blank for a few seconds, then count from 0 to 99, and finally display "0.0". If the Envirometer has been stored at temperatures significantly above or below ambient temperature (68°F or 20°C), it should be allowed to equilibrate to ambient temperature for approximately 30 minutes prior to use.

Sample Reaction/Quantitation

Sample reaction and quantitation are accomplished in three easy steps:

1. Open the door, located on the front panel of the Envirometer.
2. Place reagent vial upright in the rectangular slot.
3. Close the door.

The Envirometer display will go blank for a few seconds, count from 0 to 99, then display the sample concentration in ug/L (ppb). The vial is then removed from the Envirometer and discarded. The Envirometer will display the concentration from the previous reading until another sample is read or until turned off. Once sample reaction/quantitation is initiated, do not move or shake the Envirometer, or connect or disconnect power cords.

USE OF PRECISION PIPETTE

Introduction:

The precision micropipette used with the SDIQuick VOH Water Test Kit is an accurate high precision instrument used to transfer solutions. The micropipette has an adjustable range from 100 to 1,000 uL. It works on the air displacement principle and has an overshoot movement when discharging to empty the disposable polypropylene tip.

Use the precision micropipette for this test only!

Pipette Design:
The Eppendorf Series 2000 Reference is a piston-stroke pipette. All functions of the pipette are executed with the one control button, including measurement, aspiration, blow-out, and tip ejection.

Tips:
The tip is a very important component of the pipette. For consistent results and proper operation of the pipette, use only the tips provided with the SDI Quick VOH Soil Test Kit. Use a **new** tip to transfer each solution.

Operation:
Set desired volume by pressing the gray locking button on the side, then rotating the plunger knob until desired volume appears in window. Set the volume to 600 uL for this test.

Place a clean detachable polypropylene tip on the pipette.

Phase 1: Depress plunger knob to the first stop before immersing tip for filling.
Phase 2: Immerse tip in the liquid and smoothly release plunger knob. Liquid will be drawn up into the tip. Be sure to keep the pipette upright.
Phase 3: Place tip against wall of receiving vessel and slowly depress plunger to first stop, thus emptying tip. Then depress knob to the second stop position. This will further force any remaining fluid from the tip.
Phase 4: Eject disposable polypropylene tip by pressing the plunger knob to the final stop.

Wetting the Pipette Tip:
It is recommended that liquid be aspirated and dispensed once before removing sample for transfer.

Excerpted from the Eppendorf Series 2000 Reference Adjustable volume Instruction Manual

STANDARDIZATION PROCEDURE

INTRODUCTION

Standardization refers to the reaction and electronic storage of results obtained with the standards which make up the standard curve. The standard curve is used to determine the analyte concentration. It is recommended that the user standardize the Envirometer at the beginning of each analysis period, when a large temperature variation (greater than 30°F or 15° C) occurs, or when a calibration check sample is out of stated control limits (± 20%). The standard curve can be set with the standard ampules supplied with each test kit.

5 ug/L Standard

A. Carefully open the Reaction Vial (green top) and the 0.5 ug/mL Standard Ampule using the supplied ampule crackers.
B. Pipette all of the liquid from the 5 ug/L Standard Ampule into a Reaction Vial using the transfer pipettes supplied.
C. Cap the Reaction Vial and shake gently (invert approximately 4 to 5 times).
D. Place the Reaction Vial in the Envirometer. After exposure is complete the Envirometer display will indicate a concentration.
E. Save the data from the 5 ug/L Standard in the Envirometer by gently pulling up on the calibration lever, located on the back panel of the Envirometer. Immediately after pulling up on the calibration lever, the Envirometer display should read "5", which indicates that the 5 ug/L Standard was stored correctly in the Envirometer.

90 ug/L Standard

Setting the 90 ug/L Standard is performed identically to the 5 ug/L standard, except the 90 ug/L Standard Ampule is used in place of the 5 ug/L ampule. The Envirometer should read "90" after pulling up on the calibration lever, indicating that the 90 ug/L Standard was stored correctly in the Envirometer.

