UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
Office of Research and Development
Washington, D.C. 20460

ENVIRONMENTAL TECHNOLOGY VERIFICATION PROGRAM
VERIFICATION STATEMENT

TECHNOLOGY TYPE:	**SOIL SAMPLER**
APPLICATION:	**SUBSURFACE SOIL SAMPLING**
TECHNOLOGY NAME:	**LARGE-BORE SOIL SAMPLER**
COMPANY: ADDRESS:	**GEOPROBE® SYSTEMS, INC. 601 NORTH BROADWAY SALINA, KANSAS 67401**
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ETV PROGRAM DESCRIPTION

The U.S. Environmental Protection Agency (EPA) created the Environmental Technology Verification (ETV) Program to facilitate the deployment of innovative technologies through performance verification and information dissemination. The goal of the ETV Program is to further environmental protection by substantially accelerating the acceptance and use of improved and cost-effective technologies. The ETV Program is intended to assist and inform those involved in the design, distribution, permitting, and purchase of environmental technologies. This document summarizes the results of a demonstration of the Geoprobe® Systems, Inc., Large-Bore Soil Sampler.

PROGRAM OPERATION

Under the ETV Program and with the full participation of the technology developer, the EPA evaluates the performance of innovative technologies by developing demonstration plans, conducting field tests, collecting and analyzing demonstration data, and preparing reports. The technologies are evaluated under rigorous quality assurance (QA) protocols to ensure that data of known and adequate quality are generated and that the demonstration results are defensible. The EPA's National Exposure Research Laboratory, which demonstrates field characterization and monitoring technologies, selected Tetra Tech EM Inc. as the verification organization to assist in field testing various soil and soil gas sampling technologies. This demonstration was conducted under the EPA's Superfund Innovative Technology Evaluation Program.

DEMONSTRATION DESCRIPTION

In May and June 1997, the EPA conducted a field test of the Geoprobe® Large-Bore Soil Sampler along with three other soil and two soil gas sampling technologies. This verification statement focuses on the Geoprobe® Large-Bore Soil Sampler; similar statements have been prepared for each of the other technologies. The performance of the Large-Bore Soil Sampler was compared to a reference subsurface soil sampling method (hollow-stem auger drilling and split-spoon sampling) in terms of the following parameters: (1) sample recovery, (2) volatile organic compound (VOC) concentrations in recovered samples, (3) sample integrity, (4) reliability and throughput, and (5) cost. Data quality indicators for precision, accuracy, representativeness, completeness, and comparability were also assessed against project-specific QA objectives to ensure the usefulness of the data for the purpose of this evaluation.

The Large-Bore Soil Sampler was demonstrated at two sites: the Small Business Administration (SBA) site in Albert City, Iowa, and the Chemical Sales Company (CSC) site in Denver, Colorado. These sites were chosen because of the wide range of VOC concentrations detected at the sites and because each has a distinct soil type. The VOCs detected at the sites include cis-1,2-dichloroethene (cis-1,2-DCE); 1,1,1-trichloroethane (1,1,1-TCA); trichloroethene (TCE); and tetrachloroethene (PCE). The SBA site is composed primarily of clay soil, and the CSC site is composed primarily of medium- to fine-grained sandy soil. A complete description of the demonstration, including a data summary and discussion of results, is available in the report titled *Environmental Technology Verification Report: Soil Sampler, Geoprobe® Systems, Inc., Large-Bore Soil Sampler,* EPA 600/R-98/092.

TECHNOLOGY DESCRIPTION

The Large-Bore Soil Sampler is a single tube-type, solid-barrel, closed-piston device advanced by using direct-push techniques to collect discrete interval samples of unconsolidated materials at depth. The sampler is 24 inches long with a 1.5-inch outside diameter. It is capable of recovering a discrete sample in the form of a 22-inch by 1-1/16-inch core. The sampler can be used with 24-inch long and 1-1/8-inch diameter disposable liners. In some cases, liners may facilitate retrieval of the sample and may be used for sample storage when applicable.

VERIFICATION OF PERFORMANCE

The demonstration data indicate the following performance characteristics for the Large-Bore Soil Sampler:

Sample Recovery: For purposes of this demonstration, sample recovery was defined as the ratio of the length of recovered sample to the length of sampler advancement. Sample recoveries from 42 samples collected at the SBA site ranged from 65 to 100 percent, with an average sample recovery of 98 percent. Sample recoveries from 42 samples collected at the CSC site ranged from 42 to 94 percent, with an average sample recovery of 78 percent. Using the reference method, sample recoveries from 42 samples collected at the SBA site ranged from 40 to 100 percent, with an average recovery of 88 percent. Sample recoveries from the 41 samples collected at the CSC site ranged from 53 to 100 percent, with an average recovery of 87 percent. A comparison of average recovery data from the Large-Bore Soil Sampler and the reference sampler indicates that the Large-Bore Soil Sampler achieved higher sample recoveries in the clay soil at the SBA site and lower recoveries in the sandy soil at the CSC site relative to the sample recoveries achieved by the reference sampling method.