190 ug/L Standard

Setting the 190 ug/L Standard is performed identically to the 5 ug/L Standard, except the 190 ug/L Standard Ampule is used in place of the 5 ug/L ampule. The Envirometer display should read "190" after pulling up on the calibration lever, indicating that the 190 ug/L standard was stored correctly in the Envirometer.

CALIBRATION CHECK PROCEDURE

INTRODUCTION

Calibration check refers to the reaction of a calibration solution to verify instrument standardization, and is not stored electronically. If a calibration check is outside the stated control limits (± 20%), the Envirometer must be restandardized. It is recommended that the user perform a calibration check once every 10 samples, when instrument error is suspected, or at the end of an analysis period or a work day.

A. Carefully open the Reaction Vial (green top) and the Calibration Check Ampule using the supplied ampule crackers.
B. Pipette all of the liquid from the Calibration Check Ampule to a Reaction Vial using the transfer pipettes supplied.
C. Cap the Reaction Vial and shake gently (invert approximately 4 to 5 times).
D. Place the Reaction Vial in the Envirometer. After exposure is complete, the Envirometer display will indicate the concentration.
E. The acceptable range for the Calibration Check Ampule is 72 to 108 ug/L (± 20%). If the indicated concentration is outside the specified range, the Envirometer must be restandardized as described in the Standardization Section (page 7).

QUALITY ASSURANCE CHECK PROCEDURE

INTRODUCTION

This procedure refers to the spike and extraction of a QA solution to verify operator performance, and is not stored electronically. If a QA run is outside the stated control limits (90 ppb ± 20%), please review the Assay Procedure carefully and repeat QA Check.

A. Fill an Extraction Container with distilled water to the neck, just below the threads.
B. Pipette all of the liquid from the QA Sample Ampule to the Container using the transfer pipettes supplied.
C. Cap the Extraction Container and invert gently 4 to 5 times.
D. Proceed to Assay Procedure, starting with Step 1: C. treating the spiked sample as a normal sample.

SDI Quick VOH WATER TEST KIT
ASSAY PROCEDURE

Note: When possible, water samples should be processed within 1 hour after sampling to avoid excessive volatilization of analyte.

Step 1: Extraction

A. Remove the cap from an Extraction Container. Retrieve one unit of reagents for each sample to be tested. Close kit box.
B. Fill the Extraction Container with Water Sample to the neck of the container, just below the threads. (Figure 1)
C. Remove the cap from an Extraction Solvent Vial (red top). Pour all of the clear solution from the Extraction Solvent Vial into the Extraction Container (*figure 2*). The red crystals should remain in the Extraction Solvent Vial (red top). Cap vial.
C. Cap the Extraction Container and shake vigorously for 3 minutes *(Figure 3)*.

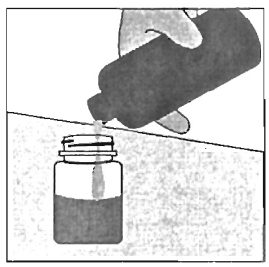


figure 1

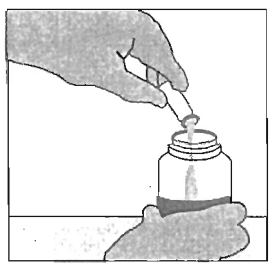


figure 2

Step 2: Extraction Solvent Transfer

A. Remove the plunger from the barrel of the Extraction Solvent Transfer Syringe. Remove the cap of the Extraction Solvent Vial (red top). Remove the cap from the Extraction Container.
B. Quickly transfer the Teflon Tape, using the plastic tweezers, from the Extraction Container and place in the Extraction Solvent Transfer Syringe (*figure 4*). Cap the Extraction Container for disposal.
C. Place tip of Extraction Solvent Transfer Syringe into the Extraction Solvent Vial (red top). Replace the plunger in the barrel of the Extraction Solvent Transfer Syringe.

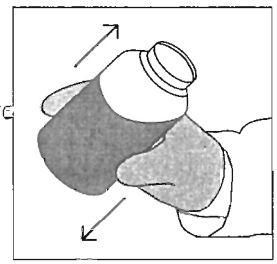


figure 3

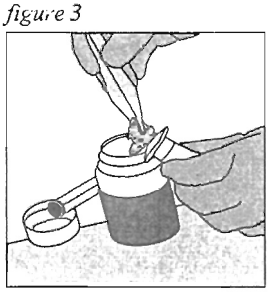


figure 4

D. Force the plunger of the Extraction Solvent Transfer Syringe onto the Teflon Tape, expelling as much of the solution from the tape as possible into the Extraction Solvent Vial (*figure 5*).

E. Cap the Extraction Solvent Vial (red top). Invert the vial three or four times. (*figure 6*) Allow separation of liquid into two layers.

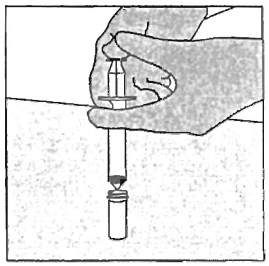


figure 5

Step 3: Drying

A. Remove the cap from a Drying Vial (black top). Place a new disposable tip on the pipette. Use the pipette to transfer all of the clear **upper** layer (which contains the volatile organic halides) from the Extraction Solvent Vial (red top) to the Drying Vial (black top) (*figure 7*).

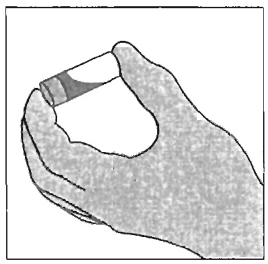


figure 6

Note: Be careful to remove only the upper layer from the Extraction Solvent Vial. Removal of the red colored lower layer can negatively affect the result of the test.

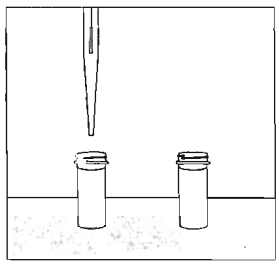


figure 7

Step 4: Liquid/Liquid Transfer

A. Remove the cap from a Liquid/Liquid Transfer Vial (blue top). Place a new disposable pipette tip on the pipette. Using the pipette, transfer all of the solution from the Drying Vial (black top) to the Liquid/Liquid Transfer Vial (blue top) (*figure 8*).

B. Cap the Liquid/Liquid Transfer Vial. Shake vigorously for approximately 1 minute.

C. Allow the contents to separate into two layers.

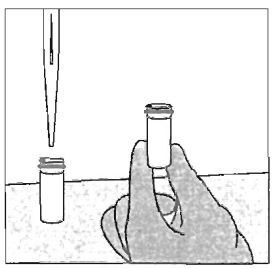


figure 8

D. Place a new disposable pipette tip on the pipette. Using the pipette, transfer all of the **upper** layer (waste) from the Liquid/Liquid Transfer Vial (blue top) to the Drying Vial (black top) and cap for discard.

Note: Be careful to remove only the upper layer from the Liquid/ Liquid Transfer Vial. When approaching the meniscus between the two layers, the user may pipet up some of the lower layer into the tip then carefully force the bottom layer back into the vial. This technique can be used to ensure that all of the top layer is removed. If too much of the lower layer is removed, or too much of the upper layer is left behind, the final concentration reading may be effected and result in a low or diluted reading.

E. Remove the cap from a Reaction Vial (green top). Transfer 0.6 mL (600 uL) of the remaining liquid from the Liquid/Liquid Transfer Vial (blue top) to the Reaction Vial (*figure 9*).