Volatile Organic Compound Concentrations: Soil samples collected using the Large-Bore Soil Sampler and the reference sampling method at six sampling depths within nine grids (five at the SBA site and four at the CSC site) were analyzed for VOCs. For 20 of the 23 Large-Bore Soil Sampler and reference sampling method pairs (12 at the SBA site and 11 at the CSC site), a statistical analysis using the Mann-Whitney test indicated no significant statistical difference at the 95 percent confidence level between the VOC concentrations detected in samples collected with the Large-Bore Soil Sampler and those collected with the reference sampling method. A statistically significant difference was identified for three sample pairs: one pair at the SBA site and two pairs at the CSC site. Analysis of the SBA site data, using the sign test, indicated no statistical difference between the data obtained by the Large-Bore Soil Sampler and by the reference sampling method. However, at the CSC site, the sign test indicated that the VOC data (cis-1,2-DCE, 1,1,1-TCA, TCE, and PCE) obtained by the Large-Bore Soil Sampler are statistically significantly different than the data obtained by the reference sampling method, suggesting that the reference method tends to yield higher concentrations in sampling coarse-grain soils than does the Large-Bore Soil Sampler.

Sample Integrity: Six integrity samples were collected with the Large-Bore Soil Sampler at each site to determine if potting soil in a lined sampler became contaminated after it was advanced through a zone of high VOC concentrations. Seven integrity samples were collected with the reference sampling method at the SBA site and five integrity samples were collected at the CSC site. For the Large-Bore Soil Sampler, VOCs were detected in five of the 12 integrity samples, all at the SBA site. The range of VOC concentrations detected above the analytical detection limit in the potting soil at the SBA site were: cis-1,2-DCE (3.42 to 295 micrograms per kilogram [Fg/kg]) and TCE (14.4 to 46.3 Fg/kg). These results indicate that the integrity of the lined chamber in the Large-Bore Soil Sampler may not be preserved when the sampler is advanced through highly contaminated soils. Results of sample integrity tests for the reference sampling method indicate no contamination in the potting soil after advancement through a zone of high VOC concentrations. Because potting soil has an organic carbon content many times greater than typical soils, the integrity tests represent a worst-case scenario for VOC absorbance and may not be representative of cross-contamination under normal field conditions.

Reliability and Throughput: At the SBA site, the Large-Bore Soil Sampler collected a sample from the desired depth on the initial attempt 93 percent of the time. Sample collection in the initial push was achieved 100 percent of the time at the CSC site. The initial push success rate was less than 100 percent primarily because of refusal due to cobbles. By conducting multiple pushes, the Large-Bore Soil Sampler did collect all of the samples required for this demonstration, yielding a sampling completeness of 100 percent. For the reference sampling method, the initial sampling success rates at the SBA and CSC sites were 90 and 95 percent, respectively. Success rates for the reference sampling method were less than 100 percent due to (1) drilling beyond the target sampling depth, (2) insufficient sample recovery, or (3) auger refusal. The average sample retrieval time for the Large-Bore Soil Sampler to set up on a sampling point, collect the specified sample, grout the hole, decontaminate the sampler, and move to a new sampling location was 27.5 minutes per sample at the SBA site and 15.3 minutes per sample at the CSC site. For the reference sampling technique, the average sample retrieval times at the SBA and CSC sites were 26 and 8.4 minutes per sample, respectively. During the performance range tests at Grid 5 at the CSC site, the Large-Bore Soil Sampler successfully collected all seven soil samples within the saturated zone from 40 feet below ground surface (bgs) at Grid 5; however, the Large-Bore Soil Sampler failed once to collect a sample on the initial attempt from the target depth of 40 feet in Grid 5. This sample was collected on the subsequent push. The reference method collected all seven samples from the saturated zone at 40 feet bgs on the initial attempts. One person collected soil samples using the Large-Bore Soil Sampler at the SBA site (except Grid 1 where a two-person crew was used), and a two-person sampling crew collected soil samples at the CSC site. A three-person sampling crew collected soil samples using the reference method at both sites. One additional person was present at the CSC site to oversee and assist with sample collection using the reference method.

Cost: Based on the demonstration results and information provided by the vendor, the Large-Bore Soil Sampler and equipment costs ranged from $1,330 to $1,450 per day at both sites. Oversight costs for the Large-Bore Soil Sampler ranged from $1,480 to $2,510 at the clay soil site and $1,080 to $1,860 at the sandy soil site. For this demonstration, reference sampling was procured at a lump sum of $13,400 for the clay soil site and $7,700 for the sandy soil site. Oversight costs for the reference sampling method ranged from $4,230 to $6,510 at the clay soil site and $1,230 to $2,060 at the sandy soil site. A site-specific cost and performance analysis is recommended before selecting a subsurface soil sampling method.

A qualitative performance assessment of the Large-Bore Soil Sampler indicated that (1) the reliability of the sampler was better than the reference sampling method; (2) the sampler is easy to use and requires minimal training to operate; (3) logistical requirements are similar to those of the reference sampling method; (4) sample handling is similar to the reference method; (5) the performance range is primarily a function of the advancement platform; and (6) no drill cuttings are generated when using the Large-Bore Soil Sampler with a push platform.

The demonstration results indicate that the Large-Bore Soil Sampler can provide useful, cost-effective samples for environmental problem-solving. However, in some cases, VOC data collected using the Large-Bore Soil Sampler may be statistically different from VOC data collected using the reference sampling method. Also, the integrity of a lined sample chamber may not be preserved when the sampler is advanced thorough highly contaminated zones in clay soils. As with any technology selection, the user must determine what is appropriate for the application and project data quality objectives.

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