F. Cap the Liquid/Liquid Transfer Vial for discard.

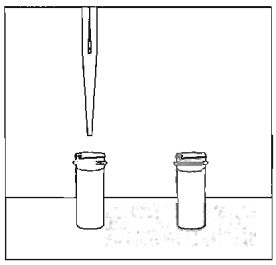


figure 9

Step 5: Reaction/Reading Concentration

A. Cap and invert the Reaction Vial (green top) three or four times. (*figure 10*)

B. Place the Reaction Vial in the Envirometer (*figure 11*).

C. After exposure is complete (Approx. 5 min.), read the sample concentration from the Envirometer display.

D. If "OL" (over limit) appears on the Envirometer display, the sample concentration is greater than 200 ppb for PCE, TCE and THMs.

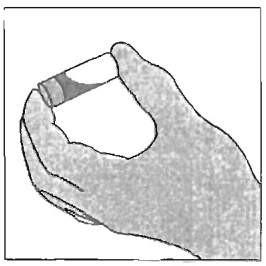


figure 10

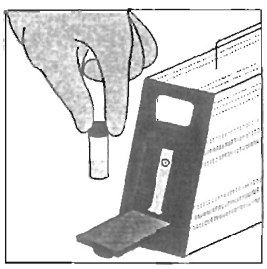


figure 11

Note: For quantitative determination of Vola tile Organic Halides greater than 200 ppb for PCE, TCE and THMs, a dilu tion is required (see Dilution Procedure below).

F. After exposure is complete and the user has recorded the displayed concentration, remove the Reaction Vial (green top) from the Envirometer.

DILUTION PROCEDURE AND CALCULATIONS

The following steps will allow the user to obtain quantitative results for water samples with a sample concentration of greater than 200 ppb:

1. Fill the Extraction Container with water sample to the line on the Dilution Label. Then continue filling the Extraction Container with distilled water to the neck of the container, below the threads

Note: It is important that the user add distilled water when per forming a dilution. Use of deionized water or tap water will effect the result of the test due to the possible residual organic chlo rides in the water from the purification process.

2. Follow the instructions for the SDIQuick VOH Water Test Kit, starting with Step 1: C. Extraction.
3. Multiply the reading from the Envirometer instrument display by the dilution factor of 10 to arrive at the concentration of VOH in the water sample.

INTERPRETATION OF RESULTS

The results obtained with the VOH Test Kit are subject to the following limitations:

1. Results obtained with the SDIQuick VOH Water Test Kit are intended for the purposes of screening only.
2. Test results for samples which read at or near the site specific target level should be confirmed by a reference analytical method.
3. The user can establish a correlation between results obtained with the SDIQuick VOH Water Test Kit and results obtained with a reference analytical method. This relationship can be used to increase confidence in interpretation of kit results. When determining this relationship, best results are obtained by comparisons of samples which cover the range of volatile organic halide con-

centrations (from low to high) found at the site.

4. **Possible volatilization of halides during sampling and extraction procedures can lead to inaccurate test results. It is important that efforts are made to minimize the possibilities of volatilization.**

QUALITY CONTROL

All product lots have been tested for quality using standard quality control procedures. Claims for the SDIQuick VOH Water Test Kit are based on results obtained by qualified scientists in accordance with valid statistical methods as specified by the U.S. Environmental Protection Agency (EPA).

Standard QC procedures should be employed by users of this field test system. Due to varying quality control standards and operator error, SDI does not guarantee that the results obtained with this kit will always be in agreement with standard analytical methods.

METHOD PERFORMANCE

The SDI Quick VOH Water Test Kit has been tested according to EPA guidelines for field test methods. A summary of the Kit performance data is given in Table 1.

Table 1: Performance Parameters

Performance Parameters:				
Dynamic Range	5 - 2,000 ppb (with dilution)			
Number of False Positives	0			
Number of False Negatives	0			
Method Detection Limit (MDL):				
Trichloroethylene (TCE)	4 ppb			
Perchloroethylene (PCE)	4 ppb			
Carbon Tetrachloride (CCl_4)	3 ppb			
Chloroform ($CHCl_3$)	5 ppb			
Method Quantitation Limit (MQL):				
Trichloroethylene (TCE)	9 ppb			
Perchloroethylene (PCE)	8 ppb			
Carbon Tetrachloride (CCl_4)	7 ppb			
Chloroform ($CHCl_3$)	10 ppb			
Other Volatile Organic Halides:	Relative Sensitivity Compared to:			
	TCE	PCE	CCl_4	$CHCl_3$
Trichloroethylene (TCE)	**100%**	122%	38%	122%
Perchloroethylene (PCE)	82%	**100%**	72%	100%
Carbon Tetrachloride (CCl_4)	114%	139%	**100%**	139%
Chloroform ($CHCl_3$)	82%	100%	72%	**100%**
1,1-Dichloroethene	69%	84%	61%	84%
Vinyl Chloride	0.8%	1.0%	0.7%	1.0%
Trans-1,2-Dichloroethene	69%	74%	54%	74%
Cis-1,2-Dichloroethene	43%	52%	38%	52%
Dichloromethane	20%	24%	18%	24%
1,1,1-Trichloroethane	112%	137%	98%	137%
1,1,2-Trichloroethane	80%	98%	70%	98%
1,2-Dichloroethane	15%	18%	13%	18%
Bromoform	77%	94%	68%	94%
Bromodichloromethane	75%	91%	65%	91%
Chlorodibromomethane	71%	87%	63%	87%

[1]False positive and false negative study conducted on TCE only.

INTERFERENCE DATA

The SDI Quick VOH Water Test Kit has been tested for possible interference with structual analogs and degradation products of volatile organic halides. Table 2 summarizes the interference data for these compounds using the Envirometer instrument.

Table 2: Interference Data.

Interferences[1]	Concentration Required for a Positive or Negative Interference (ppb)
Benzene	>2,000
Methanol	>2,000
Toluene	>2,000
Oxalic Acid	>2,000
Glyoxylic Acid	>2,000
Sodium Trichloroacetate	>2,000
Sodium Dichloroacetate	>2,000
2,2,2-Trichloroethanol	>200
Vinyl Chloride	>200

[1] Initial Trichloroethylene concentration was 20 ppb.

HEALTH & SAFETY

Material Safety Data Sheets (MSDS) for the chemicals used in the SDIQuick® VOH Water Test Kit are supplied upon request. Precautions should be taken to ensure that solutions from the test do not come in contact with skin. Symptoms of exposure may include: irritation to skin, eyes, and mucous membranes on contact.

Protect eyes with safety glasses! Protect skin with protective gloves!

GENERAL LIMITED WARRANT

This is not a consumer product. This product is for commercial or industrial use only. Strategic Diagnostics Inc. warrants that this product meets all specifications set forth on product labels and, if used in accordance with prescribed procedures, conforms to the descriptions contained herein. STRATEGIC DIAGNOSTICS INC. MAKES NO OTHER WARRANTIES, EXPRESS OR IMPLIED, INCLUDING ANY WARRANTY OF MERCHANTIBILITY OR FITNESS FOR A PARTICULAR PURPOSE. Any change or modification to this product or failure to follow its prescribed procedure for use shall make the warranty null and void. Strategic Diagnostics Inc. is not liable in the event of any such changes, or for any indirect, special, incidental, punitive or consequential damages. This product is sold on the condition that it will be used and disposed of properly and lawfully, and within the scope of all applicable laws, rules, regulations and standards related to human health and the environment.

Quick Tips: SDI Quick VOH Water Test Kit

General Tips:

As an operator becomes more familiar with this test procedure, it may be feasible to run 2 samples simultaneously. For example, the test operator will likely save time by shaking 2 extraction containers (Step 1D) at a time rather than just one.

For Step 1: Extraction

1. After transferring the water sample to the Extraction Container, add the Extraction Solvent and proceed to Step 2 within 10 minutes.

For Step 2: Extraction Solvent Transfer

1. Transfer the Teflon Tape to Extraction Solvent Transfer Syringe and force the octane out of Teflon Tape as quickly as possible to avoid volatilization of VOH's.

For Step 3: Drying

1. It may be difficult to distinguish between the two layers in the extraction solvent vial. After shaking allow the layers to separate completely (4 to 5 seconds). The top layer is clear with VOH and the bottom layer is red color solution without VOH.
2. Do not transfer the red solution to the drying vial.
3. In Step 5, 0.6 mL of extract is needed, so in this step transferring 0.8 ~1.0 mL extract to drying vial is sufficient. To transfer 0.8 ~ 1.0 mL of extract, leave the pipette set to 0.6 mL and pipette the extract 1½ times.

For Step 4: Liquid/Liquid Transfer

1. VOHs are stable in the Liquid/Liquid Transfer Vial up to 24 hours. If you do not have sufficient time to run the samples, you can test them the following day.
2. When pipette upper layer out of the Liquid/Liquid Transfer Vial; be careful to remove only the upper layer. When approaching the meniscus between the two layers, the user may pipette up some of the bottom layer into the pipette tip. Separation of the two solvents will be visible in the pipette tip. Carefully force the bottom layer back into the Liquid/Liquid Transfer Vial.
3. Small amount of top layer in the Liquid/Liquid Transfer Vial will not

affect the test results.

4. When transferring the bottom layer of extract from the Liquid/ Liquid Transfer Vial to the Reaction Vial, place the pipette tip near the bottom of the Liquid/Liquid Transfer Vial and slowly draw up the solution.

For Step 5: Reaction/Reading Concentration

1. The reaction time is about 5 minutes. The display will cycle through 0-99 in succession, after which the display will indicate the sample concentration.
2. If 'OL" appears on the Envirometer display, the sample concentra tion is greater than 200 ppb for PCE, TCE and THMs.

For Using Envirometer:

1. Prior to first use of day, turn Envirometer on and place an empty vial (supplied with the Envirometer) or used vial in the Envirometer and shut the door. Wait approximately 5 minutes for the instrument to generate a reading—this will allow the Envirometer to warm up.
2. Charge the battery in the Envirometer overnight before using in the field. The Envirometer may be used while AC battery charging unit is recharging the battery.
3. Turn off the Envirometer when not being used for an extended time (one hour).
4. If the Envirometer can not be standardized to the correct position (5, 90, or 190 ppb) then check: a) that the volume of the pipettor is set to 0.6 mL (600 uL), and b) if the exposure time is around 5 minutes. If the exposure time is more than 7 minutes, the battery is not charged enough, which will affect test results.

SDI Quick VOH Water Test Kit
SAMPLE WORKSHEET

Materials: **Soil Test Kit** Lot: _____

Envirometer Serial # _____

Kit Standard Lot #s: 5 ppb _____

90 ppb _____

190 ppb _____

Calibration Check 1: Reaction Time : _____min_____sec

Envirometer Result: _____

Specification: 72 - 108 ug/L (ppb)

Calibration Check 2: Reaction Time : _____min_____sec

Envirometer Result: _____

Specification: 72 - 108 ug/L (ppb)

Sample ID: _____ Date: _____

Reaction Time : _____min_____sec Envirometer Result: _____

Sample ID: _____ Date: _____

Reaction Time : _____min_____sec Envirometer Result: _____

Sample ID: _____ Date: _____

Reaction Time _____min_____sec Envirometer Result: _____

Sample ID:_____ Date:_____

Reaction Time . _____min_____sec Envirometer Result: _____

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Reaction Time : _____min_____sec Envirometer Result: _____

Sample ID:_____ Date:_____

Reaction Time : _____min_____sec Envirometer Result: _____

Sample ID:_____ Date:_____

Reaction Time : _____min_____sec Envirometer Result: _____

For assistance call SDI's toll free number to speak with our technical support staff. 1-800-544-8881.

SDI Quick™

NOTES